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HEALTHCARE-ASSOCIATED INFECTIONS AND ANTIMICROBIAL RESISTANCE

SURVEILLANCE OF ANTIMICROBIAL RESISTANT BACTERIA IN BELGIAN HOSPITALS

National report
Data up to and including 2022

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WHO WE ARE

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

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

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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 is called acquired antimicrobial resistance (AMR). The World Health Organization recognizes AMR as one of the top ten global health threats facing 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 analyzes AMR surveillance. 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.

The current report presents the 2021 and 2022 results of these three surveillance programs (MRSA, MRGN and VRE) and describes trends in AMR in Belgian acute and chronic care hospitals.

Methods

Surveillance data (year 2021 and 2022) were collected retrospectively in the following year by the microbiology laboratories and/or the infection prevention and control teams of the participating hospitals. It concerned data 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.

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

Following microorganisms and resistances were explored:

- *Staphylococcus aureus (S. aureus)* resistant to methicillin or oxacillin
- *Escherichia coli* (*E. coli*) and *Klebsiella pneumoniae* (*K. pneumoniae*) resistant to 3rd generation cephalosporins (3GC-R) and/or resistant to meropenem (mero-R)
- Mero-R in *Acinetobacter baumannii* (*A. baumannii*)
- 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)
- *Enterococcus (E.) faecalis* and *E. faecium* resistant to vancomycin (vanco-R)

Only hospitals providing de-duplicated data in which each patient is counted only once per period of hospitalisation (type D data), were included in the analyses. Unless otherwise stipulated (cfr. infra for MRSA), reporting here is solely based on data originating 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.

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 16 (StataCorp LP, College Station, Texas, USA) and presented by region and level of specialty care within the hospital.

Results

Table 1 presents the resistance proportion and incidence per 1 000 hospitalisations of the bacteria under surveillance (clinical samples only) in Belgian acute care hospitals in 2021 and 2022. In these years, 95.1% (n=97/102) and 92.2% (n=94/102) of all acute care hospital administrative groups (mergers) participated in the MRSA and MRGN surveillance with at least one hospital site, respectively. Despite the optional character of the VRE surveillance, 91.2% (n=93/102) and 92.2% (n=94/102) of all mergers participated with at least one hospital site in 2021 and 2022, respectively.

Since 2004, an overall decreasing trend in the resistance proportion (-1.31% per year; $p<0.001$) and incidence of MRSA (IRR=0.916, 95%CI: 0.913-0.919, $p<0.001$) can be observed. Due to the combined efforts of the infection prevention and control teams and a whole range of actions (among others recommendations for the prevention of MRSA transmission, targeted screening and decontamination policies and nationwide hand hygiene campaigns), the proportion of HA-MRSA on the total number of MRSA dropped from 78.8% in 1994 (start of the surveillance) to 39.8% in 2005 (peak in the MRSA incidence) and 43.1% in 2006 (year in which the surveillance became mandatory). In 2022, this proportion was at its lowest, i.e.15.9% (23.6% in 2021).

A decreasing trend in the resistance proportion (-0.17% per year; $p=0.024$) and incidence (IRR=0.976, 95%CI: 0.936-1.017; $p=0.252$) of vanco-R *E. faecium* can be observed between 2014 and 2022.

Between 2019 and 2022, the resistance proportion of 3GC-R *E. coli* significantly decreased (-0.63% per year; $p<0.001$). No significant trend can however be observed between the beginning of the surveillance (2014) and 2022 (-0.01% per year; $p=0.813$). The incidence of 3GC-R *E. coli* significantly decreased in the same time periods: 2020-2022 IRR=0.937 (95%CI: 0.888-0.989; $p=0.017$) and 2014-2022 IRR=0.974 (95%CI: 0.963-0.985; $p<0.001$). Between 2015 and 2022, no significant trend in the resistance proportion (-0.00% per year; $p=0.977$) and incidence (IRR=0.981, 95%CI: 0.940-1.023; $p=0.366$) of mero-R *E. coli* can be observed.

Between 2014 and 2022, no significant trend in the resistance proportion (-0.03% per year; $p=0.844$) and incidence (IRR=0.993, 95%CI: 0.979-1.001; $p=0.311$) of 3GC-R *K. pneumoniae* can be observed. Since 2018, a significant decrease in the resistance proportion (-1.82% per year; $p<0.001$) and incidence (IRR=0.907, 95%CI: 0.885-0.929; $p<0.001$) is however seen.
Between 2018 and 2021, there was a significant decrease in the resistance proportion (-0.31% per year; $p=0.001$) and incidence (IRR=0.919, 95%CI: 0.820-1.029; $p=0.143$) of mero-R *K. pneumoniae*. Between 2021 and 2022, the resistance proportion (-0.02% per year; $p=0.940$) again slightly increased .

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, 2021 and 2022

		2021				2022			
		Resistance proportion (%)		Incidence per 1 000 hospitalisations		Resistance proportion (%)		Incidence per 1 000 hospitalisations	
		Crude	Median	Crude	Median	Crude	Median	Crude	Median
Staphylococcus aureus	Methicillin R	10.7	9.1	1.72	1.29	8.4	8.0	1.32	1.24
Healthcare-associated *Staphylococcus aureus*	Methicillin R	20.3*	23.5*	0.35	0.30	21.2*	18.8*	0.28	0.20
Enterococcus faecium	Vancomycin R	1.25	0.00	0.065	0.000	1.87	0.00	0.097	0.000
Enterococcus faecalis	Vancomycin R	0.05	0.00	0.007	0.000	0.05	0.00	0.007	0.000
Escherichia coli	3GC-R	7.8	8.2	4.10	4.22	8.0	7.7	4.03	3.97
	Meropenem R	0.06	0.00	0.029	0.000	0.05	0.00	0.027	0.000
Klebsiella pneumoniae	3GC-R	18.3	16.8	2.21	1.65	17.9	16.3	2.04	1.66
	Meropenem R	1.13	0.36	0.137	0.038	1.14	0.43	0.130	0.037
Acinetobacter baumannii	Meropenem R	8.12	0.00	0.039	0.000	7.66	0.00	0.032	0.000
Pseudomonas aeruginosa	MDR	6.0	3.7	0.67	0.32	5.6	3.9	0.67	0.38

*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 (gentamicin, tobramycin or amikacin), carbapenems (meropenem or imipenem), 3rd and/or 4th generation cephalosporins (ceftazidime or cefepime)

A minority of acute care hospitals reported at least one mero-R *A. baumannii*: 26.1% (n=29/111; min-max: 1-11 isolates) in 2021 and 22.4% (n=24/107; min-max: 1-13 isolates) in 2022 (clinical samples only). Between 2015 and 2022, no significant trend in the resistance proportion (-0.04% per year; p=0.844) and incidence (IRR=0.959, 95%CI: 0.911-1.010; p=0.110) can be observed.

Definition changes in 2017, 2018 and 2020 make it difficult to interpret the evolution of MDR *P. aeruginosa.* Since 2020, no significant trend in the resistance proportion (-0.20% per year; p=0.455) and incidence (IRR=0.960, 95%CI: 0.878-1.049; p=0.369) can be observed.

Table 2 shows the resistance proportion and incidence density per 1 000 patient-days of the bacteria under surveillance in Belgian chronic care hospitals in 2021 and 2022. As the number of participating chronic care hospitals was low (≤ 13), these numbers should be interpreted with caution.

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, 2021 and 2022

		2021				2022			
		Resistance proportion (%)		Incidence density per 1 000 patient-days		Resistance proportion (%)		Incidence density per 1 000 patient-days	
		Crude	Median	Crude	Median	Crude	Median	Crude	Median
Staphylococcus aureus	Methicillin R	8.8	8.3	0.08	0.06	9.4	6.3	0.06	0.04
Healthcare-associated *Staphylococcus aureus*	Methicillin R	57.1*	38.9*	0.04	0.02	55.3*	0.0*	0.04	0.00
Enterococcus faecium	Vancomycin R	2.58	0.00	0.198	0.000	0.00	0.00	0.000	0.000
Enterococcus faecalis	Vancomycin R	0.20	0.00	0.050	0.000	0.00	0.00	0.000	0.000
Escherichia coli	3GC-R	5.3	7.4	0.17	0.17	6.5	6.8	0.18	0.14
	Meropenem R	0.06	0.00	0.002	0.000	0.24	0.22	0.007	0.000
Klebsiella pneumoniae	3GC-R	17.0	16.7	0.15	0.05	20.5	24.2	0.19	0.10
	Meropenem R	2.21	0.00	0.020	0.000	2.01	0.00	0.018	0.000
Acinetobacter baumannii	Meropenem R	35.29	0.00	0.012	0.000	23.08	0.00	0.005	0.000
Pseudomonas aeruginosa	MDR	5.4	6.1	0.05	0.06	4.4	3.7	0.03	0.02

*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 (gentamicin, tobramycin or amikacin), carbapenems (meropenem or imipenem), 3rd and/or 4th generation cephalosporins (ceftazidime or cefepime)

Recommendations

Recent EU Council recommendations advise to *"Close existing surveillance and monitoring gaps and ensure completeness of data, including real-time data and timely access to data where appropriate by 2030, on both AMR and antimicrobial consumption at all levels".* With this, surveillance is recognised as a vital component in the fight against AMR. Without such data, interventions to tackle AMR cannot be prioritised, nor evaluated.

In 2021 and 2022, a limited number of hospital laboratories pilot tested the harmonized AMR/EARS-BE protocol. In the following years, efforts will be continued to develop an integrated national epidemiological AMR surveillance in Belgian hospitals with an acceptable delay in time. This implies not only migrating the harmonized AMR/EARS-BE surveillance to a novel environment (the Healthdata.be/Healthstat.be platform), but also linking it to several other Sciensano/NSIH surveillance of healthcare-associated infections and collecting their resistance data within the integrated AMR surveillance.[9] Sciensano hopes thereby to reduce the workload for laboratories (collecting data only once).

Another crucial step to close surveillance gaps in all clinical settings is the development of AMR surveillance in primary care and in long-term care facilities (especially nursing homes). In the short term, this can be done by targeted surveillance, for example through increasing the participation of private laboratories in the EARS-BE surveillance, or through targeted studies like the MDRO carriage study in nursing homes, which will be organised nationally for the fourth time in 2024.

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ABBREVIATIONS

3GC	Third generation cephalosporins
3GC-R	Resistance to third generation cephalosporines
4GC	Fourth generation cephalosporins
A. baumannii	*Acinetobacter baumannii*
AMR	Antimicrobial resistance
AST	Antimicrobial susceptibility testing
BSI	Bloodstream infection
CLSI	Clinical and Laboratory Standard Institute, USA
ColREC	Colistin-resistant *Escherichia coli*
CPE	Carbapenemase-producing *Enterobacteriaceae*
CRE	Carbapenem-resistant *Enterobacteriaceae*
E. coli	*Escherichia coli*
E. faecalis	*Enterococcus faecalis*
E. faecium	*Enterococcus faecium*
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	Intermediate category of susceptibility
IPC	Infection prevention and control
IQR	Inter Quartile Range
IRR	Incidence Rate Ratio
I/R	Non-susceptible (intermediate susceptible or resistant)
K. pneumoniae	*Klebsiella pneumoniae*
MDR	Multidrug-resistant
Mero-R	Resistance to meropenem
MIC	Minimal inhibitory concentration
MRGN	Multiresistant Gram-negative bacteria
MRSA	Methicillin-resistant *Staphylococcus aureus*
NAP	National action plan
P. aeruginosa	*Pseudomonas aeruginosa*
R	Resistant or non-susceptible
S. aureus	*Staphylococcus aureus*
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

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 is called acquired antimicrobial resistance (AMR). The World Health Organization recognizes AMR as one of the top ten global health threats facing humanity. In addition to a considerable health impact (incl. prolonged illness, disability and death), the cost of AMR (among others due to longer hospital stays and the need for more expensive medicines) can also be significant.[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 programs, including the surveillance of vancomycin-resistant enterococci (VRE).

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 infections, bloodstream infections and pneumonia. Initially, participation in this surveillance was voluntary, but 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* was the first within the family of *Enterobacteriaceae* to be monitored (started in 2000, stopped in 2011) because it caused 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*). Owing to the upsurge of carbapenem-resistant and carbapenamase-producing Enterobacteriaceae (CRE and CPE, respectively), participation in the MRGN surveillance become compulsory in 2015.
The third surveillance program, VRE, was initiated in 2014 after multiple Belgian hospitals reported VRE outbreaks.

The primary objective of the three epidemiological AMR surveillances is to monitor the evolution of the resistance proportion and incidence of (multi)drug resistant bacteria in Belgian hospitals and thus to have national data on these resistant microorganisms. As a secondary objective, it may also encourage participating hospitals to monitor their own results over time.

The aim of the current report is to present the 2021 and 2022 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 protocols.[2,3]

The data (year 2021 and 2022) 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:

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

- **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 (gentamicin, tobramycin or amikacin), carbapenems (meropenem or imipenem), 3rd and/or 4th generation cephalosporins (ceftazidime, cefepime)

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

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.

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 from the same patient of the same species with indistinguishable anti-biograms 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[4]	Retional definition FPS[5]
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 referal' • 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 form other (primary and secondary) hospitals • Often a university hopsital 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

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 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. The same definitions as in the *résumé hospitalier minimal/minimale ziekenhuisgegevens (RHM/MZG*) are used. Nonetheless, in RHM/MZG, hospitalisation is based on discharges and not admissions, so this changes in the registration of denominator data. In addition, RHM/MZG is based on registration per semester. Denominator data are recorded for the surveillances per month. Thus, the numbers as

reported in RHM/MZG must be broken down by month to which they relate. More detailed information is available elsewhere.[6]

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 (density): total number of bacterium X with resistance Y divided by the total number of hospitalisations (or 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.

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 16 (StataCorp LP, College Station, Texas, USA).

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 2021 and 2022, 95.1% (n=97/102) and 92.2% (n=94/102) of all acute care hospital administrative groups (mergers) participated in the MRSA surveillance with at least one hospital site, respectively. In both years, two hospital administrative groups were considered as chronic care hospitals (length of stay > 16 days).

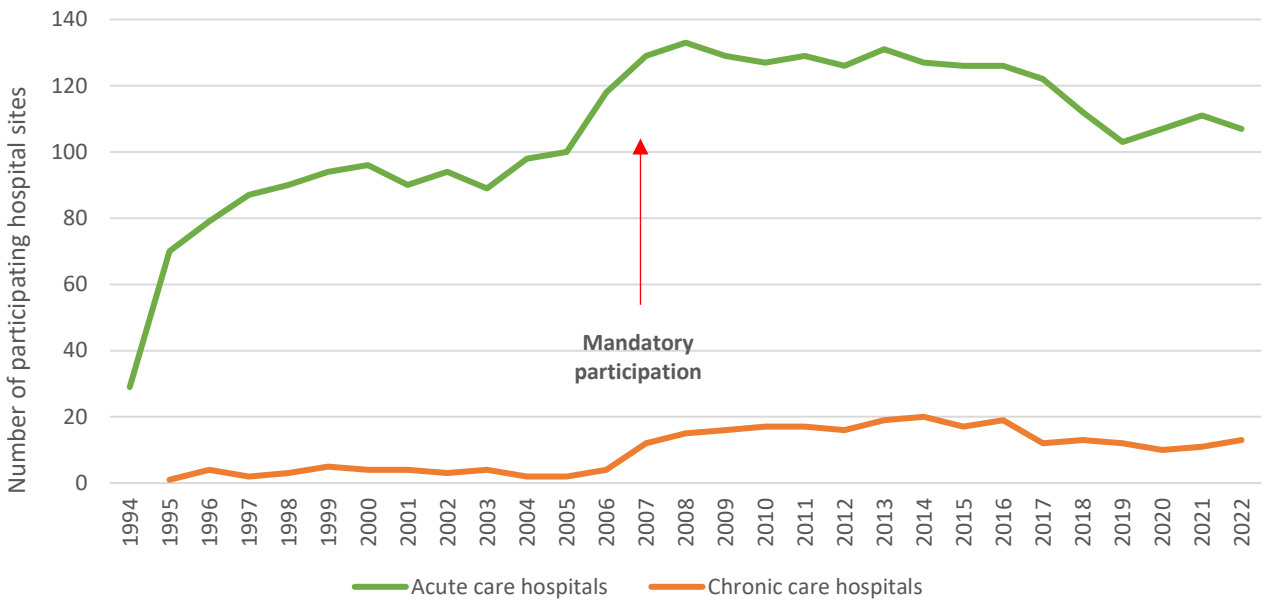
Table 3 presents the 2021 and 2022 participation in the MRSA surveillance by hospital care type, region and level of specialty care within the hospital. All hospitals provided Type D data and were therefore included. Figure 1 shows the number of participating hospital sites since the beginning of the surveillance (1994).

Table 3. Participation in the surveillance of methicillin-resistant *Staphylococcus aureus* 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, 2021 and 2022

	2021				2022			
	Flanders	Wallonia	Brussels	Belgium	Flanders	Wallonia	Brussels	Belgium
N of acute care hospitals (%)	**59**	**38**	**14**	**111**	**57**	**37**	**13**	**107**
Primary hospitals	48	27	8	83	46	27	7	80
Secondary hospitals	8	10	3	21	8	9	3	20
Tertiary hospitals	3	1	3	7	3	1	3	7
N of chronic care hospitals (%)	**5**	**5**	**1**	**11**	**5**	**7**	**1**	**13**

N = number

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, 1994-2022



1. MRSA in acute care hospitals

1.1 RESISTANCE IN *STAPHYLOCOCCUS AUREUS*

In 2021, 10.7% of all *S. aureus* isolates (clinical samples only) were MRSA. This crude proportion dropped to 8.4% in 2022. The crude incidence of MRSA was 1.72 cases per 1 000 hospitalisations or 0.28 cases per 1 000 patient-days in 2021 and 1.46 cases per 1 000 hospitalisations or 0.23 cases per 1 000 patient-days in 2022 (Table 4).

The evolution of the median resistance proportion, incidence and incidence density is shown overall and by region in Figure 2, 3 and 4, respectively. Since 2004, an overall decreasing trend in the resistance proportion (-1.31% per year; p<0.001) and incidence of MRSA (IRR=0.916, 95%CI: 0.913-0.919, p<0.001) can be observed.
In Annex (Figure A1 – A2) the evolution of the median resistance proportion and incidence (per 1 000 hospitalisations) of MRSA by level of specialty care can be consulted.

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, 1994-2022

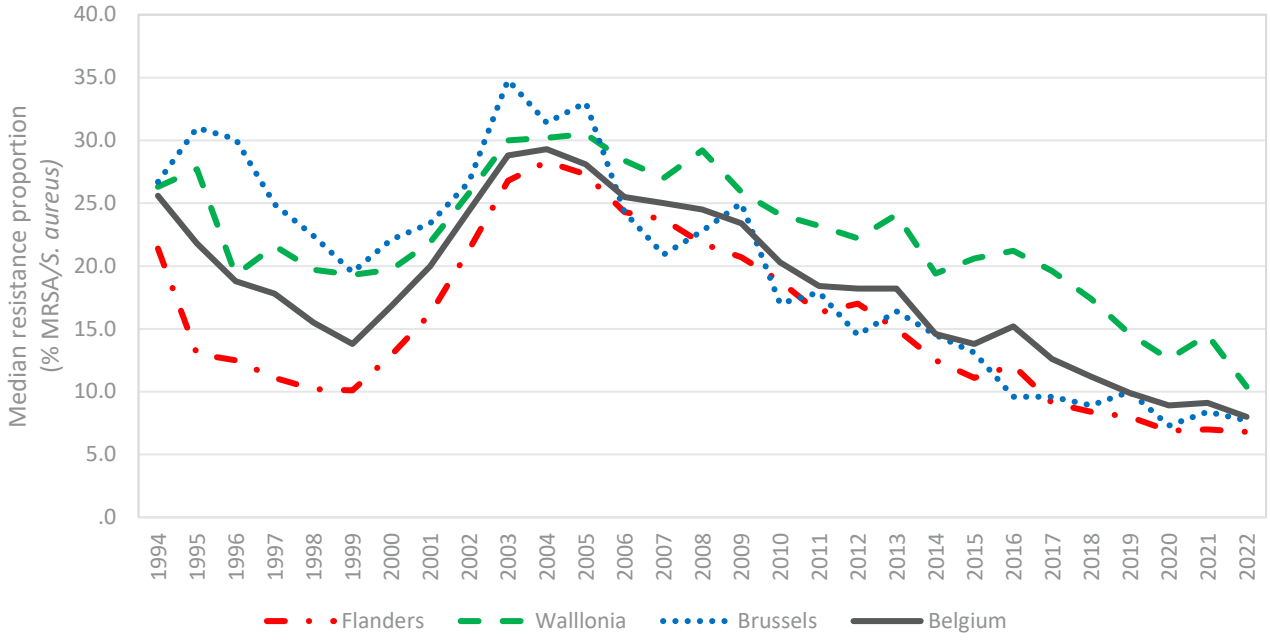


Table 4. Resistance proportion, incidence and incidence density of methicillin-resistant *Staphylococcus aureus* (MRSA) (clinical samples only) by region and level of specialty care within the hospital, Belgian acute care hospitals, 2021 and 2022

	MRSA (clinical samples only)											
	2021						2022					
	n	N	Crude	Mean	Median	P25 - P75	n	N	Crude	Mean	Median	P25 - P75
Resistance proportion (%)												
Belgium	**3 028**	**28 415**	**10.7**	**10.7**	**9.1**	**5.7-13.7**	**2 366**	**28 090**	**8.4**	**9.0**	**8.0**	**5.0-10.9**
Flanders	1 085	15 235	7.1	7.8	7.0	3.8-10.7	1 023	15 292	6.7	6.8	6.8	4.3-8.6
Wallonia	1 506	8 829	17.1	15.5	14.5	9.0-20.8	999	8 230	12.1	12.6	10.4	8.6-14.9
Brussels	437	4 351	10.0	10.3	8.4	7.0-12.7	344	4 568	7.5	8.4	7.7	7.0-8.3
Primary hosp	1 647	16 405	10.0	10.5	9.1	5.7-13.0	1 430	17 282	8.3	9.3	8.3	5.0-11.5
Secondary hosp	783	6 580	11.9	11.8	8.5	4.1-16.7	409	5 353	7.6	7.6	7.7	4.8-9.5
Tertiary hosp	598	5 430	11.0	11.0	8.5	6.7-11.6	527	5 455	9.7	9.2	7.8	5.8-8.2
Incidence per 1 000 hospitalisations												
Belgium	**3 028**	**1 756 603**	**1.72**	**1.90**	**1.29**	**0.67-2.48**	**2 366**	**1 792 213**	**1.32**	**1.46**	**1.24**	**0.72-1.89**
Flanders	1 085	1 032 941	1.05	1.21	0.79	0.46-1.45	1 023	1 085 139	0.94	1.00	0.85	0.51-1.43
Wallonia	1 506	486 473	3.10	2.93	2.44	1.20-3.85	999	472 326	2.12	2.09	1.79	1.13-2.36
Brussels	437	237 189	1.84	2.00	1.78	1.04-1.94	344	234 748	1.47	1.74	1.48	1.20-1.88
Primary hosp	1 647	1 054 753	1.56	1.76	1.20	0.69-2.25	1 430	1 103 327	1.30	1.47	1.24	0.78-1.88
Secondary hosp	783	433 758	1.81	2.28	1.83	0.52-3.27	409	414 699	0.99	1.23	1.01	0.65-1.90
Tertiary hosp	598	268 092	2.23	2.37	1.83	1.53-2.66	527	274 187	1.92	2.02	1.66	1.12-2.09
Incidence density per 1 000 patient-days												
Belgium	**3 028**	**10 933 605**	**0.28**	**0.29**	**0.20**	**0.11-0.39**	**2 366**	**10 920 063**	**0.22**	**0.23**	**0.19**	**0.12-0.30**
Flanders	1 085	6 211 457	0.17	0.20	0.15	0.08-0.26	1 023	6 340 317	0.16	0.17	0.14	0.10-0.22
Wallonia	1 506	3 092 853	0.49	0.45	0.36	0.21-0.62	999	2 928 382	0.34	0.33	0.27	0.21-0.38
Brussels	437	1 629 295	0.27	0.27	0.18	0.15-0.25	344	1 651 364	0.21	0.22	0.16	0.15-0.27
Primary hosp	1 647	6 599 215	0.25	0.27	0.19	0.11-0.38	1 430	6 726 097	0.21	0.24	0.19	0.13-0.28
Secondary hosp	783	2 605 900	0.30	0.34	0.15	0.10-0.45	409	2 441 880	0.17	0.18	0.14	0.10-0.30
Tertiary hosp	598	1 728 490	0.35	0.35	0.29	0.21-0.48	527	1 752 086	0.30	0.30	0.29	0.16-0.30

Hosp = hospital; 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

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, 1994-2022**

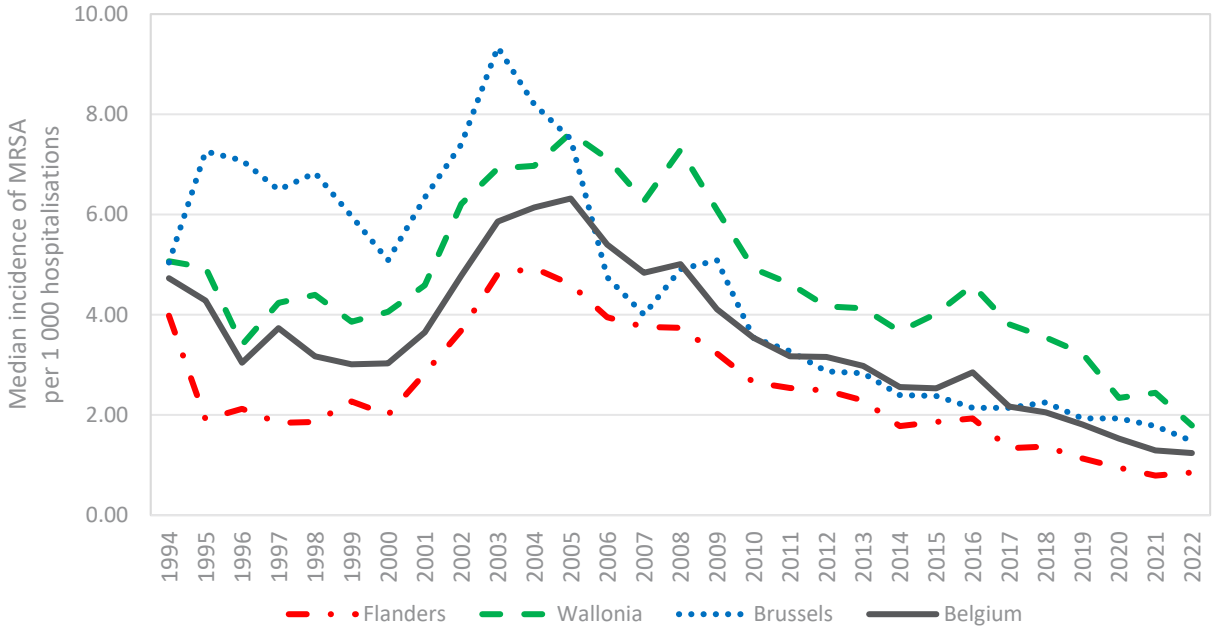
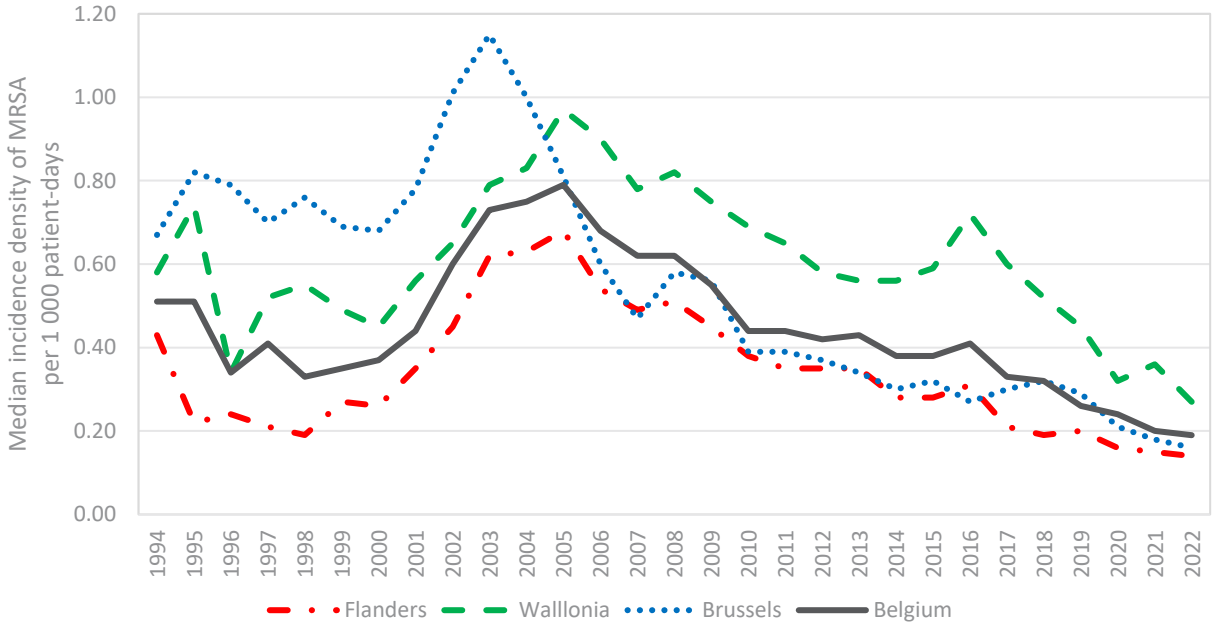


Figure 4. **Evolution of the median incidence density of methicillin-resistant *Staphylococcus aureus* (MRSA) per 1 000 patient-days by region (clinical samples only), Belgian acute care hospitals, 1994-2022**

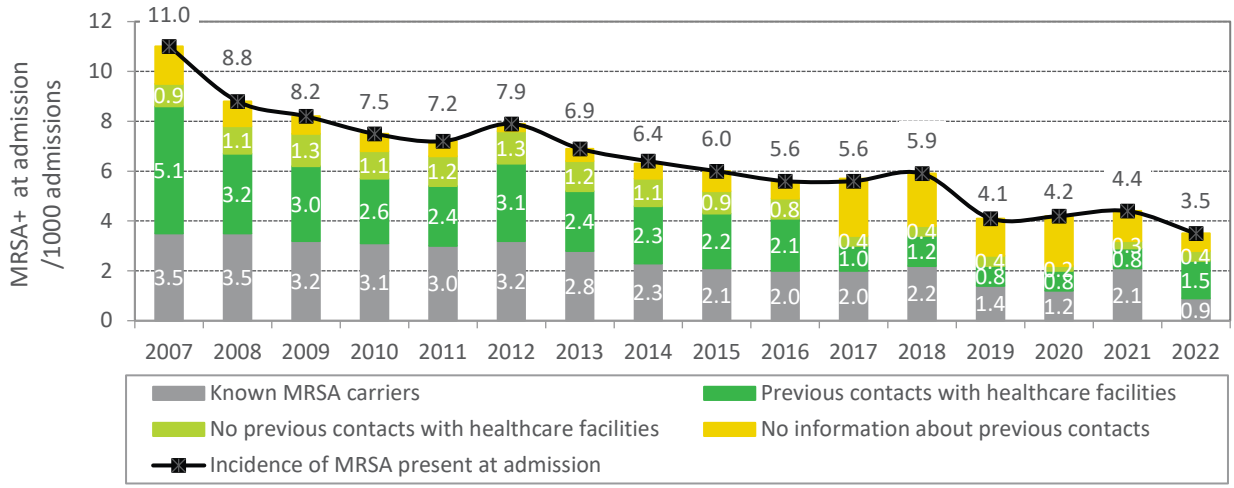


1.2 MRSA PRESENT AT ADMISSION

The incidence of patients who were MRSA positive on admission (optional data) could only be calculated for 21 and 12 acute care hospitals in 2021 and 2022, respectively. Both clinical samples and screening samples testing positive for MRSA within 48 hours after admission were taken into account.

The crude incidence of MRSA positive patients on admission was 4.4 cases per 1 000 hospitalisations (n=1 714/387 149 hospitalisations) in 2021 and 3.5 cases per 1 000 hospitalisations (n=871/254 212 hospitalisations) in 2022 (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, 2007-2022



In 2021, 48.2% of patients reported MRSA positive upon admission (n=827/1 714) were known to have been MRSA colonized/infected in the previous 12 months. Of the patients without a history of MRSA colonization/infection in the previous 12 months (n=887), 34.8% (n=309) were recently transferred to or had a recent stay in healthcare facility (e.g. acute care hospital, day care hospital, nursing home). For 14.4% of the patients (n=128), no contact with any of these facilities in the previous 12 months was reported, while for 50.7% (n=450) information about prior contact with healthcare facilities was unknown.

1.3 HEALTHCARE-ASSOCIATED MRSA

1.3.1 HEALTHCARE-ASSOCIATED MRSA IN CLINICAL SAMPLES

In 2021, 20.3% of all MRSA positive clinical samples were collected more than 48 hours after admission in patients with no known MRSA carriership in the past 12 months, i.e. cases of healthcare-associated (HA-)MRSA. In 2022, this proportion was somewhat higher. The crude incidence of HA-MRSA was 0.35 cases per 1 000 hospitalisations or 0.06 cases per 1 000 patient-days in 2021 and 0.28 cases per 1 000 hospitalisations or 0.05 cases per 1 000 patient-days in 2022 (Table 5).

The evolution of these indicators (incidence and incidence density) is shown in Figure 6 and 7, respectively. Since 2004, the incidence of HA-MRSA shows an overall decreasing trend (IRR=0.879, 95%CI: 0.876-0.882; p<0.001). In Annex (Figure A3) the evolution of the median incidence (per 1 000 hospitalisations) of HA-MRSA by level of specialty care is shown.

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, 2021 and 2022

	Healthcare-associated MRSA (clinical samples only)											
	2021						2022					
	n	N	Crude	Mean	Median	P25 - P75	n	N	Crude	Mean	Median	P25 - P75
Proportion healthcare-associated MRSA/MRSA (%)												
Belgium	**614**	**3 028**	**20.3**	**25.3**	**23.5**	**10.0-35.3**	**494**	**2 333**	**21.2**	**22.3**	**18.8**	**10.6-30.0**
Flanders	223	1 085	20.6	21.9	18.8	9.5-33.3	209	1 016	20.6	21.5	17.4	10.3-25.0
Wallonia	307	1 506	20.4	30.0	25.0	18.2-40.0	219	984	22.3	24.4	21.8	12.5-36.7
Brussels	84	437	19.2	27.4	25.1	9.5-44.4	66	333	19.8	20.0	20.4	3.4-26.4
Primary hosp	329	1 647	20.0	25.8	24.0	10.0-38.9	287	1 408	20.4	21.6	18.2	11.1-26.2
Secondary hosp	175	783	22.3	25.7	21.7	11.1-31.8	101	398	25.4	25.8	22.6	6.8-40.0
Tertiary hosp	110	598	18.4	19.4	21.6	9.5-25.3	106	527	20.1	20.8	22.6	10.6-28.6
Incidence per 1 000 hospitalisations												
Belgium	**614**	**1 756 603**	**0.35**	**0.38**	**0.30**	**0.12-0.55**	**494**	**1 770 702**	**0.28**	**0.31**	**0.20**	**0.10-0.41**
Flanders	223	1 032 941	0.22	0.24	0.14	0.07-0.34	209	1 075 436	0.19	0.20	0.15	0.07-0.23
Wallonia	307	486 473	0.63	0.61	0.56	0.28-0.82	219	466 412	0.47	0.49	0.35	0.18-0.69
Brussels	84	237 189	0.35	0.40	0.43	0.17-0.52	66	228 854	0.29	0.30	0.28	0.08-0.48
Primary hosp	329	1 054 753	0.31	0.37	0.29	0.13-0.52	287	1 087 710	0.26	0.31	0.19	0.10-0.32
Secondary hosp	175	433 758	0.40	0.43	0.33	0.10-0.61	101	408 805	0.25	0.30	0.24	0.06-0.49
Tertiary hosp	110	268 092	0.41	0.41	0.39	0.17-0.69	106	274 187	0.39	0.37	0.43	0.17-0.51
Incidence density per 1 000 patient-days												
Belgium	**614**	**10 933 605**	**0.06**	**0.06**	**0.05**	**0.02-0.08**	**494**	**10 777 146**	**0.05**	**0.05**	**0.03**	**0.02-0.06**
Flanders	223	6 211 457	0.04	0.04	0.03	0.01-0.06	209	6 276 423	0.03	0.04	0.03	0.01-0.04
Wallonia	307	3 092 853	0.10	0.09	0.09	0.05-0.11	219	2 893 347	0.08	0.08	0.06	0.03-0.11
Brussels	84	1 629 295	0.05	0.05	0.06	0.04-0.08	66	1 607 376	0.04	0.04	0.05	0.01-0.06
Primary hosp	329	6 599 215	0.05	0.06	0.05	0.02-0.08	287	6 627 168	0.04	0.05	0.03	0.02-0.05
Secondary hosp	175	2 605 900	0.07	0.06	0.04	0.01-0.10	101	2 397 892	0.04	0.05	0.03	0.01-0.08
Tertiary hosp	110	1 728 490	0.06	0.06	0.05	0.04-0.09	106	1 752 086	0.06	0.06	0.07	0.03-0.07

Hosp = hospital; 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, 1994-2022

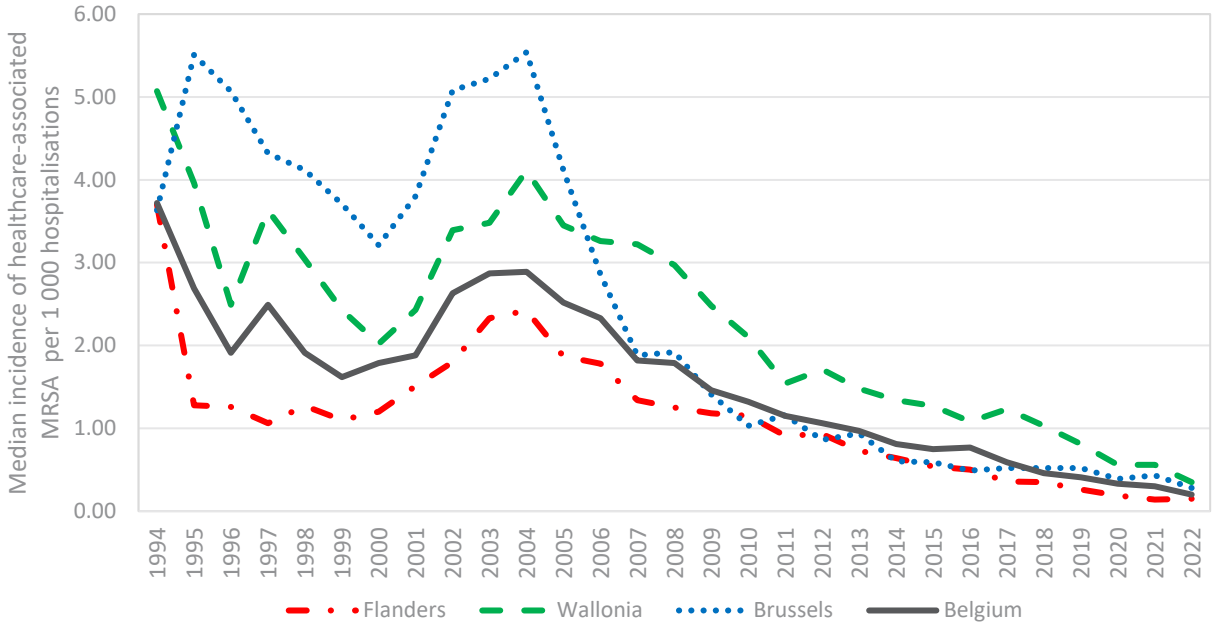


Figure 7. Evolution of the median incidence density of healthcare-associated methicillin-resistant *Staphylococcus aureus* (MRSA) per 1 000 patient-days by region (clinical samples only), Belgian acute care hospitals, 1994-2022

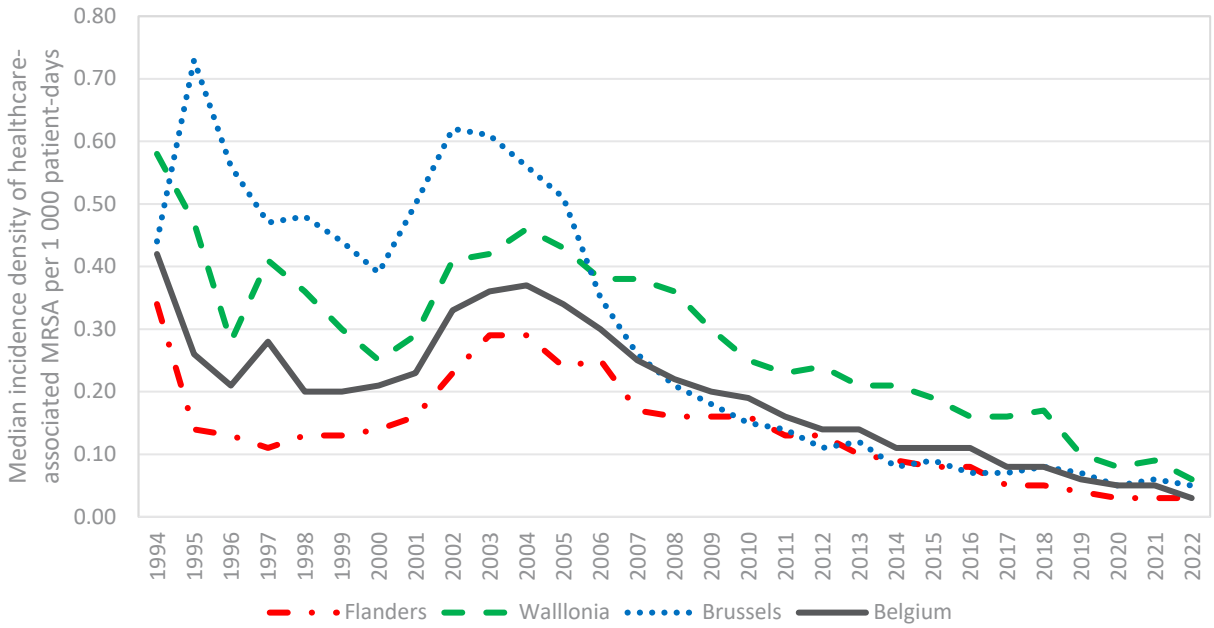
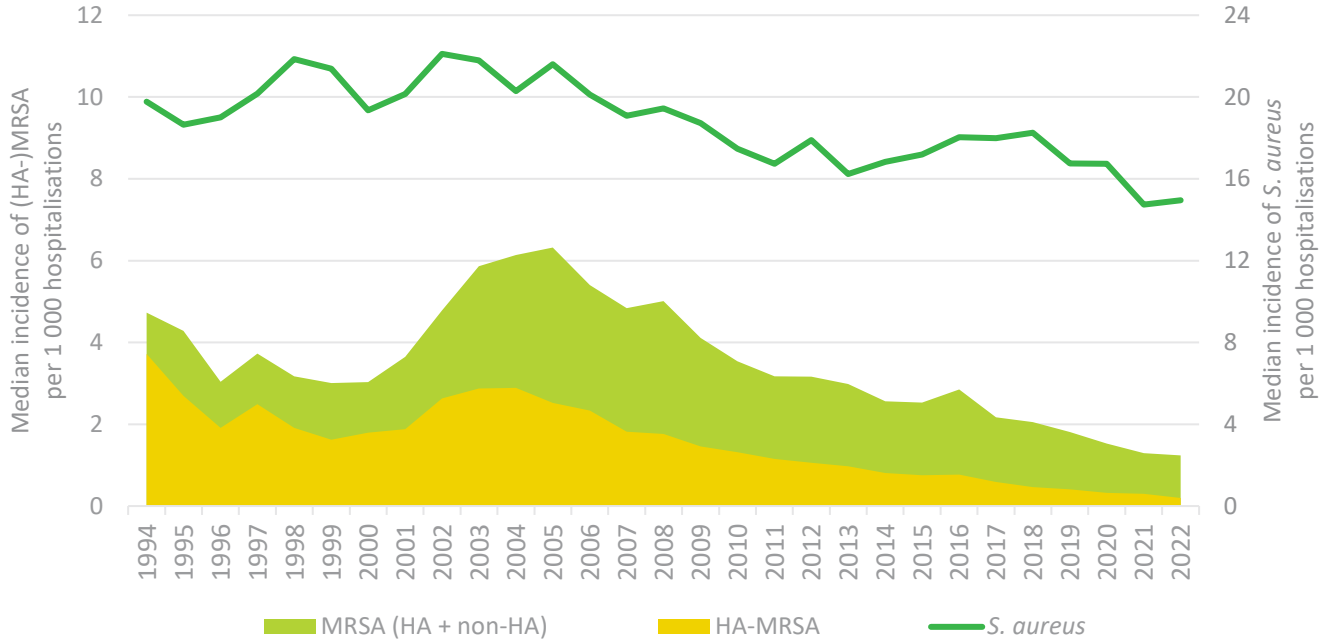


Figure 8 presents the overall evolution of the median incidence of *S. aureus*, MRSA and HA-MRSA. Due to the combined efforts of the infection prevention and control teams and a whole range of actions (among others recommendations for the prevention of MRSA transmission, more targeted screening policies and hand hygiene campaigns), the proportion of HA-MRSA on the total number of MRSA dropped from 78.8% in 1994 (start of the surveillance) to 39.8% in 2005 (peak in the MRSA incidence) and 43.1% in 2006 (year in which the surveillance became mandatory). In 2022, this proportion was at its lowest, i.e.15.9% (23.6% in 2021).

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, 1994-2022

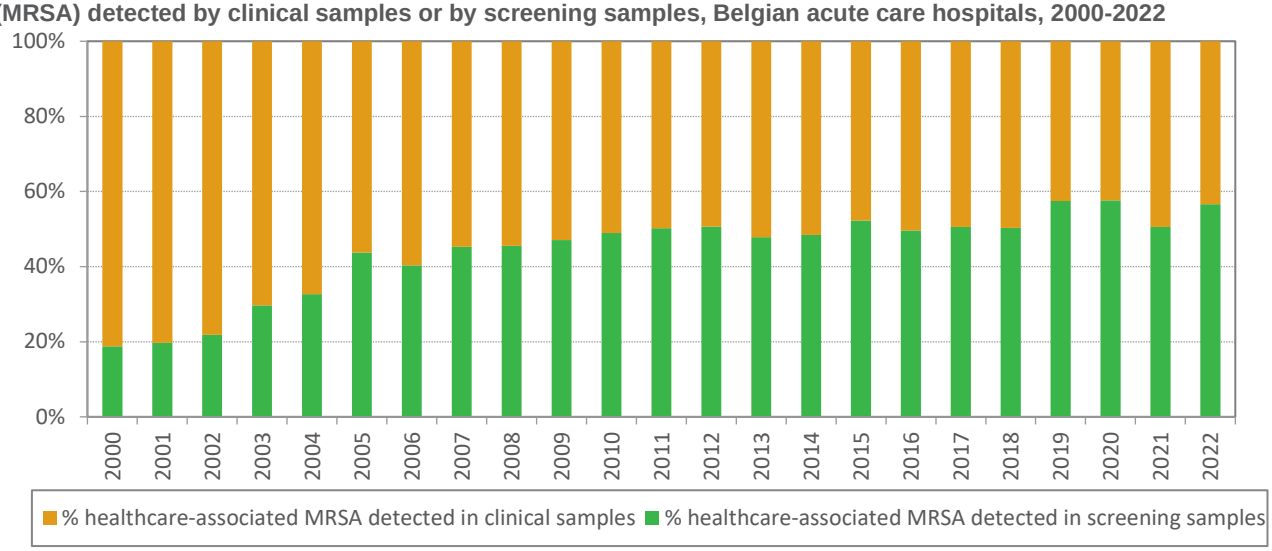


1.3.2 HEALTHCARE-ASSOCIATED MRSA IN SCREENING SAMPLES

In 2021 and 2022, 627 and 645 screening samples were reported as MRSA positive more than 48 hours after admission, respectively.

In 2021, the proportion of HA-MRSA cases detected through screening (50.5%) was comparable to proportions found between 2010 and 2018 (varying around 50%). This proportion increased to 56.6% in 2022 and was thereby more in line with the proportions observed in 2019 and 2020 (57.5% and 57.6%, respectively) (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, 2000-2022



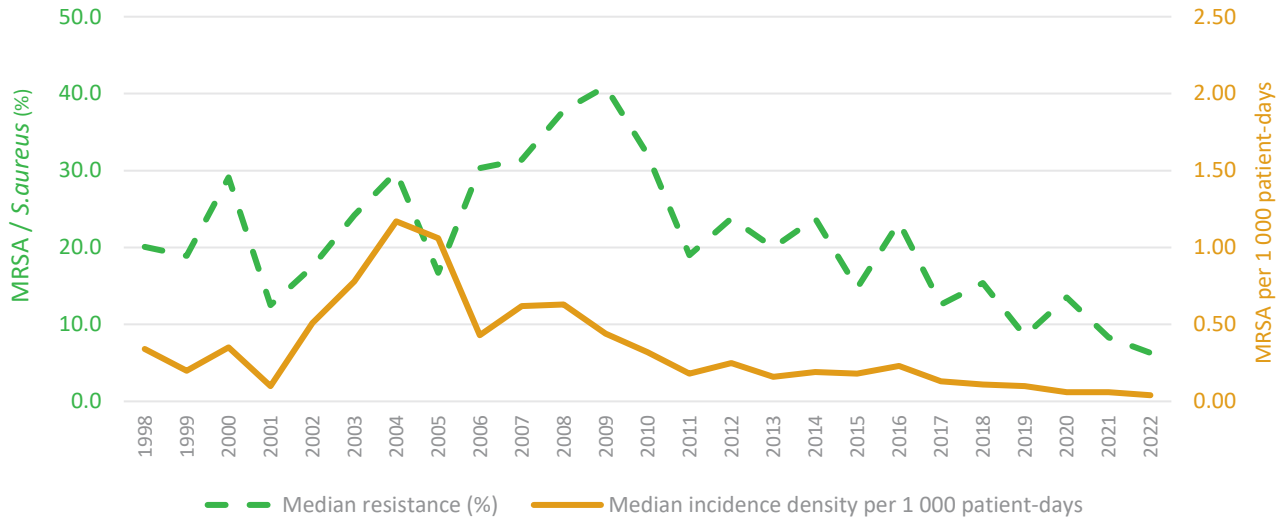
2. MRSA in chronic care hospitals

2.1 RESISTANCE IN *STAPHYLOCOCCUS AUREUS*

The crude proportion of MRSA on the total number of reported *S. aureus* was 8.8% in 2021 and 9.4% in 2022 (Table 6).

The overal 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, 1998-2022



2.2 HEALTHCARE-ASSOCIATED MRSA

In 2021 and 2022, 57.1% and 55.3% of all MRSA isolated from clinical samples were considered as healthcare-associated, respectively (Table 7). The crude incidence density of HA-MRSA was 0.04 cases per 1 000 patient-days in 2021 and in 2022.

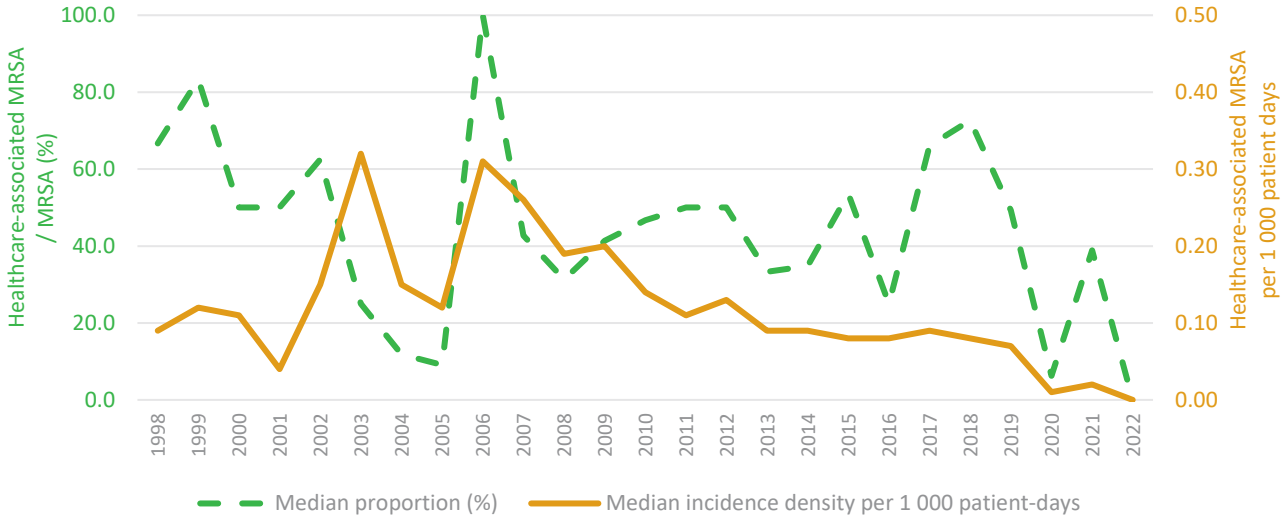
The overall evolution of these indicators (median proportion and incidence density) is presented in Figure 11.

Table 6. Resistance proportion, incidence and incidence density of methicillin-resistant *Staphylococcus aureus* (MRSA) (clinical samples only) by region, Belgian chronic care hospitals, 2021 and 2022

	MRSA (clinical samples only)											
	2021						2022					
	n	N	Crude	Mean	Median	P25 - P75	n	N	Crude	Mean	Median	P25 - P75
Resistance proportion (%)												
Belgium	**39**	**443**	**8.8**	**7.6**	**8.3**	**3.6-10.8**	**38**	**405**	**9.4**	**11.9**	**6.3**	**0.0-11.1**
Flanders	9	129	7.0	4.9	5.7	0.0-8.1	8	112	7.1	5.6	0.0	0.0-11.1
Wallonia	27	295	9.2	8.6	8.3	8.3-10.6	27	264	10.2	16.7	6.3	3.9-42.9
Brussels	3	19	15.8	-	-	-	3	29	10.3	-	-	-
Incidence per 1 000 hospitalisations												
Belgium	**39**	**20 166**	**1.93**	**2.00**	**2.02**	**1.10-3.21**	**38**	**23 860**	**1.59**	**1.88**	**1.08**	**0.00-3.82**
Flanders	9	4 584	1.96	1.43	1.23	0.00-2.85	8	5 444	1.47	1.88	0.00	0.00-4.08
Wallonia	27	14 855	1.82	2.02	1.57	1.29-2.96	27	17 631	1.53	1.60	1.08	0.80-2.77
Brussels	3	727	4.13	-	-	-	3	785	3.82	-	-	-
Incidence density per 1 000 patient-days												
Belgium	**39**	**510 936**	**0.08**	**0.08**	**0.06**	**0.01-0.10**	**38**	**596 191**	**0.06**	**0.06**	**0.04**	**0.00-0.08**
Flanders	9	200 704	0.04	0.03	0.04	0.00-0.06	8	197 484	0.04	0.03	0.00	0.00-0.07
Wallonia	27	275 837	0.10	0.12	0.10	0.07-0.14	27	361 572	0.07	0.07	0.04	0.02-0.13
Brussels	3	34 395	0.09	-	-	-	3	37 135	0.08	-	-	-

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

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, 1998-2022



In addition, 12 and 37 cases of HA-MRSA were detected through screening in 2021 and 2022, respectively. In these surveillance years, 37.5% and 63.8% of HA-MRSA were detected through screening (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, 2007-2022

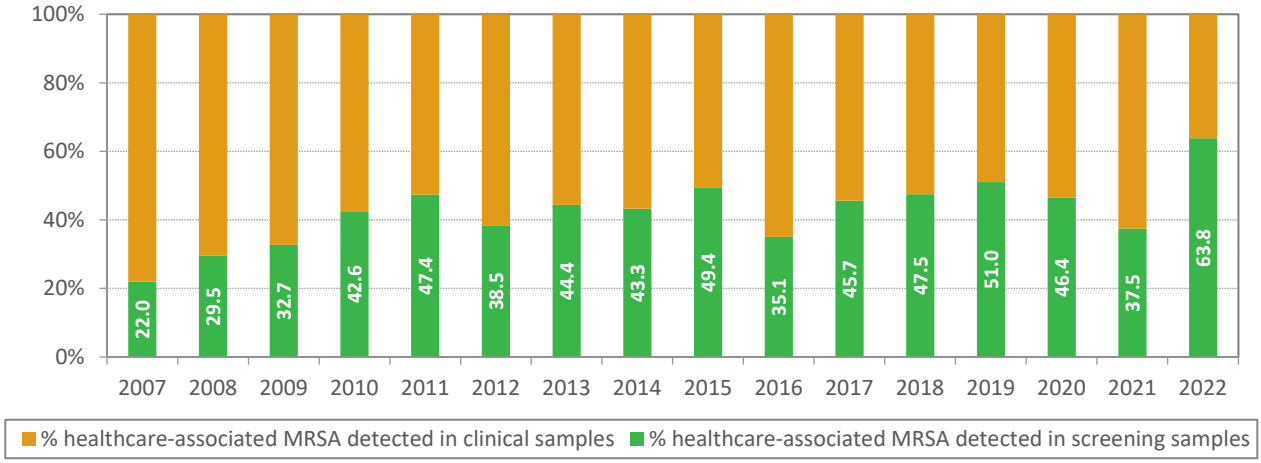


Table 7. Resistance proportion, incidence and incidence density of healthcare-associated methicillin-resistant *Staphylococcus aureus* (MRSA) (clinical samples only) by region, Belgian chronic care hospitals, 2021 and 2022

	Healthcare-associated MRSA (clinical samples only)											
	2021						2022					
	n	N	Crude	Mean	Median	P25 - P75	n	N	Crude	Mean	Median	P25 - P75
Proportion healthcare-associated MRSA/MRSA (%)												
Belgium	**20**	**35**	**57.1**	**47.8**	**38.9**	**0.0-100.0**	**21**	**38**	**55.3**	**36.7**	**0.0**	**0.0-100.0**
Flanders	1	5	20.0	8.3	0.0	0.0-16.7	2	8	25.0	8.0	0.0	0.0-0.0
Wallonia	16	27	59.3	68.9	100.0	44.4-100.0	16	27	59.3	48.2	37.5	0.0-100.0
Brussels	3	3	100.0	-	-	-	3	3	100.0	-	-	-
Incidence per 1 000 hospitalisations												
Belgium	**20**	**18 780**	**1.06**	**1.29**	**0.76**	**0.00-2.96**	**21**	**23 860**	**0.88**	**1.08**	**0.00**	**0.00-1.63**
Flanders	1	3 198	0.31	0.21	0.00	0.00-0.41	2	5 444	0.37	0.33	0.00	0.00-0.00
Wallonia	16	14 855	1.08	1.59	1.10	0.70-2.96	16	17 631	0.91	1.22	0.48	0.00-2.77
Brussels	3	727	4.13	-	-	-	3	785	3.82	-	-	-
Incidence density per 1 000 patient-days												
Belgium	**20**	**446 608**	**0.04**	**0.04**	**0.02**	**0.00-0.09**	**21**	**596 191**	**0.04**	**0.03**	**0.00**	**0.00-0.04**
Flanders	1	136 376	0.01	0.01	0.00	0.00-0.01	2	197 484	0.01	0.01	0.00	0.00-0.00
Wallonia	16	275 837	0.06	0.06	0.07	0.01-0.10	16	361 572	0.04	0.04	0.02	0.00-0.08
Brussels	3	34 395	0.09	-	-	-	3	37 135	0.08	-	-	-

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

PART 2. VANCOMYCIN-RESISTANT ENTEROCOCCI (VRE)

Although participation in the VRE surveillance was optional, 91.2% (n=93/102, i.e. four less than the mandatory MRSA surveillance) and 92.2% (n=94/102, same as for MRSA) of all Belgian acute care hospital administrative groups (mergers) participated with at least one hospital site in 2021 and 2022, respectively.

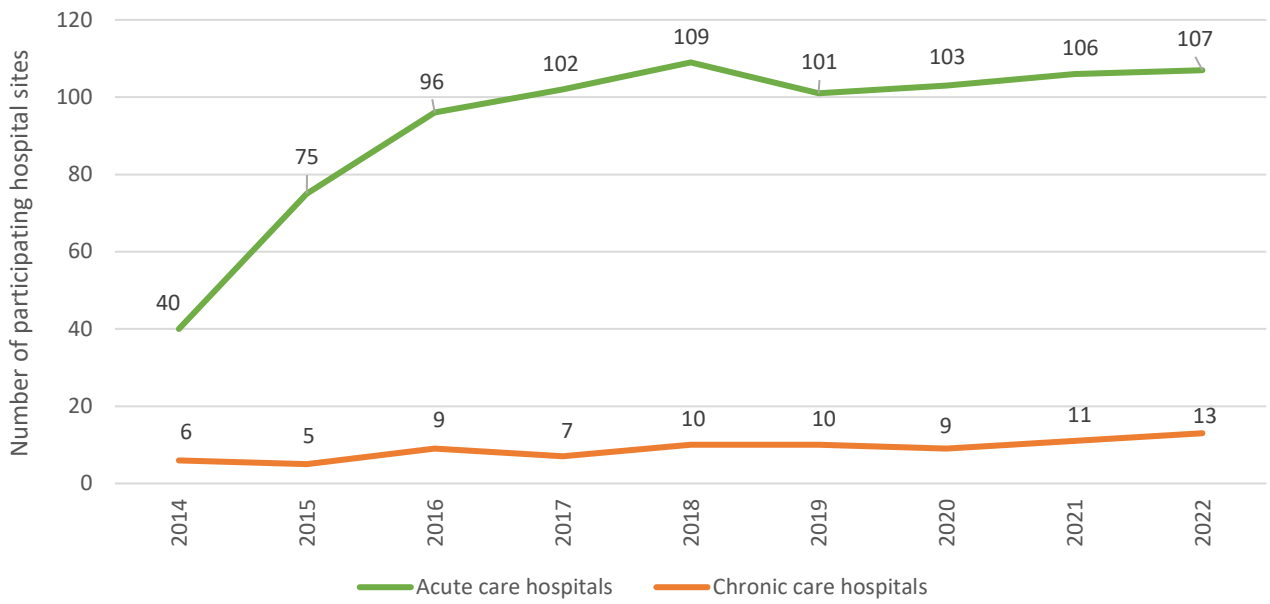
Table 8 presents the 2021 and 2022 participation in the VRE surveillance by hospital care type, region and level of specialty care within the hospital. All hospitals provided Type D data and were therefore included. Figure 13 shows the number of participating hospital sites since the beginning of the surveillance (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, 2021 and 2022

	2021				2022			
	Flanders	Wallonia	Brussels	Belgium	Flanders	Wallonia	Brussels	Belgium
N of acute care hospitals (%)	**56**	**37**	**13**	**106**	**57**	**37**	**13**	**107**
Primary hospitals	45	26	7	78	46	27	7	80
Secondary hospitals	8	10	3	21	8	9	3	20
Tertiary hospitals	3	1	3	7	3	1	3	7
N of chronic care hospitals (%)	**5**	**5**	**1**	**11**	**5**	**7**	**1**	**13**

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, 1994-2022



1. VRE in acute care hospitals

1.1 *ENTEROCOCCUS FAECIUM*

In 2021, 8 829 *E. faecium* (median: 61 isolates per hospital; IQR: 26-102) isolated from clinical samples (excluding faeces samples) were reported. These were 9 244 cases (median: 60 isolates per hospital; IQR: 27-109) in 2022.

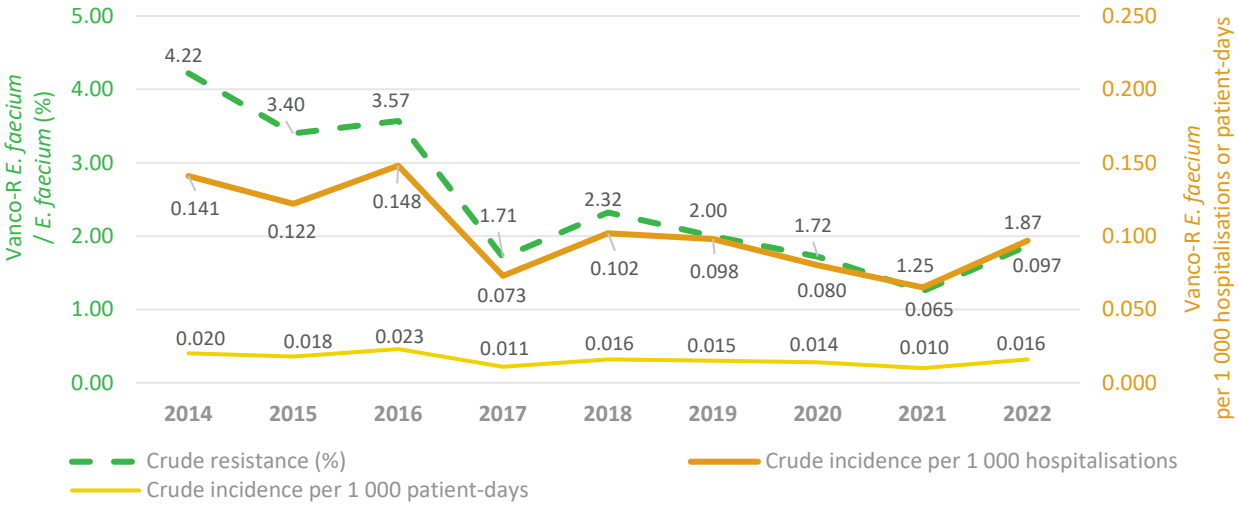
Among these, 110 cases of vanco-R *E. faecium* were reported by 39 (36.8%) acute care hospitals (min-max: 1-28 isolates per hospital) in 2021. These were 173 cases reported by 46 (43.0%) acute care hospitals (min-max: 1-39 isolates) in 2022.

The crude resistance proportion and incidence of vanco-R *E. faecium* was 1.25% and 0.065 cases per 1 000 hospitalisations in 2021. In 2022, these indicators were 1.87% and 0.097 cases per 1 000 hospitalisations, respectively (Table 9).

A decreasing trend in the resistance proportion (-0.17% per year; p=0.024) and incidence (IRR=0.976, 95%CI: 0.936-1.017; p=0.252) 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, 2014-2022



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.

1.2 *ENTEROCOCCUS FAECALIS*

A total of 25 731 *E. faecalis* (median: 169 isolates per hospital; IQR: 92-317) isolated from clinical samples (excluding faeces samples) were reported in 2021. These were 26 846 isolates (median: 176 per hospital; IQR: 82-300) in 2022.

In 2021, 12 cases of vanco-R *E. faecalis* were reported by 12 (11.3%) acute care hospitals (all one isolate). Thirteen cases were reported by 8 (7.5%) acute care hospitals (min-max: 1-3 isolates) in 2022.

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, 2021 and 2022

	Vancomycin-resistant *Enterococcus faecium* (clinical samples only)											
	2021						2022					
	n	N	Crude	Mean	Median	P25 - P75	n	N	Crude	Mean	Median	P25 - P75
Resistance proportion (%)												
Belgium	**110**	**8 829**	**1.25**	**1.14**	**0.00**	**0.00-1.19**	**173**	**9 244**	**1.87**	**1.63**	**0.00**	**0.00-1.41**
Flanders	42	5 287	0.79	0.57	0.00	0.00-0.71	47	5 403	0.87	0.63	0.00	0.00-1.06
Wallonia	58	2 650	2.19	2.10	0.00	0.00-1.54	102	2 663	3.83	3.14	0.83	0.00-3.45
Brussels	10	892	1.12	0.86	0.48	0.00-1.74	24	1 178	2.04	1.70	0.00	0.00-2.94
Primary hosp	49	4 851	1.01	0.98	0.00	0.00-0.72	92	5 274	1.74	1.37	0.00	0.00-1.13
Secondary hosp	44	1 966	2.24	1.81	0.43	0.00-2.27	52	1 848	2.81	2.69	1.00	0.00-4.14
Tertiary hosp	17	2 012	0.84	0.91	0.61	0.48-1.74	29	2 122	1.37	1.49	1.11	0.44-2.94
Incidence per 1 000 hospitalisations												
Belgium	**110**	**1 697 447**	**0.065**	**0.055**	**0.000**	**0.000-0.054**	**173**	**1 792 213**	**0.097**	**0.092**	**0.000**	**0.000-0.103**
Flanders	42	992 069	0.042	0.032	0.000	0.000-0.034	47	1 085 139	0.043	0.027	0.000	0.000-0.054
Wallonia	58	484 430	0.120	0.095	0.000	0.000-0.103	102	472 326	0.216	0.193	0.054	0.000-0.196
Brussels	10	220 948	0.045	0.042	0.036	0.000-0.054	24	234 748	0.102	0.087	0.000	0.000-0.132
Primary hosp	49	995 597	0.049	0.046	0.000	0.000-0.035	92	1 103 327	0.083	0.080	0.000	0.000-0.066
Secondary hosp	44	433 758	0.101	0.090	0.013	0.000-0.110	52	414 699	0.125	0.133	0.070	0.000-0.192
Tertiary hosp	17	268 092	0.063	0.062	0.043	0.028-0.101	29	274 187	0.106	0.111	0.106	0.027-0.136
Incidence density per 1 000 patient-days												
Belgium	**110**	**10 553 653**	**0.010**	**0.008**	**0.000**	**0.000-0.009**	**173**	**10 920 063**	**0.016**	**0.014**	**0.000**	**0.000-0.016**
Flanders	42	5 969 775	0.007	0.005	0.000	0.000-0.005	47	6 340 317	0.007	0.005	0.000	0.000-0.009
Wallonia	58	3 077 576	0.019	0.013	0.000	0.000-0.018	102	2 928 382	0.035	0.029	0.012	0.000-0.029
Brussels	10	1 506 302	0.007	0.007	0.005	0.000-0.009	24	1 651 364	0.015	0.012	0.000	0.000-0.023
Primary hosp	49	6 224 663	0.008	0.007	0.000	0.000-0.006	92	6 726 097	0.014	0.012	0.000	0.000-0.012
Secondary hosp	44	2 600 500	0.017	0.013	0.003	0.000-0.013	52	2 441 880	0.021	0.022	0.012	0.000-0.032
Tertiary hosp	17	1 728 490	0.010	0.010	0.006	0.004-0.014	29	1 752 086	0.017	0.017	0.017	0.004-0.032

Hosp = hospital; 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

1.3 OUTBREAKS

An outbreak (i.e. at least one new secondary case within the same ward and within one month) with vanco-R enterococci was reported by merely 3.8% of the participating hospitals in 2021 (COVID-19 pandemic). In 2022, 10.4% of the participating hospitals reported at least one cluster. Table 10 presents the number of clusters reported and the number of patients involved between 2014 and 2022.

Table 10. Evolution of the number of outbreaks reported in the national surveillance of resistant, Belgian acute care hospitals, 2014-2022

	2014	2015	2016	2017	2018	2021	2022	2021	2022
N of 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)	5/89 (5.6)	4/106 (3.8)	11/106 (10.4)
N of hospitals with no answer/no type D data	0	0	1	4	13	10	14	11	11
N of clusters (min-max)	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)
N of patients involved	68	140	247	166	164	285	27	10	723
% patients colonised	*79.4*	*87.7*	*88.8*	*89.8*	*88.4*	*93.1*	*77.8*	*90.0*	*91.2*
% patients infected	*20.6*	*12.3*	*11.2*	*10.2*	*11.6*	*6.9*	*22.2*	*10.0*	*8.8*

*data missing for two hospitals

2. VRE in chronic care hospitals

In total, 155 *E. faecium* (median: 12 per hospital; IQR: 5-21) and 498 *E. faecalis* (median: 48 per hospital; IQR: 26-58) isolated from clinical samples (excluding faeces samples) were reported in 2021. These were 174 *E. faecium* (median: 8 per hospital; IQR: 2-21) and 644 *E. faecalis* (median: 50 per hospital; IQR: 15-75) in 2022.

There were four cases of vanco-R *E. faecium* and one case of vanco-R *E. faecalis* reported in 2021. In 2022, no cases of vanco-R *E. faecium* or *E. faecalis* were noted.

No outbreaks with vanco-R enterococci were reported by the participating chronic care hospitals between 2014 and 2022.

PART 3. RESISTANCE IN GRAM-NEGATIVE BACTERIA

Similar to the MRSA surveillance, 95.1% (n=97/102) and 92.2% (n=94/102) of all acute care hospital administrative groups (mergers) participated in the MRGN surveillance with at least one hospital site in 2021 and 2022, respectively. All hospitals provided Type D data and were therefore included.

The number of participating hospital sites can be found in Table 11 by hospital care type, region and level of specialty care within the hospital.

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, 2021 and 2022

	2021				2022			
	Flanders	Wallonia	Brussels	Belgium	Flanders	Wallonia	Brussels	Belgium
N of acute care hospitals (%)	**59**	**38**	**14**	**111**	**57**	**37**	**13**	**107**
Primary hospitals	48	27	8	83	46	27	7	80
Secondary hospitals	8	10	3	21	8	9	3	20
Tertiary hospitals	3	1	3	7	3	1	3	7
N of chronic care hospitals (%)	**5**	**5**	**1**	**11**	**5**	**7**	**1**	**13**

N = number

1. Resistant Gram-negative bacteria in acute care hospitals

1.1 RESISTANCE IN *ESCHERICHIA COLI*

In 2021, 7.8% of all *E. coli* isolated from clinical samples were 3GC-R. This crude resistance proportion increased to 8.0% in 2022. The crude incidence remained stable: 4.10 in 2021 and 4.06 per 1 000 hospitalisations in 2022 (Table 12a).

Between 2019 and 2022, the resistance proportion of 3GC-R *E. coli* significantly decreased (-0.63% per year; p<0.001). No significant trend can however be observed between the beginning of the surveillance (2014) and 2022 (-0.01% per year; p=0.813). The incidence of 3GC-R *E. coli* significantly decreased in the same time periods: 2020-2022 IRR=0.937 (95%CI: 0.888-0.989; p=0.017) and 2014-2022 IRR=0.974 (95%CI: 0.963-0.985; 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 51 cases of mero-R *E. coli* were reported by 28 (25.2%) acute care hospitals (n=28/111; min-max: 1-5 isolates) in 2021. In 2022, these were 48 mero-R *E. coli* isolates reported by 29 (27.1%) hospitals (n=29/107; min-max: 1-7). The crude resistance proportion was 0.06% and 0.05% in 2021 and 2022, respectively. The crude incidence of mero-R *E. coli* was 0.029 cases and 0.027 cases per 1 000 hospitalisations, respectively (Table 12b).

Between 2015 and 2022, no significant trend in the resistance proportion (-0.00% per year; p=0.977) and incidence (IRR=0.981, 95%CI: 0.940-1.023; p=0.366) of mero-R *E. coli* can be observed.

Table 12a. 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) by region and level of specialty care within the hospital, Belgian acute care hospitals, 2021 and 2022

	Escherichia coli resistant to third generation cephalosporins (clinical samples only)											
	2021						2022					
	n	N	Crude	Mean	Median	P25 - P75	n	N	Crude	Mean	Median	P25 - P75
Resistance proportion (%)												
Belgium	**7 210**	**91 915**	**7.8**	**8.0**	**8.2**	**6.1-9.5**	**7 274**	**91 022**	**8.0**	**8.3**	**7.7**	**6.4-9.6**
Flanders	4 023	55 787	7.2	6.9	6.7	5.4-8.7	4 142	56 189	7.4	7.4	7.0	5.8-8.6
Wallonia	2 085	25 359	8.2	8.6	8.5	7.9-10.2	1 961	25 988	7.5	7.9	7.7	6.7-9.2
Brussels	1 102	10 769	10.2	10.6	9.6	9.3-12.4	1 171	8 845	13.2	13.4	13.3	10.4-14.1
Primary hosp	4 556	63 245	7.2	7.5	7.6	5.5-9.3	4 672	63 466	7.4	7.9	7.3	6.1-9.2
Secondary hosp	1 431	16 150	8.9	9.1	8.5	7.8-10.7	1 312	14 885	8.8	9.0	9.0	7.4-10.1
Tertiary hosp	1 223	12 520	9.8	9.5	9.2	8.8-10.5	1 290	12 671	10.2	10.5	10.5	7.6-13.1
Incidence per 1 000 hospitalisations												
Belgium	**7 210**	**1 756 603**	**4.10**	**4.43**	**4.22**	**2.81-5.52**	**7 274**	**1 792 213**	**4.06**	**4.47**	**3.97**	**2.95-5.22**
Flanders	4 023	1 032 941	3.89	3.97	4.19	2.83-5.27	4 142	1 085 139	3.82	4.04	3.94	2.95-4.79
Wallonia	2 085	486 473	4.29	4.96	3.98	2.52-6.05	1 961	472 326	4.15	4.69	4.01	2.75-5.08
Brussels	1 102	237 189	4.65	4.93	5.33	4.40-5.85	1 171	234 748	4.99	5.70	4.36	3.29-6.96
Primary hosp	4 556	1 054 753	4.32	4.57	4.25	2.52-6.02	4 672	1 103 327	4.23	4.51	3.97	2.88-4.97
Secondary hosp	1 431	433 758	3.30	3.84	3.90	3.12-4.45	1 312	414 699	3.16	4.10	3.70	2.92-4.96
Tertiary hosp	1 223	268 092	4.56	4.60	5.30	3.13-6.06	1 290	274 187	4.70	4.98	5.82	3.78-6.56
Incidence density per 1 000 patient-days												
Belgium	**7 210**	**10 928 205**	**0.66**	**0.69**	**0.65**	**0.41-0.85**	**7 274**	**10 920 063**	**0.67**	**0.69**	**0.63**	**0.49-0.80**
Flanders	4 023	6 206 057	0.65	0.65	0.64	0.43-0.82	4 142	6 340 317	0.65	0.67	0.62	0.52-0.77
Wallonia	2 085	3 092 853	0.67	0.74	0.67	0.38-0.90	1 961	2 928 382	0.67	0.71	0.63	0.49-0.81
Brussels	1 102	1 629 295	0.68	0.67	0.65	0.42-0.84	1 171	1 651 364	0.71	0.70	0.50	0.36-0.81
Primary hosp	4 556	6 599 215	0.69	0.71	0.66	0.41-0.90	4 672	6 726 097	0.69	0.71	0.63	0.50-0.77
Secondary hosp	1 431	2 600 500	0.55	0.57	0.60	0.37-0.71	1 312	2 441 880	0.54	0.58	0.58	0.36-0.79
Tertiary hosp	1 223	1 728 490	0.71	0.68	0.64	0.49-0.86	1 290	1 752 086	0.74	0.73	0.80	0.49-0.93

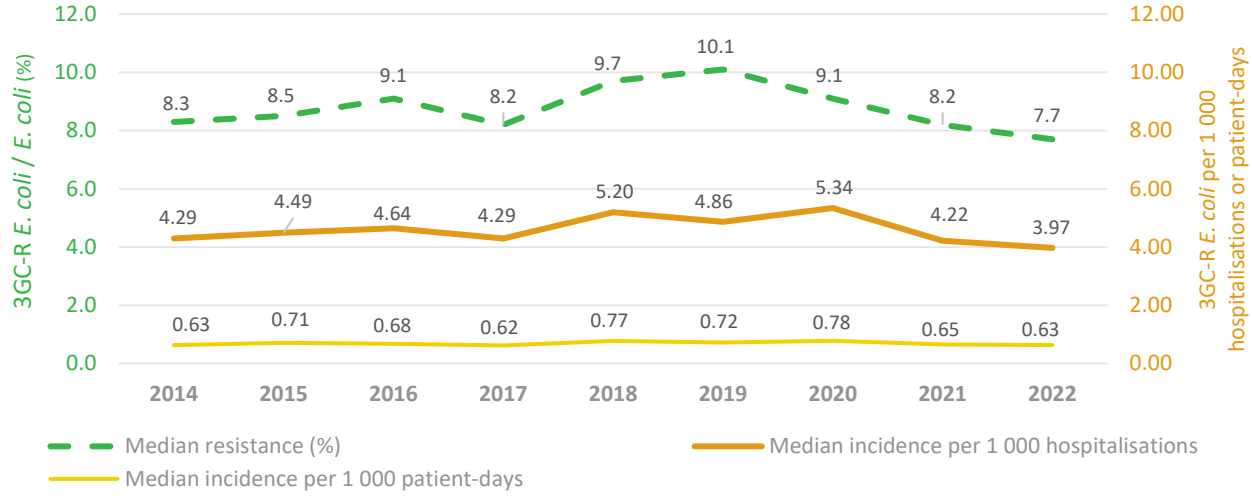
Hosp = hospital; n = total number of *Escherichia coli* resistant to 3rd generation cephalosporins isolates, N = total number of *Escherichia coli* isolates for the calculation of the resistance proportion, total number of hospitalisations for the incidence or total number of patient-days for the incidence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

Table 12b. Resistance proportion, incidence (per 1 000 hospitalisations) and incidence density (per 1 000 patient-days) of *Escherichia coli* resistant to meropenem (clinical samples only) by region and level of specialty care within the hospital, Belgian acute care hospitals, 2021 and 2022

	Escherichia coli resistant to meropenem (clinical samples only)											
	2021						2022					
	n	N	Crude	Mean	Median	P25 - P75	n	N	Crude	Mean	Median	P25 - P75
Resistance proportion (%)												
Belgium	**51**	**91 915**	**0.06**	**0.06**	**0.00**	**0.00-0.04**	**48**	**91 022**	**0.05**	**0.08**	**0.00**	**0.00-0.06**
Flanders	19	55 787	0.03	0.03	0.00	0.00-0.00	20	56 189	0.04	0.07	0.00	0.00-0.03
Wallonia	13	25 359	0.05	0.05	0.00	0.00-0.00	8	25 988	0.03	0.04	0.00	0.00-0.00
Brussels	19	10 769	0.18	0.21	0.12	0.00-0.30	20	8 845	0.23	0.25	0.16	0.00-0.47
Primary hosp	30	63 245	0.05	0.05	0.00	0.00-0.00	29	63 466	0.05	0.08	0.00	0.00-0.00
Secondary hosp	9	16 150	0.06	0.06	0.00	0.00-0.00	10	14 885	0.07	0.08	0.00	0.00-0.10
Tertiary hosp	12	12 520	0.10	0.16	0.00	0.00-0.34	9	12 671	0.07	0.10	0.07	0.00-0.16
Incidence per 1 000 hospitalisations												
Belgium	**51**	**1 756 603**	**0.029**	**0.029**	**0.000**	**0.000-0.031**	**48**	**1 792 213**	**0.027**	**0.030**	**0.000**	**0.000-0.031**
Flanders	19	1 032 941	0.018	0.018	0.000	0.000-0.000	20	1 085 139	0.018	0.020	0.000	0.000-0.017
Wallonia	13	486 473	0.027	0.028	0.000	0.000-0.000	8	472 326	0.017	0.019	0.000	0.000-0.000
Brussels	19	237 189	0.080	0.076	0.036	0.000-0.159	20	234 748	0.085	0.106	0.057	0.000-0.132
Primary hosp	30	1 054 753	0.028	0.028	0.000	0.000-0.000	29	1 103 327	0.026	0.028	0.000	0.000-0.000
Secondary hosp	9	433 758	0.021	0.021	0.000	0.000-0.000	10	414 699	0.024	0.035	0.000	0.000-0.044
Tertiary hosp	12	268 092	0.045	0.061	0.036	0.000-0.174	9	274 187	0.033	0.034	0.035	0.000-0.054
Incidence density per 1 000 patient-days												
Belgium	**51**	**10 928 205**	**0.005**	**0.005**	**0.000**	**0.000-0.006**	**48**	**10 920 063**	**0.004**	**0.004**	**0.000**	**0.000-0.005**
Flanders	19	6 206 057	0.003	0.003	0.000	0.000-0.000	20	6 340 317	0.003	0.003	0.000	0.000-0.002
Wallonia	13	3 092 853	0.004	0.005	0.000	0.000-0.000	8	2 928 382	0.003	0.003	0.000	0.000-0.000
Brussels	19	1 629 295	0.012	0.011	0.008	0.000-0.021	20	1 651 364	0.012	0.014	0.009	0.000-0.016
Primary hosp	30	6 599 215	0.005	0.004	0.000	0.000-0.000	29	6 726 097	0.004	0.004	0.000	0.000-0.000
Secondary hosp	9	2 600 500	0.003	0.003	0.000	0.000-0.000	10	2 441 880	0.004	0.005	0.000	0.000-0.007
Tertiary hosp	12	1 728 490	0.007	0.010	0.006	0.000-0.021	9	1 752 086	0.005	0.006	0.006	0.000-0.009

Hosp = hospital; n = total number of *Escherichia coli* resistant to meropenem isolates, 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

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, 2014-2022



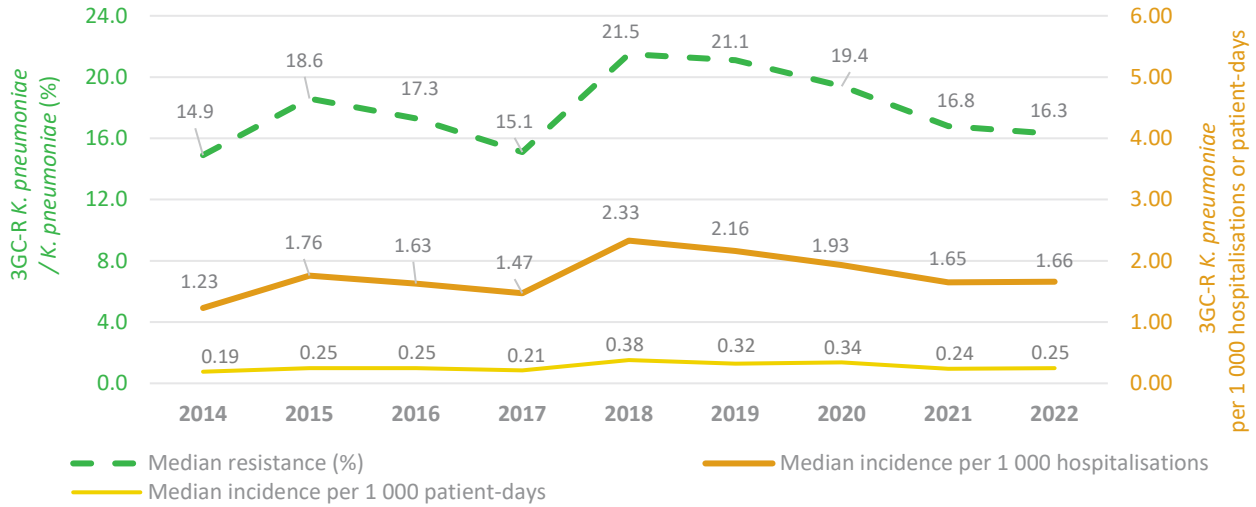
3GC-R = resistant to 3rd cephalosporins; note: prior to 2018 non-susceptibility to 4th generation cephalosporins was included, prior to 2021 I/R (resistant, incl. also susceptible, increased exposure (intermediate result)) is displayed.

1.2 RESISTANCE IN *KLEBSIELLA PNEUMONIAE*

In 2021, the crude resistance proportion 3GC-R *K. pneumoniae* was 18.3%, while the crude incidence was 2.21 per 1 000 hospitalisations (clinical samples only). In 2022, these were 17.9% and 2.04 cases per 1 000 hospitalisations, respectively (Table 13a).

Between 2014 and 2022, no significant trend in the resistance proportion (-0.03% per year; p=0.844) and incidence (IRR=0.993, 95%CI: 0.979-1.001; p=0.311) of 3GC-R *K. pneumoniae* can be observed. Since 2018, a significant decrease in the resistance proportion (-1.82% per year; p<0.001) and incidence (IRR=0.907, 95%CI: 0.885-0.929; p<0.001) is however seen (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, 2014-2022



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 13a. 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) by region and specialty care level within the hospital, Belgian acute care hospitals, 2021 and 2022

	Klebsiella pneumoniae resistant to third generation cephalosporins (clinical samples only)											
	2021						2022					
	n	N	Crude	Mean	Median	P25 - P75	n	N	Crude	Mean	Median	P25 - P75
Resistance proportion (%)												
Belgium	**3 880**	**21 219**	**18.3**	**17.9**	**16.8**	**11.1-24.7**	**3 658**	**20 478**	**17.9**	**18.1**	**16.3**	**10.5-25.0**
Flanders	1 574	11 106	14.2	12.8	11.4	7.4-17.1	1 509	11 046	13.7	12.4	12.2	8.3-15.2
Wallonia	1 668	7 052	23.7	24.6	23.9	18.8-30.8	1 511	6 724	22.5	24.6	24.4	19.0-33.1
Brussels	638	3 061	20.8	21.0	19.9	15.6-26.9	638	2 708	23.6	24.9	23.8	18.9-26.7
Primary hosp	2 341	13 180	17.8	17.4	15.2	10.5-24.7	2 116	12 866	16.4	17.1	13.8	10.1-24.2
Secondary hosp	835	4 280	19.5	19.8	19.7	11.9-25.4	803	3 735	21.5	21.4	21.4	15.7-26.0
Tertiary hosp	704	3 759	18.7	17.8	17.3	12.8-21.5	739	3 877	19.1	19.6	18.9	14.7-24.8
Incidence per 1 000 hospitalisations												
Belgium	**3 880**	**1 756 603**	**2.21**	**2.53**	**1.65**	**0.95-3.03**	**3 658**	**1 792 213**	**2.04**	**2.41**	**1.66**	**0.89-3.03**
Flanders	1 574	1 032 941	1.52	1.42	1.16	0.79-1.63	1 509	1 085 139	1.39	1.41	1.06	0.68-1.67
Wallonia	1 668	486 473	3.43	4.12	2.92	1.84-5.04	1 511	472 326	3.20	3.74	3.03	1.69-4.73
Brussels	638	237 189	2.69	2.93	2.33	1.82-4.58	638	234 748	2.72	2.99	2.51	1.92-4.24
Primary hosp	2 341	1 054 753	2.22	2.56	1.44	0.93-3.03	2 116	1 103 327	1.92	2.30	1.45	0.84-2.66
Secondary hosp	835	433 758	1.93	2.34	1.87	1.23-2.99	803	414 699	1.94	2.68	2.14	0.96-3.84
Tertiary hosp	704	268 092	2.63	2.75	2.30	1.65-4.33	739	274 187	2.70	2.95	2.72	2.51-3.27
Incidence density per 1 000 patient-days												
Belgium	**3 880**	**10 928 205**	**0.36**	**0.38**	**0.24**	**0.15-0.47**	**3 658**	**10 920 063**	**0.33**	**0.36**	**0.25**	**0.16-0.50**
Flanders	1 574	6 206 057	0.25	0.24	0.19	0.12-0.26	1 509	6 340 317	0.24	0.24	0.18	0.11-0.25
Wallonia	1 668	3 092 853	0.54	0.59	0.48	0.31-0.78	1 511	2 928 382	0.52	0.55	0.51	0.31-0.77
Brussels	638	1 629 295	0.39	0.38	0.35	0.22-0.56	638	1 651 364	0.39	0.37	0.37	0.23-0.51
Primary hosp	2 341	6 599 215	0.35	0.38	0.23	0.15-0.44	2 116	6 726 097	0.31	0.35	0.23	0.14-0.42
Secondary hosp	835	2 600 500	0.32	0.35	0.37	0.19-0.49	803	2 441 880	0.33	0.38	0.28	0.17-0.61
Tertiary hosp	704	1 728 490	0.41	0.39	0.39	0.21-0.60	739	1 752 086	0.42	0.42	0.40	0.34-0.49

Hosp = hospital; n = total number of *Klebsiella pneumoniae* resistant to 3rd generation cephalosporins isolates, 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

Table 13b. Resistance proportion, incidence (per 1 000 hospitalisations) and incidence density (per 1 000 patient-days) of *Klebsiella pneumoniae* resistant to meropenem (clinical samples only) by region and level of specialty care within the hospital, Belgian acute care hospitals, 2021 and 2022

	Klebsiella pneumoniae resistant to meropenem (clinical samples only)											
	2021						2022					
	n	N	Crude	Mean	Median	P25 - P75	n	N	Crude	Mean	Median	P25 - P75
Resistance proportion (%)												
Belgium	**240**	**21 219**	**1.13**	**1.13**	**0.36**	**0.00-1.56**	**233**	**20 478**	**1.14**	**1.11**	**0.43**	**0.00-1.47**
Flanders	60	11 106	0.54	0.70	0.00	0.00-0.98	90	11 046	0.81	0.65	0.00	0.00-0.91
Wallonia	118	7 052	1.67	1.51	0.80	0.00-2.17	93	6 724	1.38	1.66	0.91	0.00-1.83
Brussels	62	3 061	2.03	1.92	1.39	0.49-2.96	50	2 708	1.85	1.59	1.07	0.00-3.00
Primary hosp	155	13 180	1.18	1.14	0.00	0.00-1.48	113	12 866	0.88	1.09	0.00	0.00-1.43
Secondary hosp	48	4 280	1.12	1.07	0.78	0.22-1.75	49	3 735	1.31	1.01	0.66	0.00-1.55
Tertiary hosp	37	3 759	0.98	1.16	0.66	0.36-2.45	71	3 877	1.83	1.68	1.17	0.75-2.80
Incidence per 1 000 hospitalisations												
Belgium	**240**	**1 756 603**	**0.137**	**0.168**	**0.038**	**0.000-0.204**	**233**	**1 792 213**	**0.130**	**0.134**	**0.037**	**0.000-0.172**
Flanders	60	1 032 941	0.058	0.064	0.000	0.000-0.110	90	1 085 139	0.083	0.063	0.000	0.000-0.083
Wallonia	118	486 473	0.243	0.291	0.081	0.000-0.299	93	472 326	0.197	0.208	0.135	0.000-0.330
Brussels	62	237 189	0.261	0.274	0.207	0.055-0.437	50	234 748	0.213	0.235	0.106	0.000-0.319
Primary hosp	155	1 054 753	0.147	0.172	0.000	0.000-0.175	113	1 103 327	0.102	0.125	0.000	0.000-0.153
Secondary hosp	48	433 758	0.111	0.150	0.083	0.026-0.210	49	414 699	0.118	0.120	0.067	0.000-0.154
Tertiary hosp	37	268 092	0.138	0.176	0.110	0.067-0.287	71	274 187	0.259	0.281	0.141	0.106-0.457
Incidence density per 1 000 patient-days												
Belgium	**240**	**10 928 205**	**0.022**	**0.024**	**0.006**	**0.000-0.028**	**233**	**10 920 063**	**0.021**	**0.021**	**0.006**	**0.000-0.023**
Flanders	60	6 206 057	0.010	0.011	0.000	0.000-0.017	90	6 340 317	0.014	0.011	0.000	0.000-0.015
Wallonia	118	3 092 853	0.038	0.041	0.017	0.000-0.046	93	2 928 382	0.032	0.033	0.016	0.000-0.048
Brussels	62	1 629 295	0.038	0.037	0.030	0.006-0.051	50	1 651 364	0.030	0.027	0.017	0.000-0.023
Primary hosp	155	6 599 215	0.023	0.025	0.000	0.000-0.026	113	6 726 097	0.017	0.020	0.000	0.000-0.021
Secondary hosp	48	2 600 500	0.018	0.020	0.016	0.005-0.035	49	2 441 880	0.020	0.018	0.010	0.000-0.023
Tertiary hosp	37	1 728 490	0.021	0.025	0.015	0.009-0.052	71	1 752 086	0.041	0.038	0.026	0.017-0.065

Hosp = hospital; n = total number of *Klebsiella pneumoniae* resistant to meropenem isolates, 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

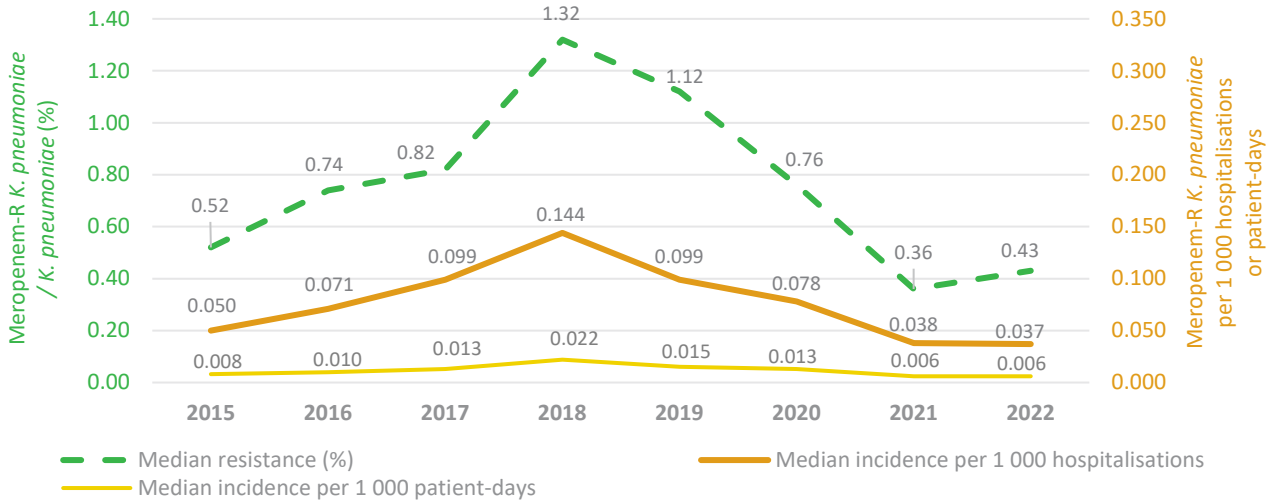
The evolution of the median resistance proportion and incidence (per 1 000 hospitalisations) of 3GC-R *K. pneumoniae* by region and by level of specialty care can be found in Annex (Figure A12 – A15).

Cases of mero-R *K. pneumoniae* were reported by 54.1% (n=60/111; min-max: 1-22 isolates) and 50.5% (n=54/107; min-max: 1-27 isolates) of the acute care hospitals in 2021 and 2022, respectively. The crude resistance proportion and incidence were 1.13% or 0.137 cases per 1 000 hospitalisations in 2021 and 1.14% or 0.130 cases per 1 000 hospitalisations in 2022, respectively (Table 13b).

Between 2018 and 2021, there was a significant decrease in the resistance proportion (-0.31% per year; p=0.001) and incidence (IRR=0.919, 95%CI: 0.820-1.029; p=0.143) of mero-R *K. pneumoniae*. Between 2021 and 2022, the resistance proportion (-0.02% per year; p=0.940) increased slightly again (Figure 17).

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

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, 2014-2022



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 reported at least one mero-R *A. baumannii*: 26.1% (n=29/111; min-max: 1-11 isolates) in 2021 and 22.4% (n=24/107; min-max: 1-13 isolates) in 2022 (clinical samples only). The crude resistance proportion and incidence of mero-R *A. baumannii* in clinical samples was 8.12% and 0.039 cases per 1 000 hospitalisations in 2021. In 2022, these indicators were slightly lower: 7.66% and 0.032 cases per 1 000 hospitalisations, respectively (Table 14).

Figure 18 presents the evolution of the crude (median all zero values) resistance proportion and incidence of mero-R *A. baumannii*. Between 2015 and 2022, no significant trend in the resistance proportion (-0.04% per year; p=0.844) and incidence (IRR=0.959, 95%CI: 0.911-1.010; p=0.110) can be observed.

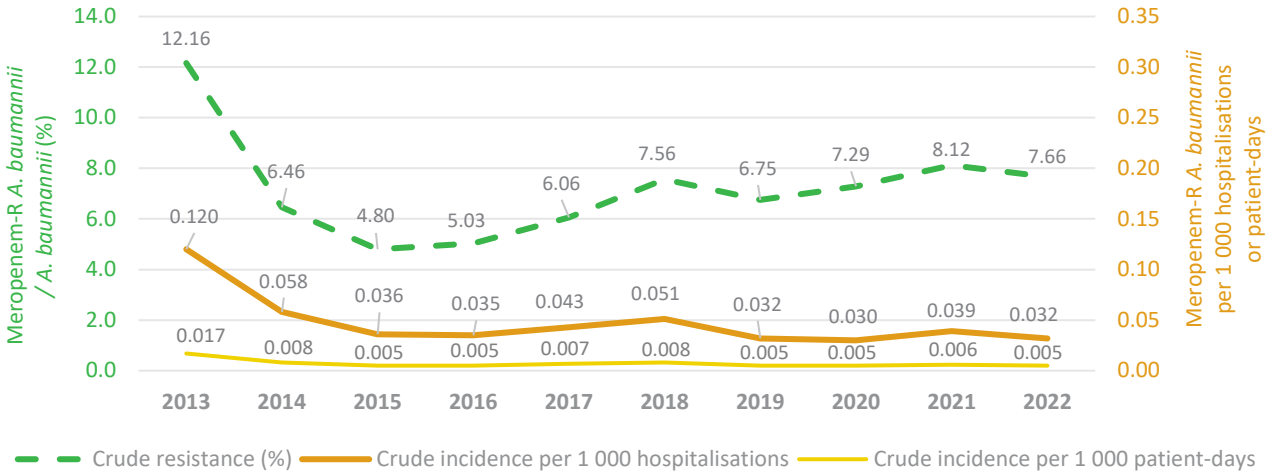
The evolution of the crude resistance proportion and incidence (per 1 000 hospitalisations) of mero-R *A. baumannii* by region and by level of specialty care can be found in Annex (Figure A20 – A23).

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, 2021 and 2022

	Acinetobacter baumannii resistant to meropenem (clinical samples only)											
	2021						2022					
	n	N	Crude	Mean	Median	P25 - P75	n	N	Crude	Mean	Median	P25 - P75
Resistance proportion (%)												
Belgium	**69**	**850**	**8.12**	**4.99**	**0.00**	**0.00-2.08**	**58**	**757**	**7.66**	**4.04**	**0.00**	**0.00-0.00**
Flanders	30	487	6.16	3.40	0.00	0.00-0.00	21	460	4.57	1.97	0.00	0.00-0.00
Wallonia	19	242	7.85	5.65	0.00	0.00-10.00	26	183	14.21	5.10	0.00	0.00-0.00
Brussels	20	121	16.53	9.89	0.00	0.00-20.00	11	114	9.65	9.92	0.00	0.00-16.67
Primary hosp	20	415	4.82	3.07	0.00	0.00-0.00	13	335	3.88	2.44	0.00	0.00-0.00
Secondary hosp	21	183	11.48	9.83	0.00	0.00-18.75	15	190	7.89	7.66	0.00	0.00-15.48
Tertiary hosp	28	252	11.11	13.21	10.53	2.08-25.00	30	232	12.93	11.73	9.38	6.25-15.38
Incidence per 1 000 hospitalisations												
Belgium	**69**	**1 756 603**	**0.039**	**0.028**	**0.000**	**0.000-0.026**	**58**	**1 792 213**	**0.032**	**0.023**	**0.000**	**0.000-0.000**
Flanders	30	1 032 941	0.029	0.015	0.000	0.000-0.000	21	1 085 139	0.019	0.013	0.000	0.000-0.000
Wallonia	19	486 473	0.039	0.032	0.000	0.000-0.031	26	472 326	0.055	0.032	0.000	0.000-0.000
Brussels	20	237 189	0.084	0.074	0.000	0.000-0.165	11	234 748	0.047	0.041	0.000	0.000-0.082
Primary hosp	20	1 054 753	0.019	0.013	0.000	0.000-0.000	13	1 103 327	0.012	0.011	0.000	0.000-0.000
Secondary hosp	21	433 758	0.048	0.061	0.000	0.000-0.150	15	414 699	0.036	0.037	0.000	0.000-0.047
Tertiary hosp	28	268 092	0.104	0.113	0.054	0.028-0.185	30	274 187	0.109	0.115	0.085	0.035-0.161
Incidence density per 1 000 patient-days												
Belgium	**69**	**10 928 205**	**0.006**	**0.004**	**0.000**	**0.000-0.003**	**58**	**10 920 063**	**0.005**	**0.004**	**0.000**	**0.000-0.000**
Flanders	30	6 206 057	0.005	0.002	0.000	0.000-0.000	21	6 340 317	0.003	0.002	0.000	0.000-0.000
Wallonia	19	3 092 853	0.006	0.005	0.000	0.000-0.009	26	2 928 382	0.009	0.005	0.000	0.000-0.000
Brussels	20	1 629 295	0.012	0.010	0.000	0.000-0.015	11	1 651 364	0.007	0.006	0.000	0.000-0.009
Primary hosp	20	6 599 215	0.003	0.002	0.000	0.000-0.000	13	6 726 097	0.002	0.002	0.000	0.000-0.000
Secondary hosp	21	2 600 500	0.008	0.009	0.000	0.000-0.015	15	2 441 880	0.006	0.006	0.000	0.000-0.008
Tertiary hosp	28	1 728 490	0.016	0.016	0.013	0.004-0.026	30	1 752 086	0.017	0.016	0.013	0.006-0.022

Hosp = hospital; 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

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, 2013-2022



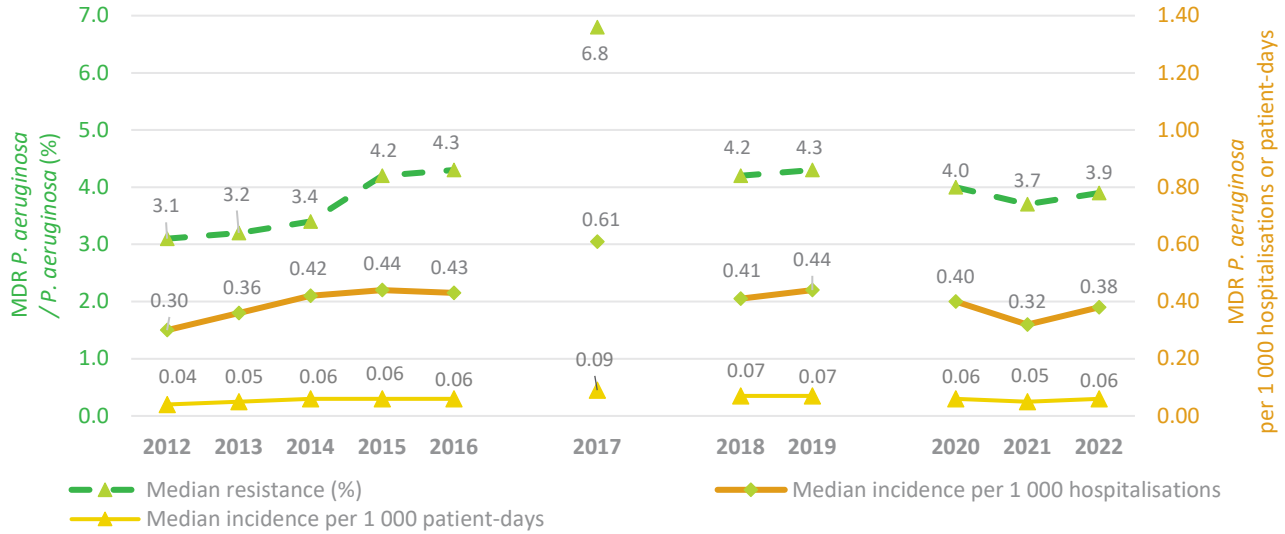
Note: prior to 2021 I/R (resistant, incl. also susceptible, increased exposure (intermediate result)) is displayed.

1.4 RESISTANCE IN *PSEUDOMONAS AERUGINOSA*

The crude resistance proportion of multidrug-resistant (MDR) *P. aeruginosa* varied from 6.0% in 2021 tot 5.6% in 2022. The crude incidence was 0.67 cases per 1 000 hospitalisations in both years (Table 15).

Definition changes in 2017, 2018 and 2020 (see methods) make it difficult to interpret the evolution of MDR *P. aeruginosa.* Since 2020, no significant trend in the resistance proportion (-0.20% per year; p=0.455) and incidence (IRR=0.960, 95%CI: 0.878-1.049; p=0.369) can be observed (Figure 19).
In 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, 2012-2022



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.

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, 2021 and 2022

	multidrug-resistant (MDR) *Pseudomonas aeruginosa* (clinical samples only)											
	2021						2022					
	n	N	Crude	Mean	Median	P25 - P75	n	N	Crude	Mean	Median	P25 - P75
Resistance proportion (%)												
Belgium	**1 185**	**19 717**	**6.0**	**5.1**	**3.7**	**1.7-7.8**	**1 071**	**19 003**	**5.6**	**5.0**	**3.9**	**1.6-7.0**
Flanders	534	10 389	5.1	3.7	2.6	1.1-4.8	520	10 561	4.9	3.8	2.6	0.4-5.3
Wallonia	353	5 988	5.9	6.4	4.9	1.9-8.8	286	5 839	4.9	5.0	4.9	2.1-7.1
Brussels	298	3 340	8.9	7.6	6.9	3.8-10.5	265	2 603	10.2	9.9	8.0	6.1-12.2
Primary hosp	488	11 425	4.3	4.5	3.4	1.2-5.4	413	11 333	3.6	4.1	3.5	1.3-6.0
Secondary hosp	272	4 200	6.5	5.7	5.0	2.2-8.4	223	3 545	6.3	5.4	3.7	2.5-8.1
Tertiary hosp	425	4 092	10.4	10.5	10.5	6.7-14.1	435	4 125	10.5	13.1	8.0	7.6-12.2
Incidence per 1 000 hospitalisations												
Belgium	**1 185**	**1 756 603**	**0.67**	**0.64**	**0.32**	**0.14-0.89**	**1 192**	**1 792 213**	**0.67**	**0.64**	**0.38**	**0.13-0.80**
Flanders	534	1 032 941	0.52	0.39	0.22	0.09-0.44	641	1 085 139	0.59	0.57	0.22	0.06-0.45
Wallonia	353	486 473	0.73	0.83	0.65	0.22-1.02	286	472 326	0.61	0.58	0.49	0.23-0.76
Brussels	298	237 189	1.26	1.20	0.80	0.48-1.75	265	234 748	1.13	1.14	0.96	0.58-1.39
Primary hosp	488	1 054 753	0.46	0.52	0.26	0.11-0.67	534	1 103 327	0.48	0.55	0.32	0.12-0.66
Secondary hosp	272	433 758	0.63	0.79	0.46	0.15-0.92	223	414 699	0.54	0.62	0.35	0.19-0.79
Tertiary hosp	425	268 092	1.59	1.66	1.75	0.89-2.41	435	274 187	1.59	1.76	1.28	1.10-1.99
Belgium	**1 185**	**10 928 205**	**0.11**	**0.09**	**0.05**	**0.02-0.13**	**1 192**	**10 920 063**	**0.11**	**0.11**	**0.06**	**0.02-0.12**
Flanders	534	6 206 057	0.09	0.06	0.04	0.02-0.08	641	6 340 317	0.10	0.11	0.04	0.01-0.08
Wallonia	353	3 092 853	0.11	0.12	0.10	0.04-0.15	286	2 928 382	0.10	0.09	0.07	0.04-0.13
Brussels	298	1 629 295	0.18	0.16	0.12	0.05-0.28	265	1 651 364	0.16	0.14	0.15	0.06-0.22
Primary hosp	488	6 599 215	0.07	0.08	0.05	0.02-0.12	534	6 726 097	0.08	0.10	0.05	0.02-0.10
Secondary hosp	272	2 600 500	0.10	0.11	0.08	0.03-0.15	223	2 441 880	0.09	0.08	0.06	0.03-0.11
Tertiary hosp	425	1 728 490	0.25	0.25	0.28	0.16-0.33	435	1 752 086	0.25	0.28	0.21	0.17-0.22

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

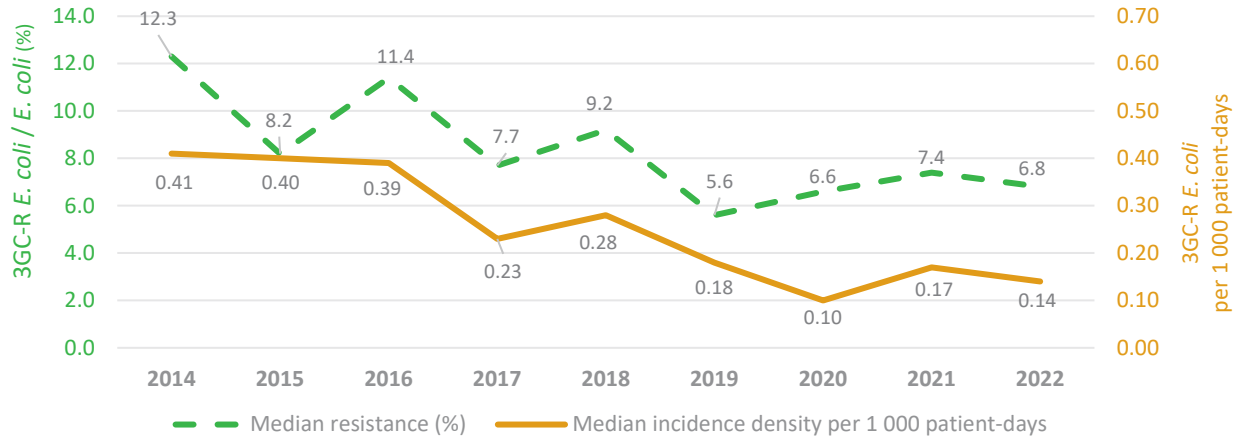
2. Resistant Gram-negative bacteria in chronic care hospitals

2.1 RESISTANCE IN *ESCHERICHIA COLI*

In 2021, the crude resistance proportion was 5.3% for 3GC-R *E. coli* and 0.06% for mero-R *E. coli* (clinical samples only). The crude incidence density was 0.17 per 1 000 patient-days for 3GC-R *E. coli* and 0.002 per 1 000 patient-days for mero-R *E. coli*. The crude resistance proportion (6.5%) and incidence density (0.18 cases per 1 000 patient-days) of 3GC-R *E. coli* were slightly higher in 2022. The same was true for the crude resistance proportion (0.24%) and incidence density (0.007 cases per 1 000 patient-days) of mero-R *E. coli* (Table 16a and 16b).

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, 2014-2022



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 16a. **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) by region, Belgian chronic care hospitals, 2021 and 2022**

	Escherichia coli resistant to third generation cephalosporins (clinical samples only)											
	2021						2022					
	n	N	Crude	Mean	Median	P25 - P75	n	N	Crude	Mean	Median	P25 - P75
Resistance proportion (%)												
Belgium	**89**	**1 668**	**5.3**	**6.5**	**7.4**	**2.5-9.5**	**110**	**1 682**	**6.5**	**6.9**	**6.8**	**2.1-9.5**
Flanders	40	557	7.2	6.7	6.8	5.8-8.1	34	475	7.2	6.8	6.3	6.3-9.6
Wallonia	39	1 006	3.9	5.7	7.4	0.9-7.7	52	1 091	4.8	5.0	6.8	0.0-9.1
Brussels	10	105	9.5	-	-	-	24	116	20.7	-	-	-
Incidence per 1 000 hospitalisations												
Belgium	**89**	**20 166**	**4.41**	**8.50**	**3.65**	**1.61-12.94**	**110**	**23 860**	**4.61**	**7.91**	**3.37**	**0.94-10.58**
Flanders	40	4 584	8.73	13.90	12.35	5.77-12.94	34	5 444	6.25	11.73	10.58	6.69-10.62
Wallonia	39	14 855	2.63	2.05	2.36	1.61-2.62	52	17 631	2.95	1.95	1.62	0.00-3.37
Brussels	10	727	13.76	-	-	-	24	785	30.57	-	-	-
Incidence density per 1 000 patient-days												
Belgium	**89**	**510 936**	**0.17**	**0.20**	**0.17**	**0.06-0.33**	**110**	**596 191**	**0.18**	**0.20**	**0.14**	**0.04-0.27**
Flanders	40	200 704	0.20	0.20	0.17	0.12-0.32	34	197 484	0.17	0.16	0.15	0.14-0.21
Wallonia	39	275 837	0.14	0.18	0.06	0.05-0.39	52	361 572	0.14	0.16	0.04	0.00-0.47
Brussels	10	34 395	0.29	-	-	-	24	37 135	0.65	-	-	-

Hosp = hospital; n = total number of *Escherichia coli* resistant to 3rd generation cephalosporins isolates, 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

Table 16b. Resistance proportion, incidence (per 1 000 hospitalisations) and incidence density (per 1 000 patient-days) of *Escherichia coli* resistant to meropenem (clinical samples only) by region, Belgian chronic care hospitals, 2021 and 2022

	Escherichia coli resistant to meropenem (clinical samples only)											
	2021						2022					
	n	N	Crude	Mean	Median	P25 - P75	n	N	Crude	Mean	Median	P25 - P75
Resistance proportion (%)												
Belgium	**1**	**1 668**	**0.06**	**0.07**	**0.00**	**0.00-0.00**	**4**	**1 682**	**0.24**	**0.12**	**0.00**	**0.00-0.00**
Flanders	1	557	0.18	0.15	0.00	0.00-0.00	0	475	0.00	0.00	0.00	0.00-0.00
Wallonia	0	1 006	0.00	0.00	0.00	0.00-0.00	4	1 091	0.37	0.22	0.00	0.00-0.45
Brussels	0	105	0.00	-	-	-	0	116	0.00	-	-	-
Incidence per 1 000 hospitalisations												
Belgium	**1**	**20 166**	**0.050**	**0.066**	**0.000**	**0.000-0.000**	**4**	**23 860**	**0.168**	**0.079**	**0.000**	**0.000-0.000**
Flanders	1	4 584	0.218	0.144	0.000	0.000-0.000	0	5 444	0.000	0.000	0.000	0.000-0.000
Wallonia	0	14 855	0.000	0.000	0.000	0.000-0.000	4	17 631	0.227	0.147	0.000	0.000-0.398
Brussels	0	727	0.000	-	-	-	0	785	0.000	-	-	-
Incidence density per 1 000 patient-days												
Belgium	**1**	**510 936**	**0.002**	**0.001**	**0.000**	**0.000-0.000**	**4**	**596 191**	**0.007**	**0.006**	**0.000**	**0.000-0.000**
Flanders	1	200 704	0.005	0.003	0.000	0.000-0.000	0	197 484	0.000	0.000	0.000	0.000-0.000
Wallonia	0	275 837	0.000	0.000	0.000	0.000-0.000	4	361 572	0.011	0.011	0.000	0.000-0.025
Brussels	0	34 395	0.000	-	-	-	0	37 135	0.000	-	-	-

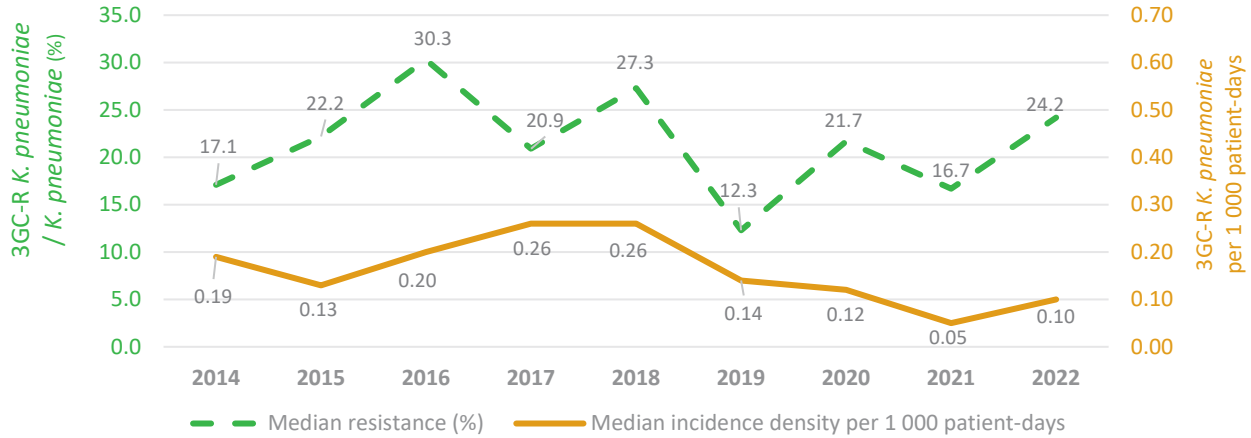
Hosp = hospital; n = total number of *Escherichia coli* resistant to meropenem isolates, N = total number of *Escherichia coli* isolates for the calculation of the resistance proportion, total number of hospitalisations for the incidence or total number of patient-days for the incidence density calculations,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

2.2 RESISTANCE IN *KLEBSIELLA PNEUMONIAE*

The crude resistance proportion of 3GC-R *K. pneumoniae* isolated from clinical samples was 17.0% in 2021 and 20.5% in 2022. The crude incidence density increased from 0.15 to 0.19 per 1 000 patient-days in the same time span (Table 17a).

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, 2014-2022

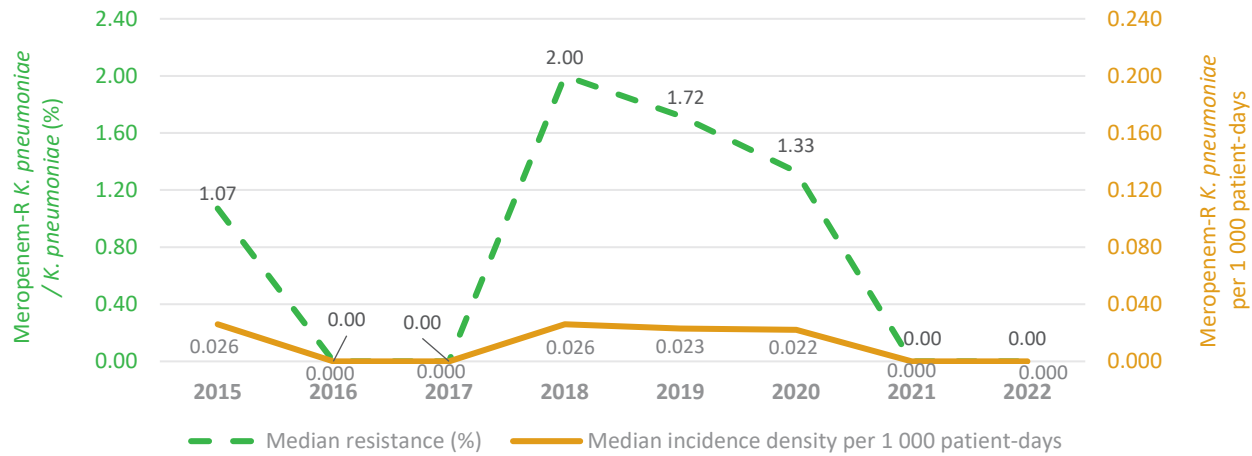


3GC-R = resistant to 3rd cephalosporins; note: prior to 2018 non-susceptibility to 4th generation cephalosporins was included, prior to 2021 I/R (resistant, incl. also susceptible, increased exposure (intermediate result)) is displayed.

The crude resistance proportion and incidence density of mero-R *K. pneumoniae* was 2.21% and 0.020 cases per 1 000 patient-days in 2021. In 2022, these indicators were 2.01% and 0.018 cases per 1 000 patient-days, respectively (Table 17b).

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, 2015-2022



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

Table 17a. 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) by region, Belgian chronic care hospitals, 2021 and 2022

	Klebsiella pneumoniae resistant to third generation cephalosporins (clinical samples only)											
	2021						2022					
	n	N	Crude	Mean	Median	P25 - P75	n	N	Crude	Mean	Median	P25 - P75
Resistance proportion (%)												
Belgium	**77**	**453**	**17.0**	**15.3**	**16.7**	**1.1-24.0**	**112**	**547**	**20.5**	**21.7**	**24.2**	**11.8-32.6**
Flanders	26	177	14.7	10.2	6.8	0.0-20.0	43	154	27.9	29.1	24.4	18.8-32.6
Wallonia	49	264	18.6	20.1	16.7	6.1-37.3	52	345	15.1	14.4	11.8	0.9-25.0
Brussels	2	12	16.7	-	-	-	17	48	35.4	-	-	-
Incidence per 1 000 hospitalisations												
Belgium	**77**	**20 166**	**3.82**	**4.26**	**2.75**	**0.54-5.16**	**112**	**23 860**	**4.69**	**6.71**	**4.20**	**1.08-12.12**
Flanders	26	4 584	5.67	6.13	2.16	0.00-9.05	43	5 444	7.90	10.49	12.12	4.46-12.25
Wallonia	49	14 855	3.30	2.70	3.29	1.18-3.32	52	17 631	2.95	1.87	1.08	0.47-2.56
Brussels	2	727	2.75	-	-	-	17	785	21.66	-	-	-
Incidence density per 1 000 patient-days												
Belgium	**77**	**510 936**	**0.15**	**0.16**	**0.05**	**0.02-0.25**	**112**	**596 191**	**0.19**	**0.21**	**0.10**	**0.03-0.40**
Flanders	26	200 704	0.13	0.11	0.05	0.00-0.24	43	197 484	0.22	0.24	0.25	0.10-0.31
Wallonia	49	275 837	0.18	0.24	0.04	0.03-0.54	52	361 572	0.14	0.16	0.03	0.01-0.40
Brussels	2	34 395	0.06	-	-	-	17	37 135	0.46	-	-	-

Hosp = hospital; n = total number of *Klebsiella pneumoniae* resistant to 3rd generation cephalosporins isolates, 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

Table 17b. Resistance proportion, incidence (per 1 000 hospitalisations) and incidence density (per 1 000 patient-days) of *Klebsiella pneumoniae* resistant to meropenem (clinical samples only) by region, Belgian chronic care hospitals, 2021 and 2022

	Klebsiella pneumoniae resistant to meropenem (clinical samples only)											
	2021						2022					
	n	N	Crude	Mean	Median	P25 - P75	n	N	Crude	Mean	Median	P25 - P75
Resistance proportion (%)												
Belgium	**10**	**453**	**2.21**	**1.69**	**0.00**	**0.00-1.64**	**11**	**547**	**2.01**	**1.12**	**0.00**	**0.00-0.90**
Flanders	0	177	0.00	0.00	0.00	0.00-0.00	0	154	0.00	0.00	0.00	0.00-0.00
Wallonia	10	264	3.79	3.72	1.64	1.10-4.08	11	345	3.19	2.09	0.90	0.00-4.55
Brussels	0	12	0.00	-	-	-	0	48	0.00	-	-	-
Incidence per 1 000 hospitalisations												
Belgium	**10**	**20 166**	**0.496**	**0.363**	**0.000**	**0.000-0.535**	**11**	**23 860**	**0.461**	**0.236**	**0.000**	**0.000-0.471**
Flanders	0	4 584	0.000	0.000	0.000	0.000-0.000	0	5 444	0.000	0.000	0.000	0.000-0.000
Wallonia	10	14 855	0.673	0.799	0.535	0.215-1.047	11	17 631	0.624	0.438	0.471	0.000-0.924
Brussels	0	727	0.000	-	-	-	0	785	0.000	-	-	-
Incidence density per 1 000 patient-days												
Belgium	**10**	**510 936**	**0.020**	**0.022**	**0.000**	**0.000-0.023**	**11**	**596 191**	**0.018**	**0.017**	**0.000**	**0.000-0.014**
Flanders	0	200 704	0.000	0.000	0.000	0.000-0.000	0	197 484	0.000	0.000	0.000	0.000-0.000
Wallonia	10	275 837	0.036	0.048	0.023	0.016-0.030	11	361 572	0.030	0.032	0.014	0.000-0.075
Brussels	0	34 395	0.000	-	-	-	0	37 135	0.000	-	-	-

Hosp = hospital; n = total number of *Klebsiella pneumoniae* resistant to meropenem isolates, 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*

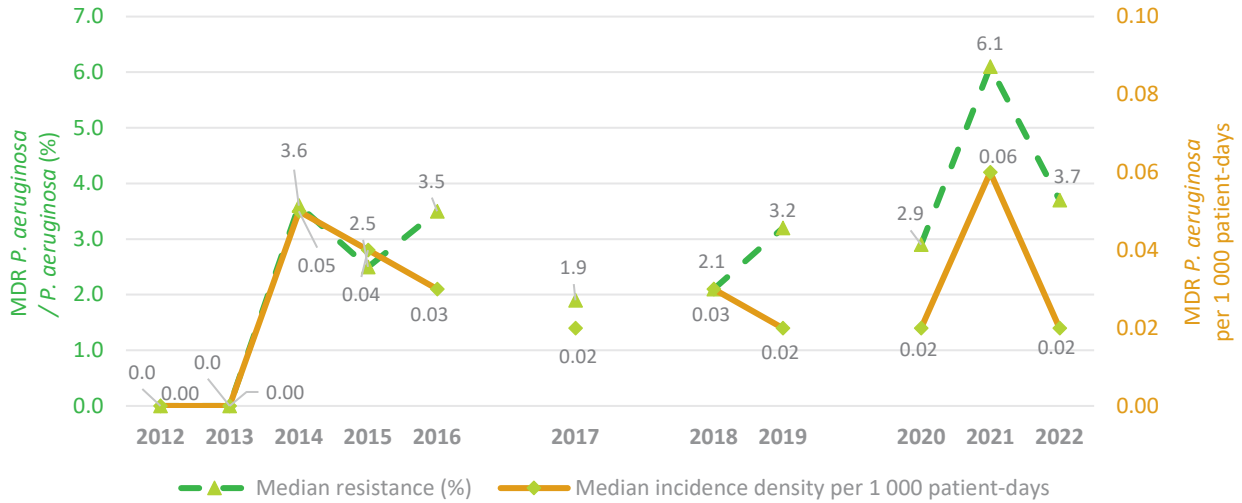
In 2021 and 2022, six and three cases of mero-R *A. baumannii* isolated from clinical samples were reported, respectively. The resistance proportions and incidence densities overall and by region can be consulted in Table 18.

2.4 RESISTANCE IN *PSEUDOMONAS AERUGINOSA*

In 2021, 5.4% of all reported *P. aeruginosa* matched the definition of multidrug-resistance (MDR; clinical samples only). The crude incidence density accounted 0.05 cases per 1 000 patient-days. The crude resistance proportion and incidence density of MDR *P. aeruginosa* were 4.4% and 0.03 cases per 1 000 patient-days in 2022, respectively (Table 19).

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

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, 2012-2022



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

Table 18. 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, Belgian chronic care hospitals, 2021 and 2022

	Acinetobacter baumannii resistant to meropenem (clinical samples only)											
	2021						2022					
	n	N	Crude	Mean	Median	P25 - P75	n	N	Crude	Mean	Median	P25 - P75
Resistance proportion (%)												
Belgium	**6**	**17**	**35.29**	**13.96**	**0.00**	**0.00-25.00**	**3**	**13**	**23.08**	**10.77**	**0.00**	**0.00-0.00**
Flanders	1	6	16.67	5.00	0.00	0.00-0.00	0	7	0.00	0.00	0.00	0.00-0.00
Wallonia	5	11	45.45	25.71	0.00	0.00-28.57	3	6	50.00	20.00	0.00	0.00-40.00
Brussels	0	0	0.00	-	-	-	0	0	0.00	-	-	-
Incidence per 1 000 hospitalisations												
Belgium	**6**	**20 166**	**0.298**	**0.292**	**0.000**	**0.000-0.523**	**3**	**23 860**	**0.126**	**0.061**	**0.000**	**0.000-0.000**
Flanders	1	4 584	0.218	0.324	0.000	0.000-0.000	0	5 444	0.000	0.000	0.000	0.000-0.000
Wallonia	5	14 855	0.337	0.319	0.000	0.000-0.523	3	17 631	0.170	0.113	0.000	0.000-0.321
Brussels	0	727	0.000	-	-	-	0	785	0.000	-	-	-
Incidence density per 1 000 patient-days												
Belgium	**6**	**510 936**	**0.012**	**0.013**	**0.000**	**0.000-0.021**	**3**	**596 191**	**0.005**	**0.005**	**0.000**	**0.000-0.000**
Flanders	1	200 704	0.005	0.004	0.000	0.000-0.000	0	197 484	0.000	0.000	0.000	0.000-0.000
Wallonia	5	275 837	0.018	0.024	0.000	0.000-0.033	3	361 572	0.008	0.009	0.000	0.000-0.015
Brussels	0	34 395	0.000	-	-	-	0	37 135	0.000	-	-	-

Hosp = hospital; n = total number of *Acinetobacter baumannii* non-susceptible (intermediate susceptibility or 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

Table 19. 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, 2021 and 2022

	Multidrug-resistant *Pseudomonas aeruginosa* (clinical samples only)											
	2021						2022					
	n	N	Crude	Mean	Median	P25 - P75	n	N	Crude	Mean	Median	P25 - P75
Resistance proportion (%)												
Belgium	**26**	**482**	**5.4**	**6.1**	**6.1**	**2.3-10.0**	**19**	**429**	**4.4**	**3.8**	**3.7**	**0.0-5.6**
Flanders	13	159	8.2	8.1	7.7	6.1-11.8	10	116	8.6	5.6	5.6	0.0-9.1
Wallonia	11	303	3.6	3.4	3.3	2.3-3.8	9	292	3.1	3.0	3.7	0.0-4.3
Brussels	2	20	10.0	-	-	-	0	21	0.0	-	-	-
Incidence per 1 000 hospitalisations												
Belgium	**26**	**20 166**	**1.29**	**1.91**	**1.10**	**0.59-2.89**	**19**	**23 860**	**0.80**	**1.29**	**0.32**	**0.00-1.05**
Flanders	13	4 584	2.84	2.70	2.89	0.87-3.29	10	5 444	1.84	2.57	0.74	0.00-3.27
Wallonia	11	14 855	0.74	0.94	0.87	0.59-1.10	9	17 631	0.51	0.57	0.32	0.00-1.05
Brussels	2	727	2.75	-	-	-	0	785	0.00	-	-	-
Incidence density per 1 000 patient-days												
Belgium	**26**	**510 936**	**0.05**	**0.05**	**0.06**	**0.01-0.08**	**19**	**596 191**	**0.03**	**0.03**	**0.02**	**0.00-0.05**
Flanders	13	200 704	0.06	0.06	0.06	0.06-0.08	10	197 484	0.05	0.04	0.02	0.00-0.08
Wallonia	11	275 837	0.04	0.05	0.01	0.01-0.07	9	361 572	0.02	0.02	0.02	0.00-0.05
Brussels	2	34 395	0.06	-	-	-	0	37 135	0.00	-	-	-

Hosp = hospital; 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

MAIN FINDINGS AND RECOMMENDATIONS

This report presents the 2021 and 2022 results of three national surveillance programs on antimicrobial resistance, i.e. the surveillances of (1) MRSA, (2) VRE and (3) MRGN. The data used in this report were collected retrospectively and aggregated at hospital level. Data originating from acute and chronic care hospitals were presented separately. Acute care hospitals with a length of stay of ≥ 16 days were classified as chronic care hospitals. Although data for both clinical samples and screening samples were collected in the MRSA and VRE surveillance, only data for clinical samples were used in this report (unless otherwise stipulated). This was done to limit the inter-hospital variability due to the heterogeneity in local screening practices.[1,2]

In 2021 and 2022, 95.1% and 92.2% of all hospital administrative groups (mergers) participated in the MRSA and MRGN surveillance, respectively. Despite its optional character, hardly less hospitals participated in the VRE surveillance program (91.2% in 2021 and 92.2% in 2022). Despite the mandatory character in the former surveillances, every year some hospitals do not or cannot participate. Valid reasons include among others switching IT systems. Worryingly, in recent years, there are always one or a few hospitals that cannot participate because of a reported cyber attack.

Since 2004, an overall decreasing trend in the resistance proportion and incidence of MRSA can be observed. Due to the combined efforts of the infection prevention and control teams and a whole range of actions (among others recommendations for the prevention of MRSA transmission, more targeted screening and decontamination policies and nationwide hand hygiene campaigns), the proportion of HA-MRSA on the total number of MRSA dropped from 78.8% in 1994 to 15.9% in 2022, the lowest level ever since the start of the surveillance.

A decreasing trend can also be observed in the resistance proportion and incidence of vanco-R *E. faecium*. Merely 3.8% of the participating hospitals reported an outbreak with vanco-R enterococci in 2021. This low proportion might have been caused by enhanced or altered infection prevention and control measures in place during the COVID-19 pandemic, including modified laboratory capacity. The proportion increased again to 10.4% of all hospitals in 2022. This is in line what has been reported in some neighbouring countries, and justifies a further detailed monitoring of these organisms and disease clusters.

While in recent years, a significant decrease in the resistance proportion and incidence of 3GC-R *E. coli* and *K. pneumonaie* is seen, no further clear evolution in the resistance proportion and incidence of 3GC-R *E. coli* and *K. pneumonaie* can be observed.

Only a minority of acute care hospitals (26.1% in 2021 and 22.4% in 2022) reported at least one case of mero-R *A. baumannii.* Since 2013, no significant change in the evolution of the resistance proportion of mero-R *A. baumannii* can be observed. The incidence however significantly decreased in the same time span.

Definition changes in 2017, 2018 and 2022 make it difficult to interpret the evolution of MDR *P. aeruginosa.* Since 2018, there seems to be a stabilization in the resistance proportion and incidence.

When interpreting the results, it is important to remind that the 2021 findings reflect the COVID-19 pandemic period in which hospital activities were altered as earlier mentioned. Notwithstanding, this does not seem to have had any major impact on the figures, with the exception of the number of reported VRE clusters.

In this report, data for chronic care hospitals (incl. acute care hospital sites with a long length of stay) are also presented. The number of participating chronic hospital sites was however low (11 and 13 in 2021 and 2022, respectively) which can have influenced the results because of selection bias.

The evolution of acquired AMR is also monitored by the Belgian subpart of the European Antimicrobial Resistance Surveillance Network (EARS-Net), called EARS-BE. This surveillance program retrospectively collects data from clinical hospital and private 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 (i.e. blood and cerebrospinal fluid).[7]
In the latest Belgian EARS-Net report of 2022, 4.4% of *S. aureus* isolated from blood and cerebrospinal fluid (CSF) were resistant to methicillin (MRSA). In *E. faecium* isolates, 1.4% resistance to vancomycin and very low resistance to linezolid were reported. Almost no resistance to carbapenems (0.1%) and 8.6% 3GC-R were reported in *E. coli.* No clear trends could be observed for *K. pneumoniae*, although 3GC showed the lowest resistance levels of the last 4 years. Furthermore, resistance to carbapenems remained stable at just over 1.0%. In multidrug-resistant *P. aeruginosa*, no clear 4-year trends could be observed. Given the very small number of *A. baumannii* isolates, it is also very difficult to detect any meaningful trends in EARS-BE. Resistance rates vary greatly from one year to the next, but the absolute numbers of resistant isolates are quite stable.[8]

Recent EU Council recommendations advise to *"Close existing surveillance and monitoring gaps and ensure completeness of data, including real-time data and timely access to data where appropriate by 2030, on both AMR and antimicrobial consumption at all levels".* With this, surveillance is recognised as a vital component in the fight against AMR. Without such data, interventions to tackle AMR cannot be prioritised, nor evaluated.[9]

In 2021 and 2022, a limited number of hospital laboratories piloted the harmonized AMR/EARS-BE protocol. For the AMR surveillance, this implies abandoning an aggregated data collection and going for the collection of detailed laboratory data at isolate/antimicrobial susceptibility testing level. This type of data collection will result in more detailed and standardized data as data validation will be possible and interpretation discrepancies will be minimized. By combining the two surveillances, Sciensano hopes to reduce the workload for laboratories (collecting data only once) and increase the number of participants in the EARS-BE project.[10] In the following years, efforts will be continued to develop an integrated national epidemiological AMR surveillance in Belgian hospitals with an acceptable delay in time. This would allow a more contineous monitoring at the local and regional level This implies not only migrating the harmonized AMR/EARS-BE surveillance to the Healthdata.be/Healthstat platform, but also linking it to several other Sciensano/NSIH surveillance of healthcare-associated infections and collecting their resistance data within the integrated AMR surveillance.[10]

Another crucial step to close surveillance gaps in all clinical settings is the development of AMR surveillance in primary care and in long-term care facilities (especially nursing homes). In the short term, this can be done by targeted surveillance, for example through increasing the participation of private laboratories in the EARS-BE surveillance, or through targeted studies like the MDRO carriage study in nursing homes, which will be organised nationally for the fourth time in 2024.

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ANNEX

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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, 1994-2022

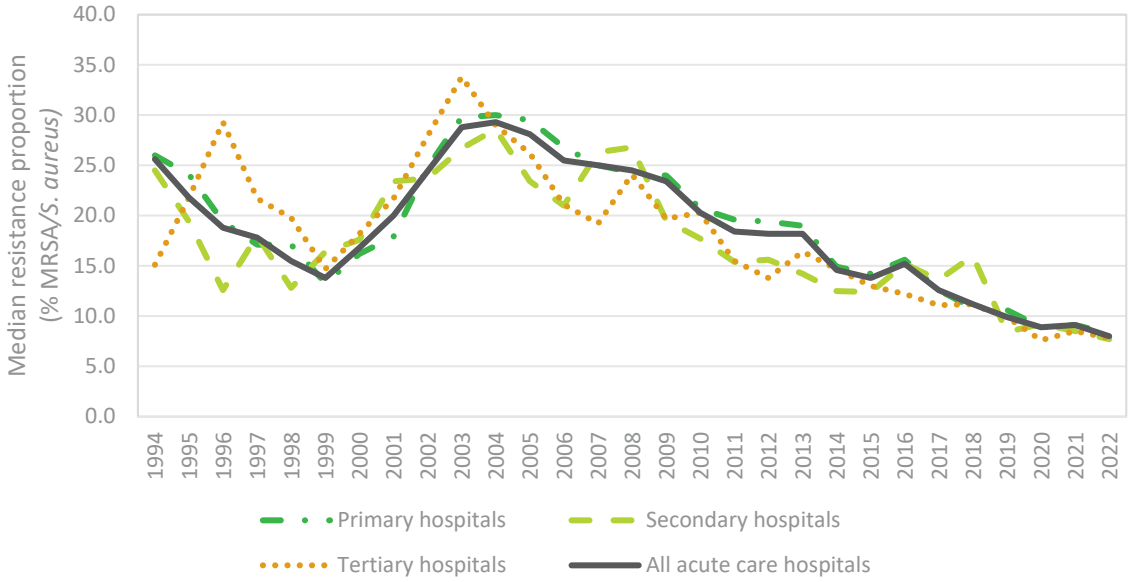


Figure A2. Evolution of the median incidence of methicillin-resistant *Staphylococcus aureus* (MRSA) per 1 000 hospitalisations by level of specialty care (clinical samples only), Belgian acute care hospitals, 1994-2022

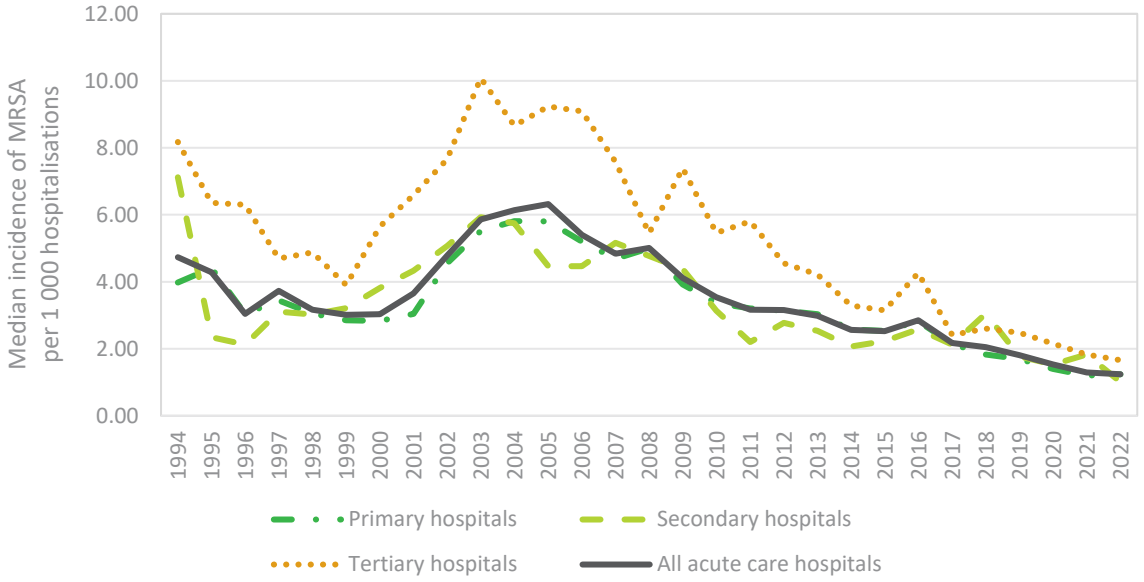


Figure A3. Evolution of the median incidence of healthcare-associated (HA-) methicillin-resistant *Staphylococcus aureus* (MRSA) per 1 000 hospitalisations by level of specialty care (clinical samples only), Belgian acute care hospitals, 1994-2022

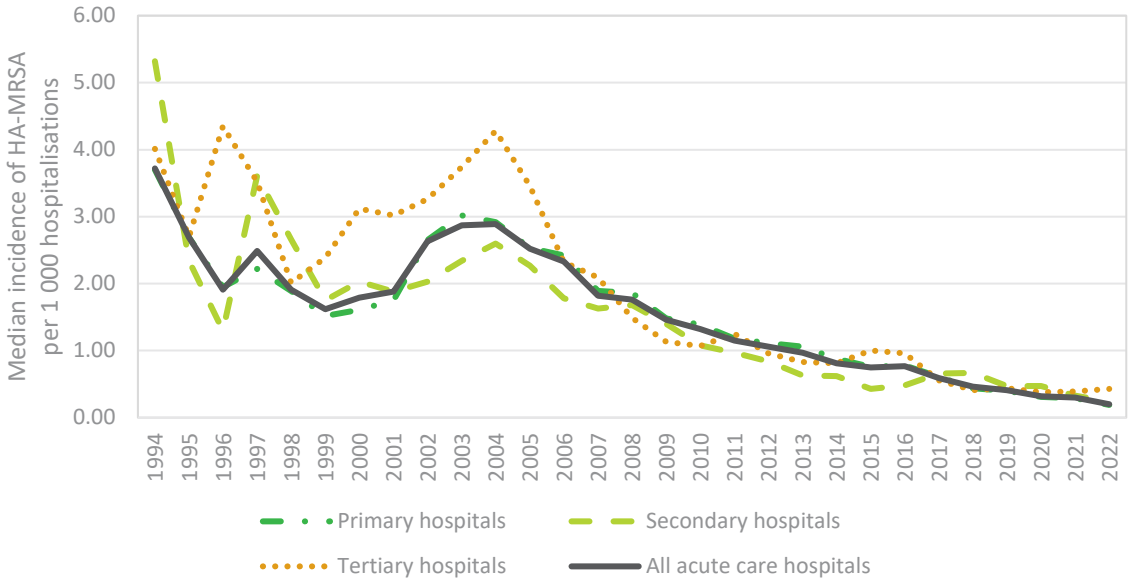


Figure A4. Evolution of the crude resistance proportion of vancomycin resistance in *Enterococcus faecium* by region (clinical samples only), Belgian acute care hospitals, 2014-2022

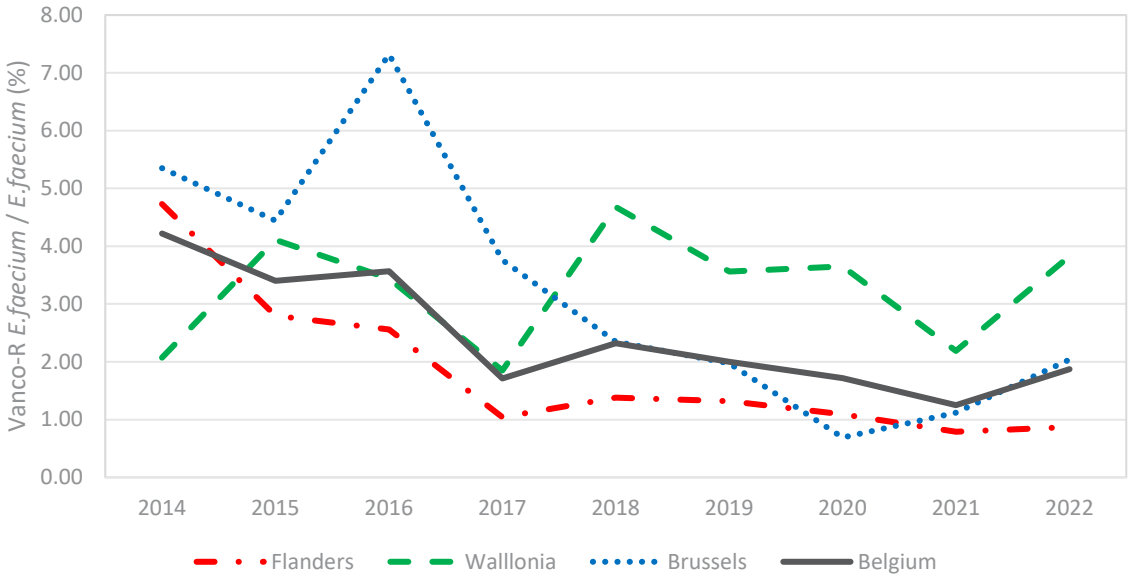


Figure A5. Evolution of the crude resistance proportion of vancomycin resistance in *Enterococcus faecium* by level of specialty care (clinical samples only), Belgian acute care hospitals, 2014-2022

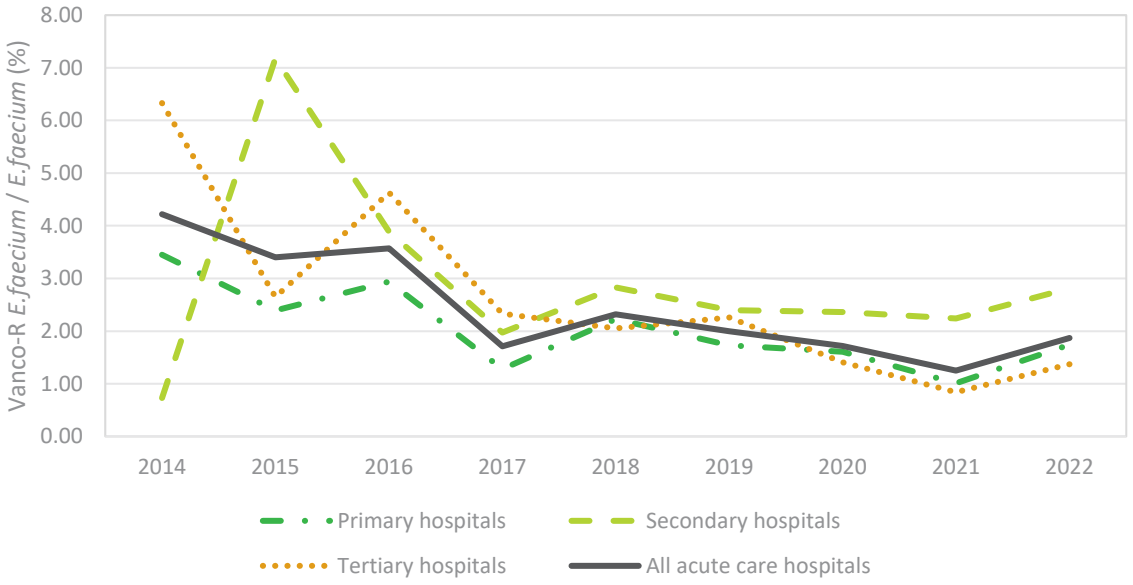


Figure A6. Evolution of the crude incidence (per 1 000 hospitalisations) of vancomycin resistance in *Enterococcus faecium* by region (clinical samples only), Belgian acute care hospitals, 2014-2022

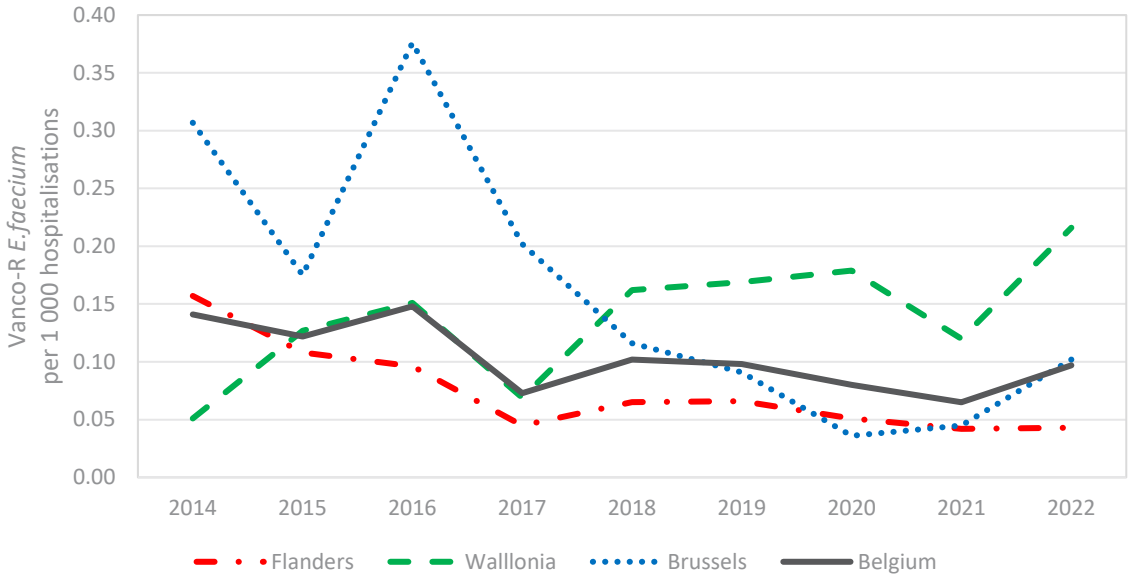


Figure A7. Evolution of the crude incidence (per 1 000 hospitalisations) of vancomycin resistance in *Enterococcus faecium* by level of specialty care (clinical samples only), Belgian acute care hospitals, 2014-2022

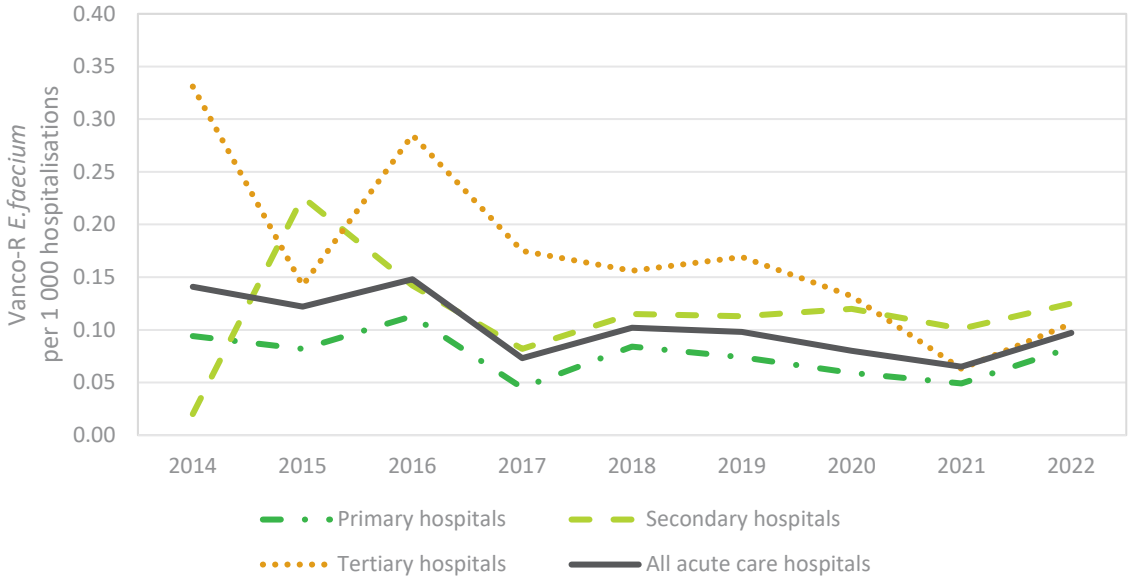
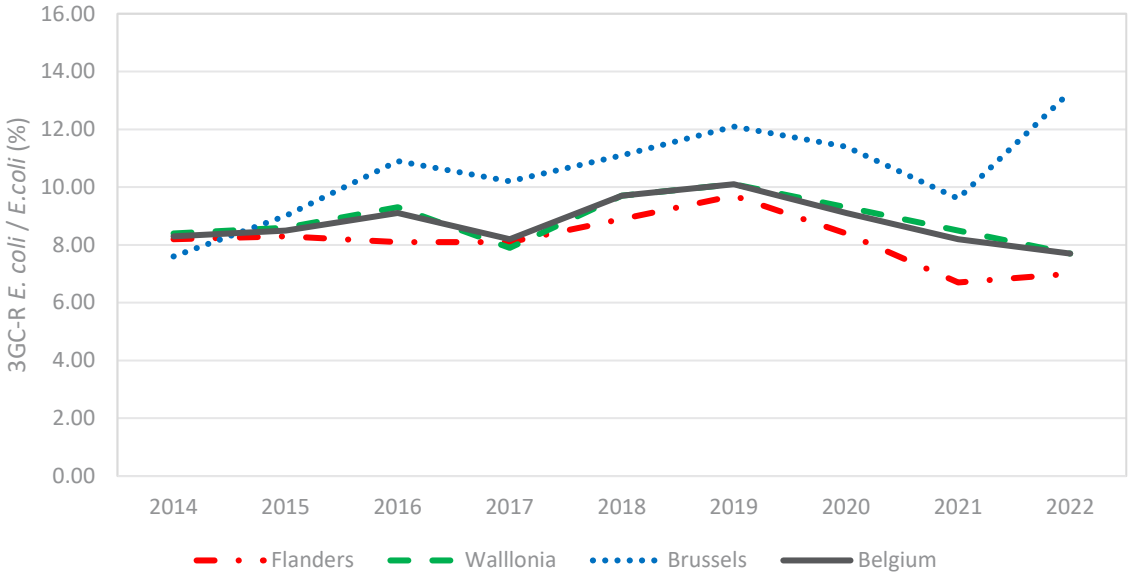
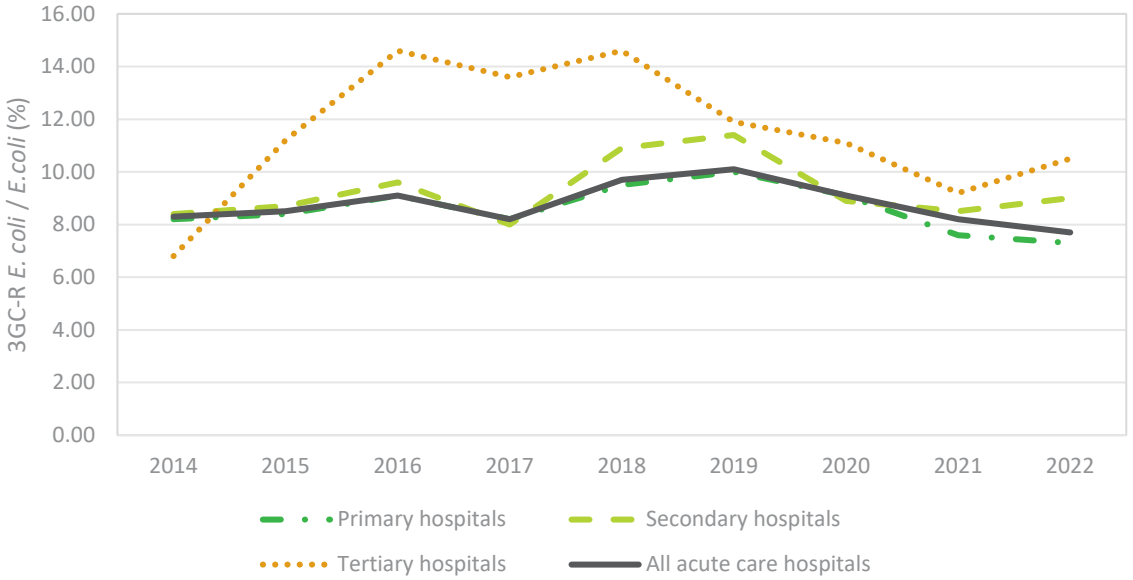


Figure A8. Evolution of the median resistance proportion of *Escherichia coli* resistant to third generation cephalosporins by region (clinical samples only), Belgian acute care hospitals, 2014-2022



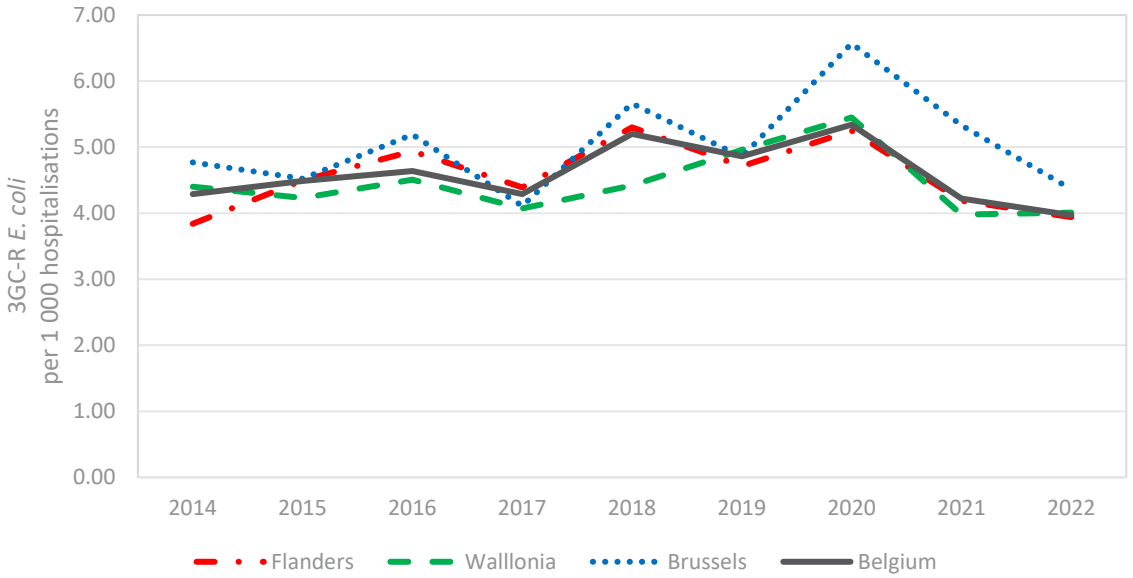
3GC-R = resistant to 3rd cephalosporins; note: prior to 2018 non-susceptibility to 4th generation cephalosporins was included, prior to 2021 I/R (resistant, incl. also susceptible, increased exposure (intermediate result)) is displayed.

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, 2014-2022



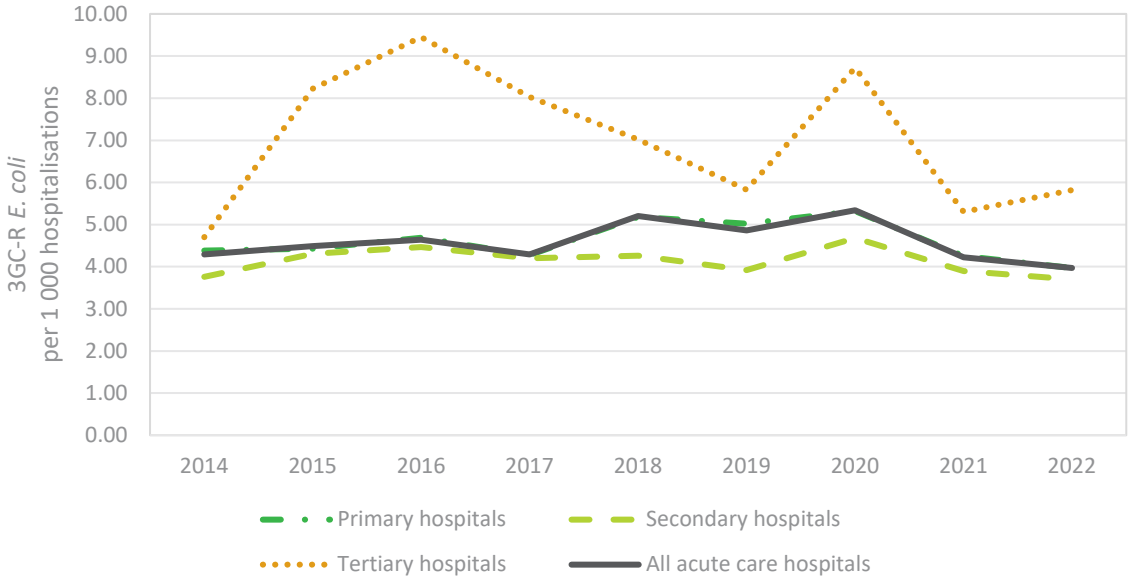
3GC-R = resistant to 3rd cephalosporins; note: prior to 2018 non-susceptibility to 4th generation cephalosporins was included, prior to 2021 I/R (resistant, incl. also susceptible, increased exposure (intermediate result)) is displayed.

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, 2014-2022



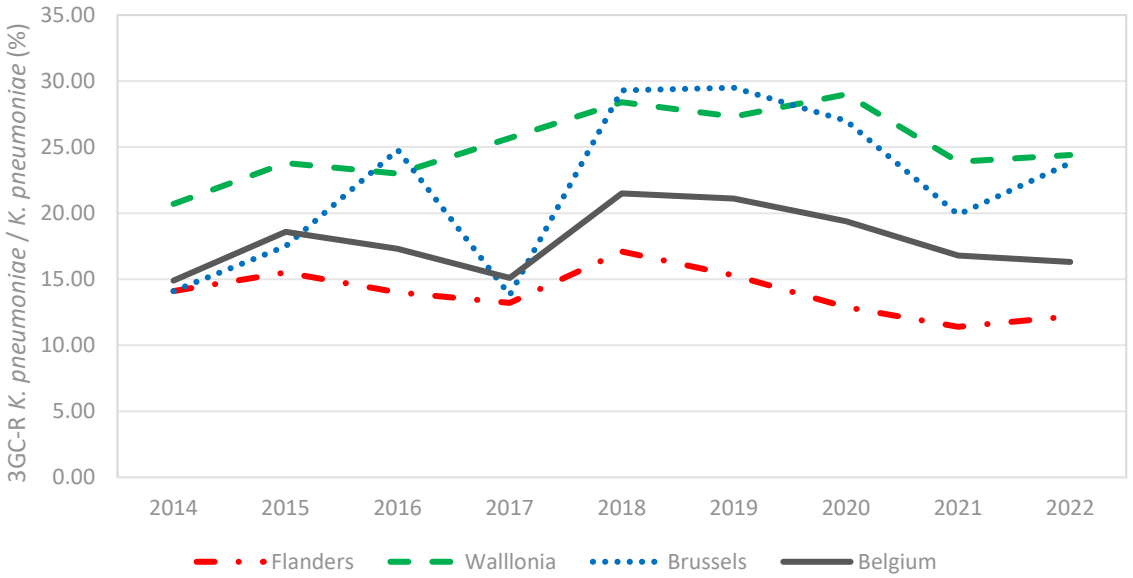
3GC-R = resistant to 3rd cephalosporins; note: prior to 2018 non-susceptibility to 4th generation cephalosporins was included, prior to 2021 I/R (resistant, incl. also susceptible, increased exposure (intermediate result)) is displayed.

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, 2014-2022



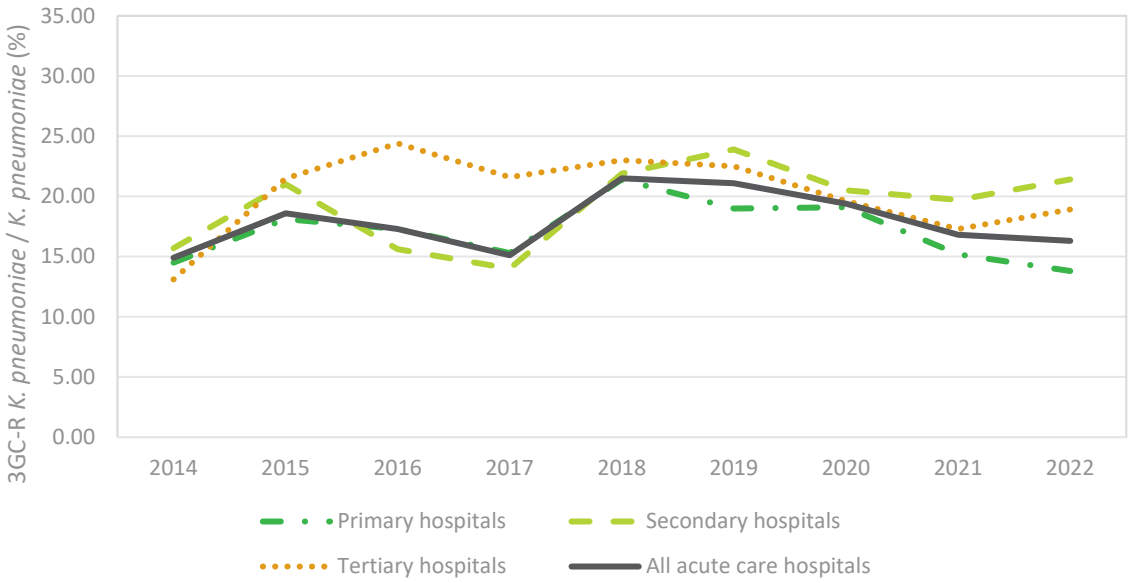
3GC-R = resistant to 3rd cephalosporins; note: prior to 2018 non-susceptibility to 4th generation cephalosporins was included, prior to 2021 I/R (resistant, incl. also susceptible, increased exposure (intermediate result)) is displayed.

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, 2014-2022



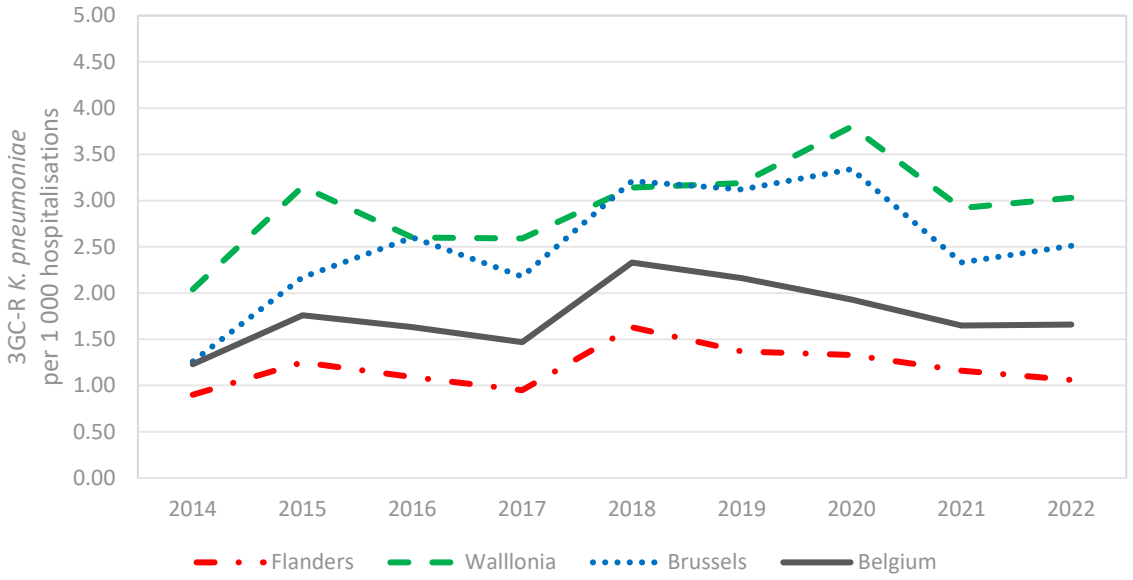
3GC-R = resistant to 3rd cephalosporins; note: prior to 2018 non-susceptibility to 4th generation cephalosporins was included, prior to 2021 I/R (resistant, incl. also susceptible, increased exposure (intermediate result)) is displayed.

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, 2014-2022



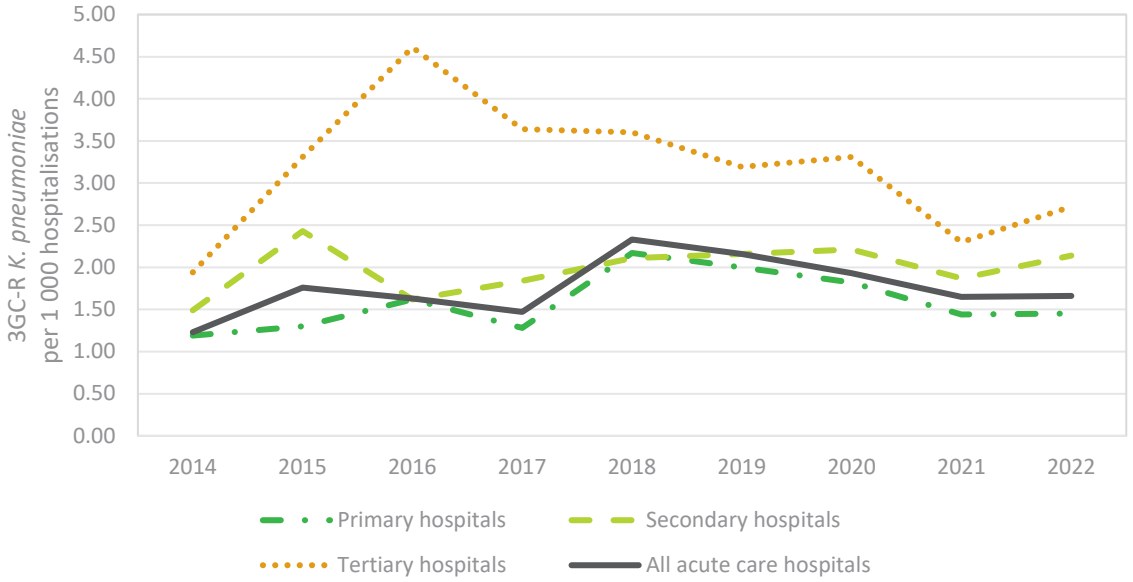
3GC-R = resistant to 3rd cephalosporins; note: prior to 2018 non-susceptibility to 4th generation cephalosporins was included, prior to 2021 I/R (resistant, incl. also susceptible, increased exposure (intermediate result)) is displayed.

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, 2014-2022



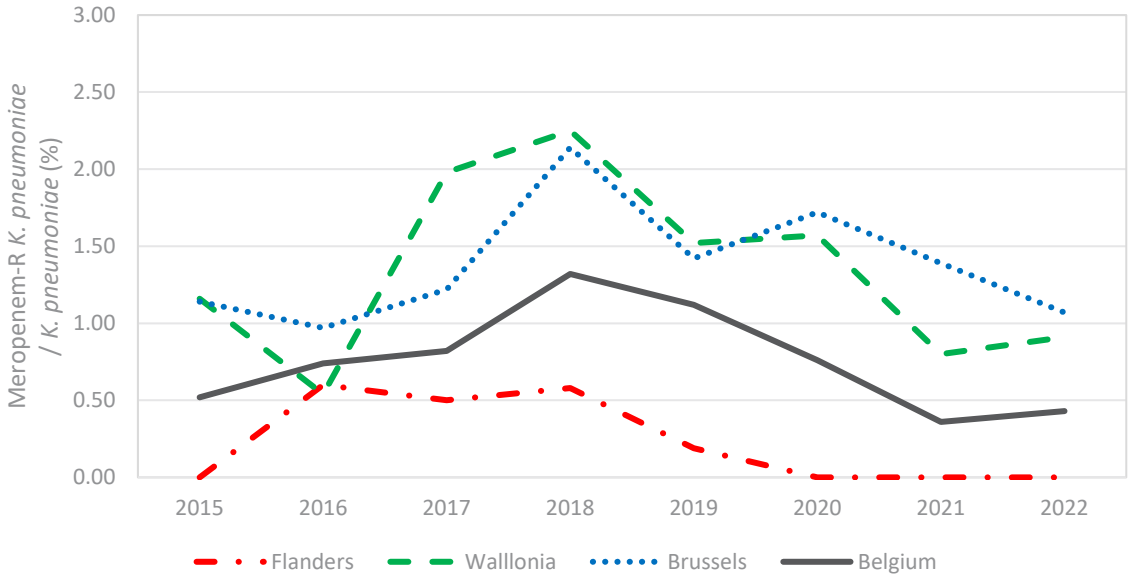
3GC-R = resistant to 3rd cephalosporins; note: prior to 2018 non-susceptibility to 4th generation cephalosporins was included, prior to 2021 I/R (resistant, incl. also susceptible, increased exposure (intermediate result)) is displayed.

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, 2014-2022



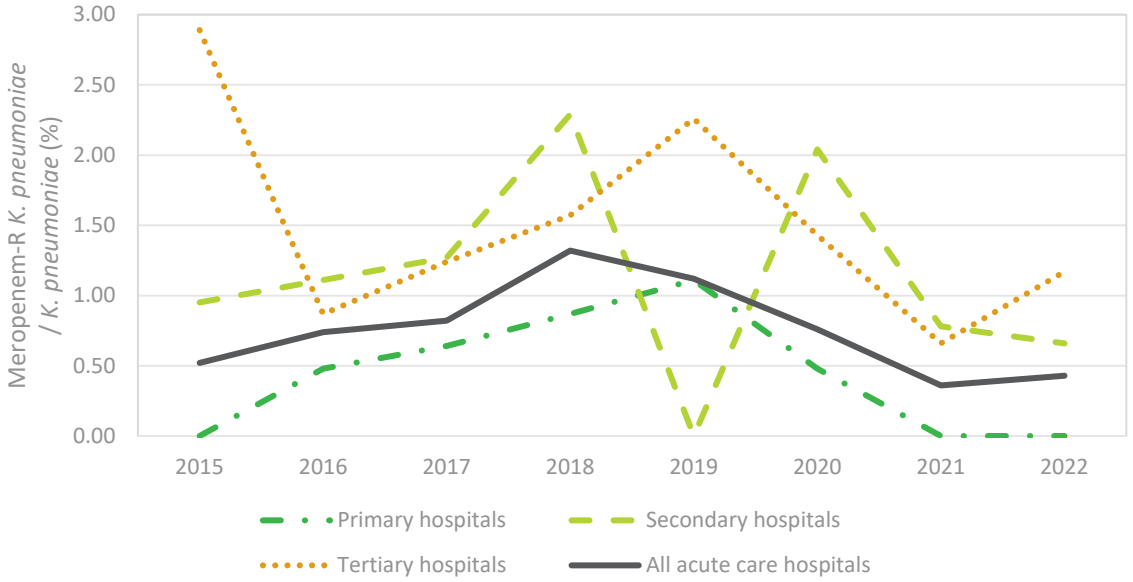
3GC-R = resistant to 3rd cephalosporins; note: prior to 2018 non-susceptibility to 4th generation cephalosporins was included, prior to 2021 I/R (resistant, incl. also susceptible, increased exposure (intermediate result)) is displayed.

Figure A16. Evolution of the median resistance proportion of *Klebsiella pneumoniae* resistant to meropenem by region (clinical samples only), Belgian acute care hospitals, 2015-2022



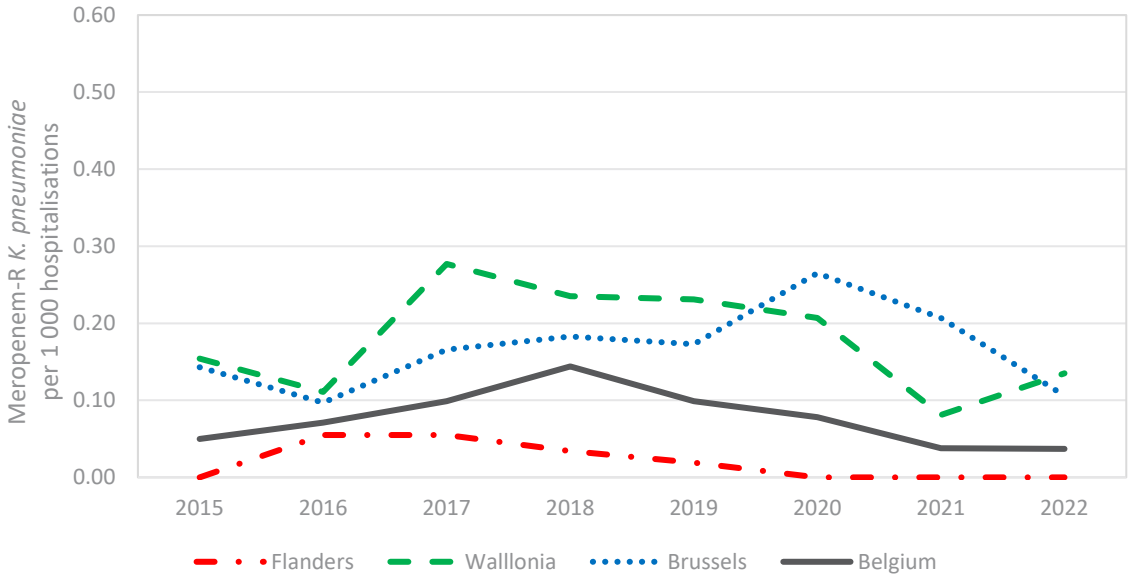
Note: prior to 2021 I/R (resistant, incl. also susceptible, increased exposure (intermediate result)) is displayed.

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, 2015-2022



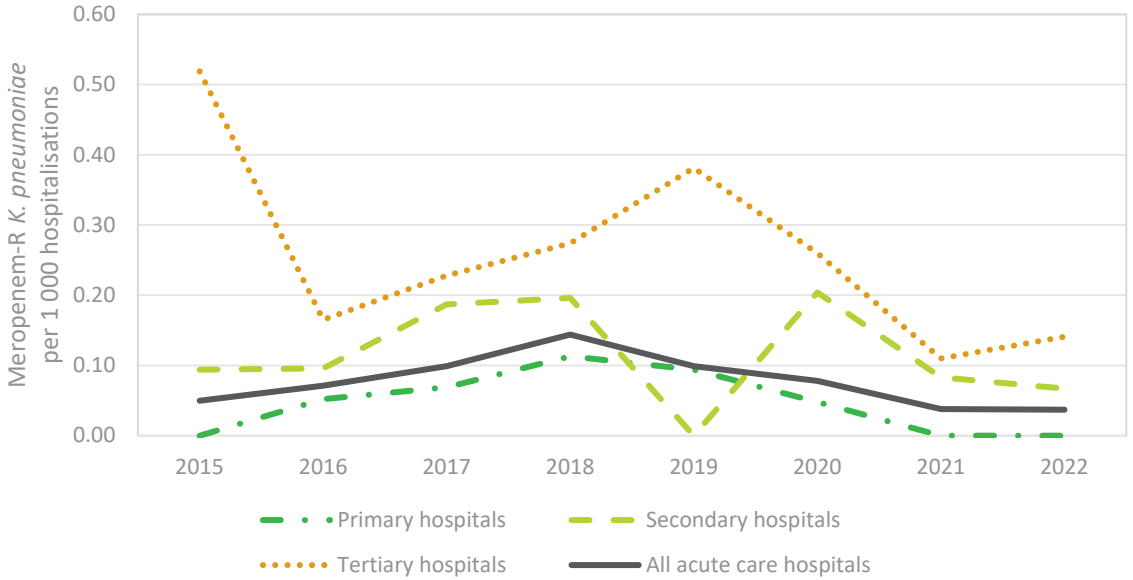
Note: prior to 2021 I/R (resistant, incl. also susceptible, increased exposure (intermediate result)) is displayed.

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, 2015-2022



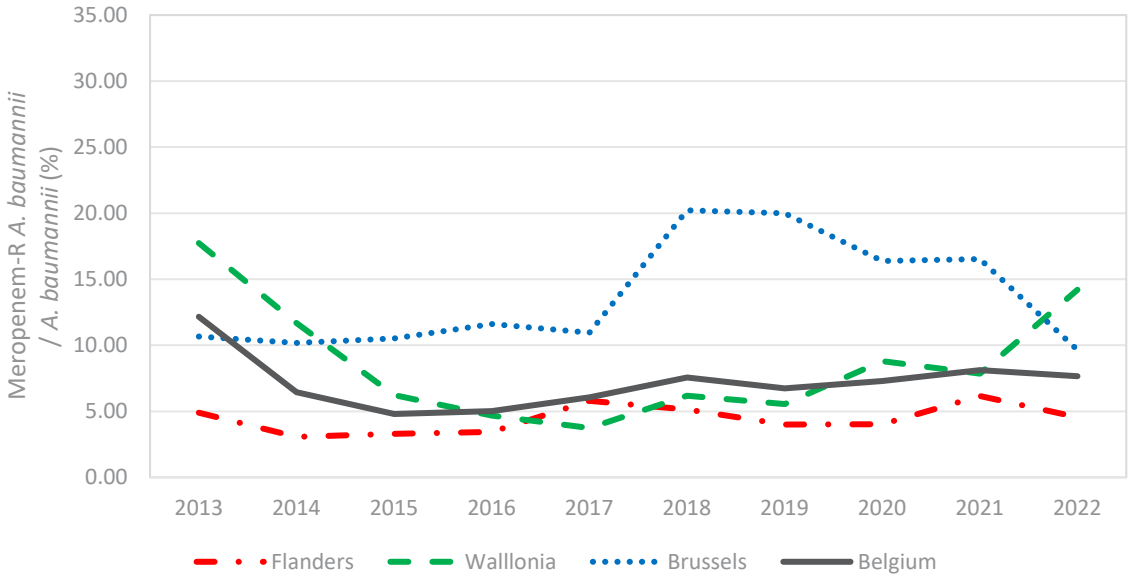
Note: prior to 2021 I/R (resistant, incl. also susceptible, increased exposure (intermediate result)) is displayed.

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, 2015-2022



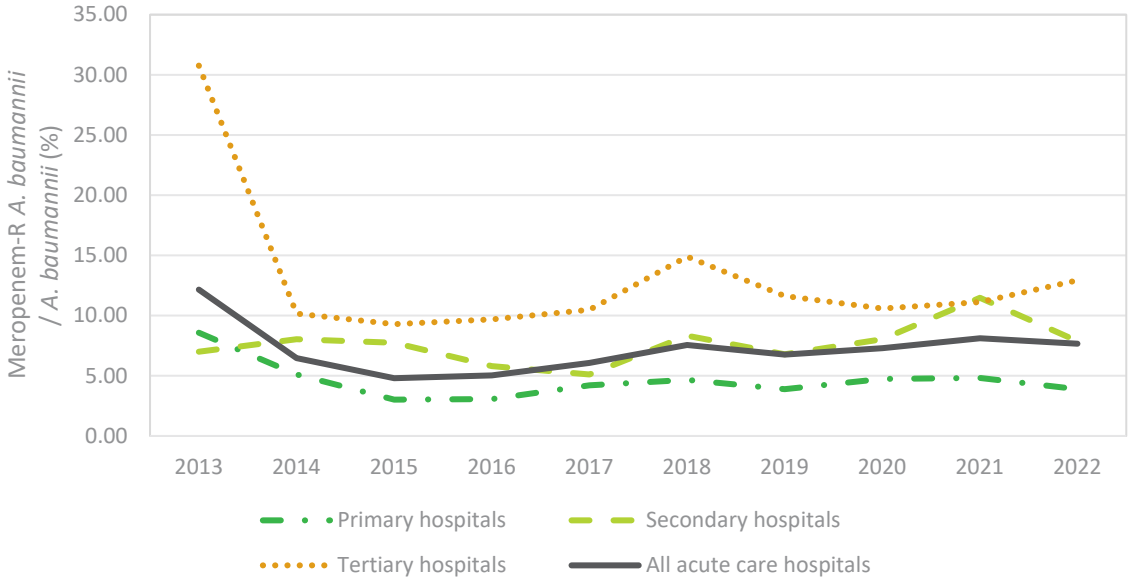
Note: prior to 2021 I/R (resistant, incl. also susceptible, increased exposure (intermediate result)) is displayed.

Figure A20. Evolution of the crude resistance proportion of *Acinetobacter baumannii* resistant to meropenem by region (clinical samples only), Belgian acute care hospitals, 2013-2022



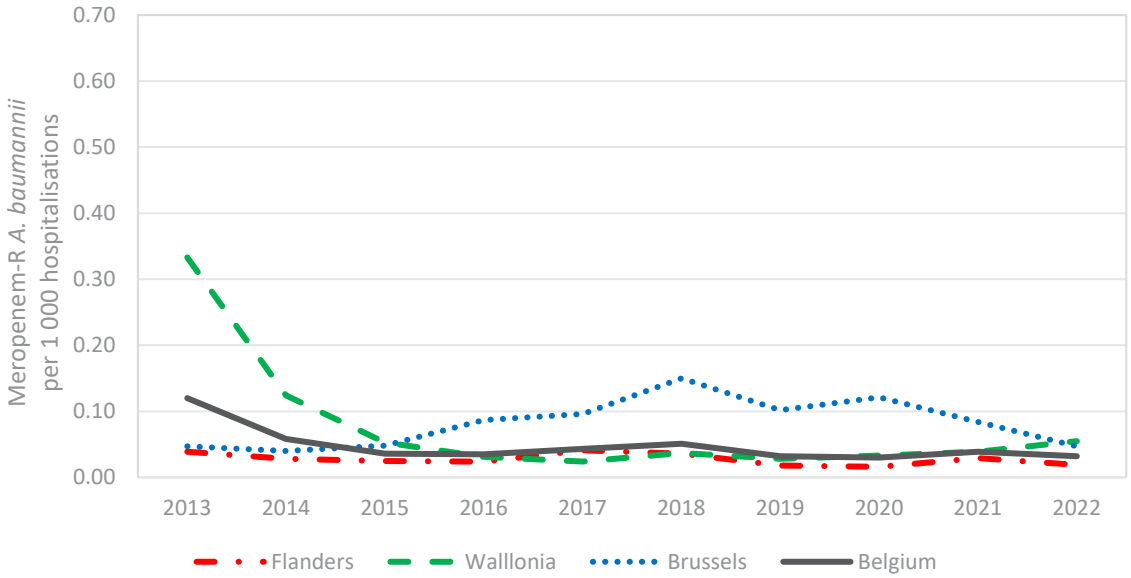
Note: prior to 2021 I/R (resistant, incl. also susceptible, increased exposure (intermediate result)) is displayed.

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, 2013-2022



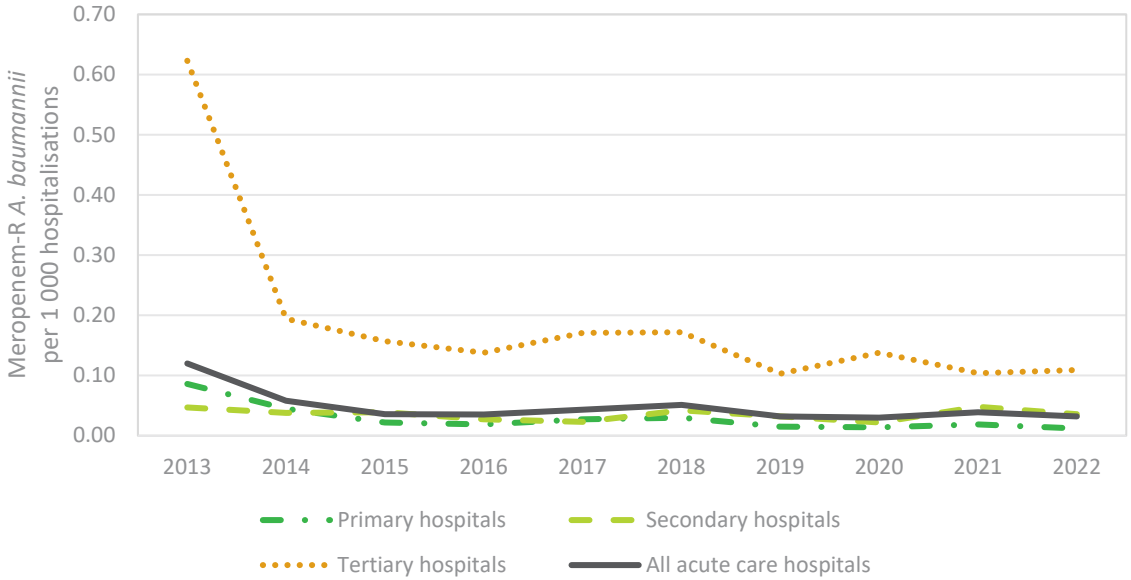
Note: prior to 2021 I/R (resistant, incl. also susceptible, increased exposure (intermediate result)) is displayed.

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, 2013-2022



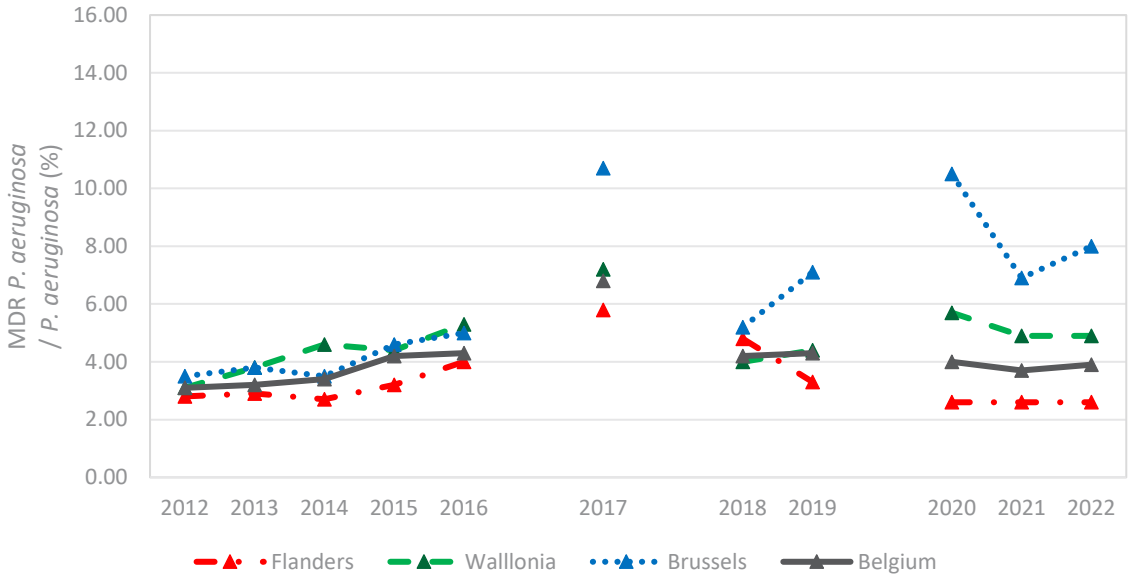
Note: prior to 2021 I/R (resistant, incl. also susceptible, increased exposure (intermediate result)) is displayed.

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, 2013-2022



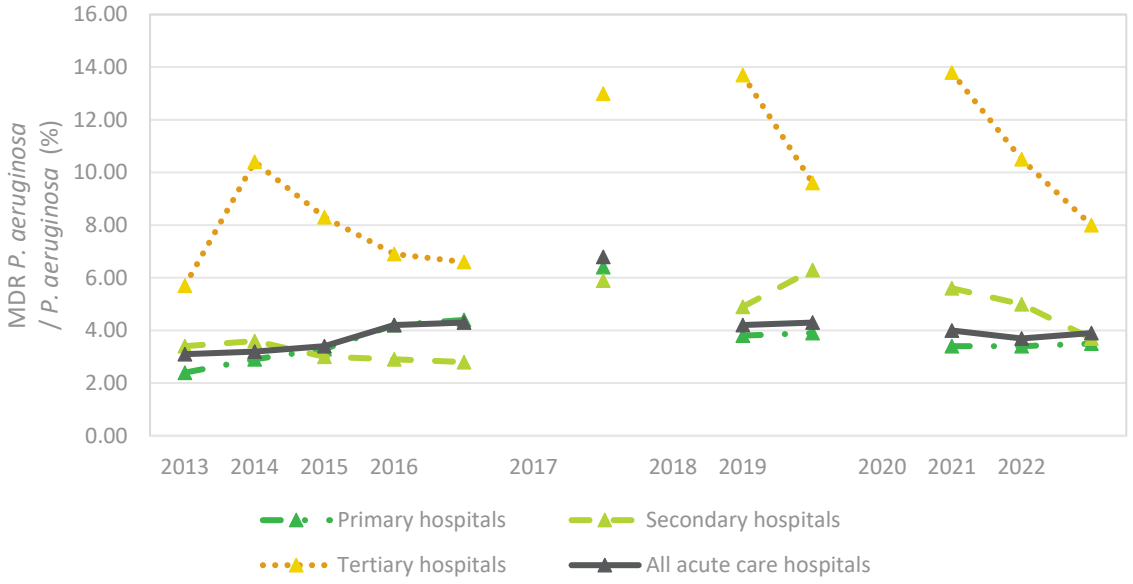
Note: prior to 2021 I/R (resistant, incl. also susceptible, increased exposure (intermediate result)) is displayed.

Figure A24. Evolution of the crude resistance proportion of multidrug-resistant (MDR) *Pseudomonas aeruginosa* by region (clinical samples only), Belgian acute care hospitals, 2012-2022



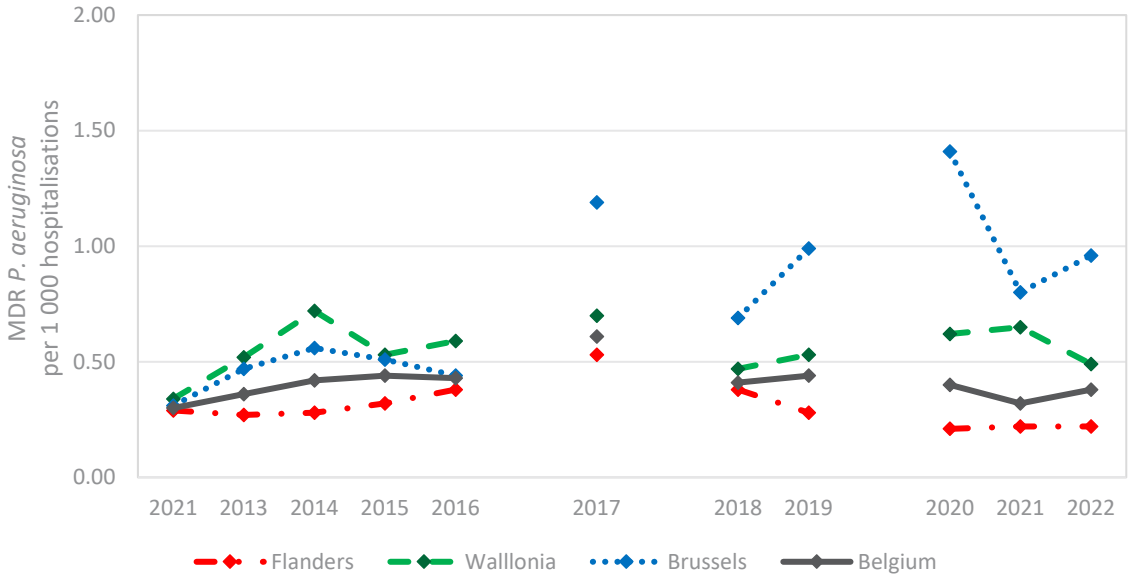
Note: Between 2016 and 2017, the definition of MDR P. aeruginosa changed from reduced susceptibility (I or R) to at least one antibiotic in four out of the five following antibiotic classes to reduced susceptibility to at least three of the following antibiotic classes: fluoroquinolones (ciprofloxacin, 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.

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, 2012-2022



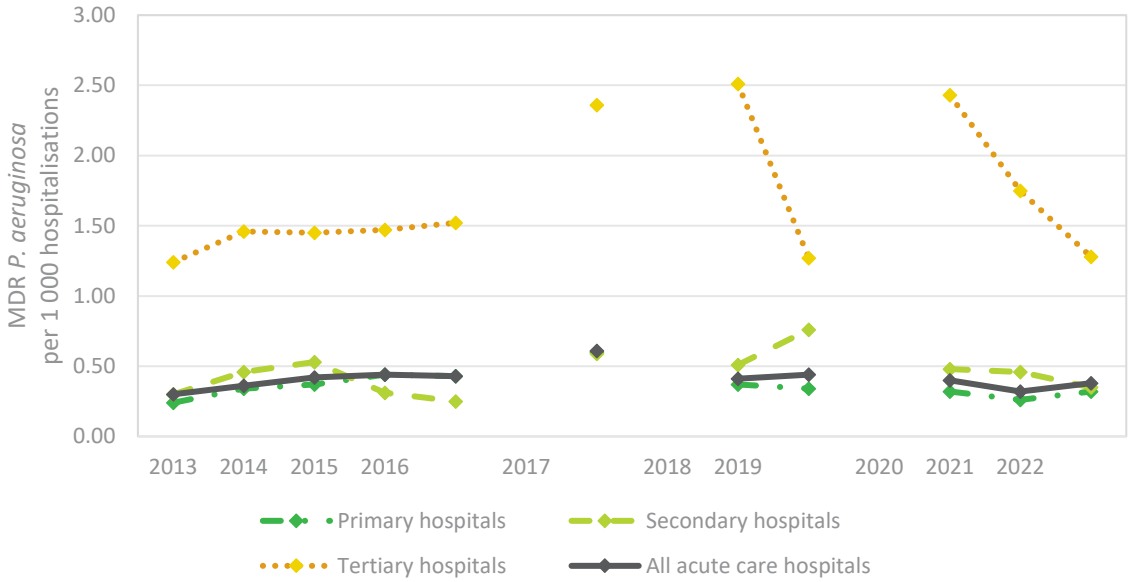
Note: Between 2016 and 2017, the definition of MDR P. aeruginosa changed from reduced susceptibility (I or R) to at least one antibiotic in four out of the five following antibiotic classes to reduced susceptibility to at least three of the following antibiotic classes: fluoroquinolones (ciprofloxacin, 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.

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, 2012-2022



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.

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, 2012-2022



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.

REPORT APPROVAL OF VARIOUS ENTITIES

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

Entity	Received	Approved
Sciensano	NA	23/04/2024
NRC for resistant Gram-negative bacilli	26/04/2024	No comments received at publication date
NRC for resistant enterococci	26/04/2024	No comments received at publication date
NRC for *Staphylococcus aureus* and other *Staphylocci*	26/04/2024	No comments received at publication date
BAPCOC	31/05/2024	No comments received at publication date
TC-MDRO	31/05/2024	No comments received at publication date
Regional authorities	31/05/2024	No comments received at publication date

**includes passive approval*

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