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HEALTHCARE-ASSOCIATED INFECTIONS AND ANTIMICROBIAL RESISTANCE

SURVEILLANCE OF ANTIMICROBIAL RESISTANT BACTERIA IN BELGIAN HOSPITALS

Report 2016

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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).

Sciensano

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EXECUTIVE SUMMARY

Introduction

Since 1994 the service “Healthcare-associated infections and antimicrobial resistance” of Sciensano (the former Belgian Scientific Institute of Public Health) closely monitors antimicrobial resistance in Belgian acute care hospitals. At present, hospitals can participate in three national, multicentric and continuous surveillance programs, i.e. (1) methicillin resistant *Staphylococcus aureus* (MRSA), (2) multiresistant Gram-negative bacteria (MRGN), and (3) resistant enterococci. All Belgian acute care hospital mandatorily have to participate in the surveillance of MRSA and MRGN.

The aim of the current report is to present the 2016 results of the three epidemiological surveillance programs and to describe trends in the antimicrobial resistance in Belgian acute and/or chronic care hospitals.

Methods

The data presented in this reported were collected retrospectively (year 2016) and were aggregated at hospital level. Hospitals could either provide annual figures or data for one semester, except for the surveillance of resistant enterococci for which solely annual data were allowed.
Only hospitals providing Type D data (with de-duplication) were included in the analyses, i.e. per period of hospitalisation and bacterium each patient should only be counted once. Clinical samples and screening samples originating from hospitalized patients could be included.

Results

In total, 140 hospitals were included in the analyse of the MRSA surveillance results: 123 acute care hospitals and 17 chronic care hospitals. The mean proportion of MRSA (among *S. aureus* isolates) was 15.7% in acute care hospitals and 29.1% in chronic care hospitals.
The mean incidence of nosocomial MRSA in acute care hospitals was 0.93 cases per 1 000 admissions. The incidence is significantly decreasing since 2003 and currently is at its lowest level since the start of the surveillance in 1994. In chronic care hospitals the mean incidence density stayed at the same level as in 2015 (0.14 cases per 1 000 patient days).
In acute and chronic care hospital 50.1% and 41.3% of all nosocomial MRSA cases were detected through screening, respectively.

One hundred and five hospitals participated to the optional surveillance of resistance in enterococci. Data were combined for acute and chronic care hospitals. The mean incidence of vancomycin and linezolid resistant *Enterococcus faecium* (*E. faecium*) was low: 0.140 and 0.009 cases per 1 000 admissions, respectively. Because of the recent character of the surveillance it is too early to see clear trends in the evolution graph of *E. faecium*.

In total, 122 acute care hospitals and 16 chronic care hospitals were included for the MRGN surveillance. The surveillance shows a unfavorable trend in the evolution of resistance in *Enterobacteriaceae*, especially in *Klebsiella pneumoniae (K. pneumoniae)* in acute care hospitals. The mean resistance proportion of extended beta-lactamase producing (ESBL+) *K. pneumoniae* increased from 6.2% in 2005 to 17.9% in 2016 in acute care hospitals. In chronic care hospitals ESBL resistance in *K. pneumoniae* rapidly increased between 2011 and 2013 but remained stable since then (19.9% in 2016).
While the mean incidence of ESBL resistance in acute care hospitals was much higher in *Escherichia coli* (*E. coli;* 4.69 cases per 1 000 admissions) compared to *K. pneumoniae* (2.53 cases per 1 000 admissions), the incidence of carbapenemase production (CPE+) and reduced susceptibility for meropenem (meropenem I/R) was higher in *K. pneumoniae* (0.15 and 0.24 cases per 1 000 admissions, respectively) compared to *E. coli* (0.03 and 0.01 cases per 1 000 admissions, respectively).
The resistance proportion of meropenem I/R *Acinetobacter baumannii* (*A. baumannii*) in acute care hospitals increased from 4.2% in 2015 to 6.1%, while the mean incidence remained the same (0.03 cases per 1 000 admissions in 2016).
The mean resistance proportion of Multi-drug resistant (MDR) *Pseudomonas aeruginosa* (*P. aeruginosa*) remains stable since 2013 (5.5% in 2016), while the incidence in acute care hospitals slowly decreases (0.69 cases per 1 000 admissions in 2016).

In chronic care hospitals the mean resistance proportion of both meropenem I/R *A. baumannii* (10.1%) and MDR *P. aeruginosa* (8.7%) was higher than in acute care hospitals. In 2016 the mean incidence of meropenem I/R *A. baumannii* (0.005 cases per 1 000 patient days) was lower than the mean incidence of MDR *P. aeruginosa* (0.13 cases per 1 000 patient days).

SAMENVATTING

Inleiding

Sinds 1994 volgt de dienst “Zorginfecties en antibioticaresistentie” van Sciensano (voorheen het Wetenschappelijk Instituut Volksgezondheid) nauwlettend de antimicrobiële resistentie in de Belgische acute ziekenhuizen op. Momenteel kunnen ziekenhuizen aan drie nationale, multicentrische en continue surveillanceprogramma’s deelnemen: (1) methicillin resistente *Staphylococcus aureus* (MRSA), (2) multiresistente Gram-negatieve bacterieën (MRGN) en (3) resistente enterokokken. Belgische acute ziekenhuizen dienen verplicht deel te nemen aan de surveillance van MRSA en MRGN.

Het doel van het huidige rapport is om de surveillancegegevens van 2016 met betrekking tot de drie bovenstaande epidemiologische surveillanceprogramma’s voor te stellen en om trends in antimicrobiële resistentie in Belgische acute en/of chronische ziekenhuizen te beschrijven.

Methodologie

De gegevens in dit rapport werden retrospectief verzameld (jaar 2016) en geaggregeerd op ziekenhuisniveau. Ziekenhuizen konden ofwel jaargegevens ofwel cijfers voor één semester aanleveren, met uitzondering van de surveillance van resistente enterokokken die enkel rekening houdt met jaargegevens.
Alleen ziekenhuizen die type D-gegevens (d.w.z. per hospitalisatieperiode en bacterie wordt elke patiënt slechts éénmaal geteld) verschaften, werden in de analyses opgenomen. Klinische stalen en screeningsstalen afkomstig van gehospitaliseerde patiënten werden geïncludeerd.

Resultaten

In totaal werden 140 ziekenhuizen opgenomen in de analyse van de MRSA surveillanceresultaten: 123 acute ziekenhuizen en 17 chronisch ziekenhuizen. Het gemiddelde resistentiecijfer (proportie MRSA stammen uit klinische isolaten met *S. aureus*) was 15.7% in acute ziekenhuizen en 29.1% in chronische ziekenhuizen.
De gemiddelde incidentie van nosocomiale MRSA in acute ziekenhuizen bedroeg 0.93 gevallen per 1000 opnames. Deze incidentie nam sinds 2003 aanzienlijk af en bevindt zich momenteel op het laagste peil sinds de start van de surveillance in 1994. In chronische ziekenhuizen bleef de gemiddelde incidentiedensiteit op hetzelfde niveau als in 2015 (0.14 gevallen per 1000 hospitalisatiedagen).
In acute en chronische ziekenhuizen werden respectievelijk 50.1% en 41.3% van alle nosocomiale MRSA gevallen aan de hand van screening gedetecteerd.

Honderdenvijf ziekenhuizen namen deel aan de optionele surveillance van resistente enterokokken. Gegevens werden gecombineerd voor acute en chronische ziekenhuizen. De gemiddelde incidentie van vancomycine en linezolid resistente *Enterococcus faecium* (*E. faecium*) was laag, respectievelijk 0.140 en 0.009 gevallen per 1000 opnames. Vanwege het recente karakter van de surveillance is het echter te vroeg om duidelijke trends in de evolutiegrafiek van *E. faecium* te zien.

De resultaten van de MRGN sureveillance hebben betrekking op 122 acute ziekenhuizen en 16 chronische ziekenhuizen. De surveillance toont een ongunstige trend in de ontwikkeling van resistentie in *Enterobacteriaceae*, vooral voor wat betreft *Klebsiella pneumoniae* (*K. pneumoniae*) in acute ziekenhuizen. In deze setting steeg het gemiddelde resistentiecijfer van extended beta-lactamase producerende (ESBL+) *K. pneumoniae* van 6.2% in 2005 naar 17.9% in 2016. In chronische ziekenhuizen nam de proportie van ESBL+ *K. pneumoniae* snel toe tussen 2011 en 2013, maar bleef sindsdien stabiel (19.9% in 2016).
Terwijl in acute ziekenhuizen de gemiddelde incidentie van ESBL+ *Escherichia coli* (*E. coli*; 4.69 gevallen per 1 000 opnames) veel hoger lag dan de incidentie van ESBL+ *K. pneumoniae* (2.53 gevallen per 1000 opnames), was de productie van carbapenamase en verminderde gevoeligheid voor meropenem (meropenem I/R) belangrijker in *K. pneumoniae* (respectievelijk 0.15 en 0.24 gevallen per 1000 opnames) in vergelijking met *E. coli* (respectievelijk 0.03 en 0.01 gevallen per 1000 opnames).

De resistentieproportie van meropenem I/R *Acinetobacter baumannii* (*A. baumannii*) in acute ziekenhuizen steeg van 4.2% in 2015 naar 6.1%, maar de gemiddelde incidentie bleef constant (0.03 gevallen per 1 000 opnames in 2016). Sinds 2013 blijft de proportie van multidrugresistente (MDR) *Pseudomonas aeruginosa* (*P. aeruginosa*) in

acute ziekenhuizen stabiel (5.5% in 2016), terwijl de incidentie langzaam afneemt (0.69 gevallen per 1 000 opnames in 2016).
In chronische ziekenhuizen lag de gemiddelde resistentie van zowel meropenem I/R *A. baumannii* (10.1%) als MDR *P. aeruginosa* (8.7%) hoger dan in acute ziekenhuizen. De gemiddelde incidentie van meropenem I/R *A. baumannii* (0.005 gevallen per 1000 patiëntdagen) was in 2016 lager dan de gemiddelde incidentie van MDR *P. aeruginosa* (0.13 gevallen per 1000 patiëntendagen).

RÉSUMÉ

Introduction

Depuis 1994, le service « Infections liées aux soins et antibiorésistance » de Sciensano (anciennement Institut scientifique de santé publique belge) surveille de près la résistance antimicrobienne dans les hôpitaux belges aigus. À ce jour, les hôpitaux peuvent prendre part à trois programmes de surveillance nationaux, multicentriques et continus : (1) *Staphylococcus aureus* résistant à la méthicilline (MRSA), (2) bactéries à Gram négatif multirésistantes (MRGN) et (3) entérocoques résistants. Tous les hôpitaux belges de soins aigus sont tenus de participer à la surveillance MRSA et à celle MRGN.

Le présent rapport a pour but de présenter les résultats des trois programmes de surveillance épidémiologique pour l'année 2016 et de décrire les tendances en matière de résistance antimicrobienne dans les hôpitaux belges de soins aigus et/ou chroniques.

Méthodes

Les données présentées dans le présent rapport ont été recueillies rétrospectivement (année 2016) et ont été agrégées à l'échelle hospitalière. Les hôpitaux pouvaient soit fournir des chiffres annuels ou des données pour un semestre, à l'exception de la surveillance des entérocoques, pour laquelle seules des données annuelles étaient autorisées.
Seuls les hôpitaux ayant fourni des données de type D (soit des données dédupliquées) ont été inclus dans les analyses : chaque patient a donc été compté une seule fois par période d'hospitalisation et par bactérie. Les échantillons cliniques et de dépistage provenant de patients hospitalisés ont pu être inclus.

Résultats

Au total, 140 hôpitaux ont été intégrés à l'analyse des résultats de surveillance MRSA : 123 hôpitaux de soins aigus et 17 hôpitaux de soins chroniques. La proportion moyenne de résistance (parmi les isolats de *S. aureus*) atteignait en moyenne 15,7 % dans les hôpitaux de soins aigus et 29,1 % dans ceux de soins chroniques.
L'incidence moyenne de MRSA nosocomiaux dans les hôpitaux de soins aigus s'élevait à 0,93 cas pour 1000 admissions. L'incidence a significativement diminué depuis 2003 et est à son niveau le plus bas depuis le début de la surveillance en 1994. Dans les hôpitaux de soins chroniques, l'incidence moyenne est restée constante par rapport à 2015 (0,14 cas pour 1000 journées patients).
Dans les hôpitaux de soins aigus et chroniques, respectivement 50,1 % et 41,3 % de l'ensemble des cas nosocomiaux de MRSA ont été détectés grâce à un dépistage.

Cent-cinq hôpitaux ont pris part à la surveillance optionnelle de la résistance des entérocoques. Les données des hôpitaux aigus et chroniques ont été combinées. L'incidence moyenne de la résistance à la vancomycine et au linézolide chez *Enterococcus faecium* (*E. faecium*) était basse : respectivement 0,140 et 0,009 cas pour 1 000 admissions. En raison du caractère récent de la surveillance, il est trop tôt pour identifier des tendances claires dans le graphique d'évolution d'*E. faecium*.

Au total, 122 hôpitaux de soins aigus et 16 de soins chroniques ont été inclus dans la surveillance MRGN. Cette dernière met en avant une tendance défavorable dans l'évolution de la résistance des *Enterobacteriaceae*, en particulier de *Klebsiella pneumoniae (K. pneumoniae)*, dans les hôpitaux de soins aigus. Le pourcentage moyen de résistance des souches de *K. pneumoniae* productrices de β-lactamase à spectre étendu (BLSE+) est passé de 6,2 % en 2005 à 17,9 % en 2016 dans les hôpitaux de soins aigus. Dans les hôpitaux de soins chroniques, la résistance BLSE chez *K. pneumoniae* a connu une hausse rapide entre 2011 et 2013, mais est restée stable depuis lors (19,9 % en 2016).
Si l'incidence de la résistance moyenne de type BLSE dans les hôpitaux de soins aigus est beaucoup plus élevée chez *Escherichia coli* (4,69 cas pour 1 000 admissions) que chez *K. pneumoniae* (2,53 cas pour 1 000 admissions), la production de carbapénémases (CPE) et la sensibilité réduite au méropénème (meropenem I/R) sont plus fréquentes chez *K. pneumoniae* (respectivement 0,15 et 0,24 cas pour 1 000 admissions) que chez *E. coli* (respectivement 0,03 et 0,01 cas pour 1 000 admissions).

RÉSUMÉ

Le pourcentage d'*Acinetobacter baumannii* (*A. baumannii*) meropenem I/R dans les hôpitaux aigus est passé de 4,2 % en 2015 à 6,1 % en 2016, l'incidence moyenne restant, quant à elle, constante (0,03 cas pour 1 000 admissions en 2016).
Le pourcentage moyen de souches *Pseudomonas aeruginosa* (*P. aeruginosa*) multirésistantes (MDR) reste stable depuis 2013 (5,5 % en 2016), tandis que l'incidence dans les hôpitaux de soins aigus décroît lentement (0,69 cas pour 1000 admissions en 2016).
Dans les hôpitaux de soins chroniques, la proportion moyenne de résistance était plus élevée que dans ceux de soins aigus, tant pour les *A. baumannii* meropenem I/R (10,1 %) que pour les *P. aeruginosa* MDR (8,7 %). En 2016, l'incidence moyenne des *A. baumannii* meropenem I/R (0,005 cas pour 1 000 journées patients) était inférieure à celle des *P. aeruginosa* MDR (0,13 cas pour 1 000 journées patients).

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ABBREVIATIONS

3GC	Third generation cephalosporins
4GC	Fourth generation cephalosporins
A. baumannii	*Acinetobacter baumannii*
CLSI	Clinical and Laboratory Standard Institute, USA
CPE	Carbapenemase producing *Enterobacteriaceae*
E. cloacae	*Enterobacter cloacae*
E. coli	*Escherichia coli*
E. faecalis	*Enterococcus faecalis*
E. faecium	*Enterococcus faecium*
ESBL	Extended spectrum beta-lactamase
EUCAST	European Committee on Antimicrobial Susceptibility Testing
I	Intermediate susceptible
K. pneumoniae	*Klebsiella pneumoniae*
Linezolid-R	Resistance to linezolid
LRE	Linezolid resistant enterococci
MDR	Multidrug-resistant
Meropenem I/R	Intermediate susceptibility or resistance to meropenem
MIC	Minimal inhibitory concentration
MRGN	Multiresistant Gram-negative bacteria
MRSA	Methicillin resistant *Staphylococcus aureus*
P. aeruginosa	*Pseudomonoas aeruginosa*
R	Resistant or non-susceptible
S	Sensitive or susceptible
S. aureus	*Staphylococcus aureus*
Type D	Data collection method with de-duplication of data: per period of hospitalisation 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.

One of the tasks of the service “Healthcare-associated infections and antimicrobial resistance” of Sciensano (previously known as the Belgian Scientific Institute of Public Health; WIV-ISP) is to closely monitor antimicrobial resistance in Belgian acute care hospitals.
In 1994, the team initiated the first national surveillance program of methicillin resistant *Staphylococcus aureus* (MRSA). This resistant Gram-positive bacterium caused and still causes difficult to treat infections, such as skin and soft tissue infections, infections of surgical sites and catheter sites, pneumonia or bloodstream infections.
A few years later (end of the 1990s) resistance in a wide range of Gram-negative bacteria started to escalate. Multiresistant *Enterobacter aerogenes* was the first out of a group of Gram-negative bacteria, called *Enterobacteriaceae*, to be monitored in Belgian hospitals (started in 2000, stopped in 2011). Later on, other *Enterobacteriaceae*, such as *Escherichia coli* (2005), *Klebsiella pneumoniae* (2005) and *Enterobacter cloacae* (2009), as well as nonfermenting Gram-negative bacteria, *Pseudomonas aeruginosa* (2009) and *Acinetobacter baumannii* (2009), were added to the second surveillance program.
Finally, in 2014 a third surveillance program was initiated after multiple Belgian hospitals reported outbreaks with resistant Gram-positive enterococci (*Enterococcus faecium* and *Enterococcus faecalis*).

By Royal Decree, Belgian non-psychiatric hospitals - with the exception of chronic care hospitals – mandatorily have to participate in the surveillance of MRSA (since 2006) and multiresistant Gram-negative bacteria (since 2015). At present, participation in the surveillance of resistant enterococci is optional.

The aim of the current report is to present the 2016 results of the three epidemiological surveillance programs and to describe trends in antimicrobial resistance in Belgian acute and/or chronic care hospitals.

METHODOLOGY

The 2016 results of three national, multicentric and continuous surveillance programs are presented in this report, i.e. surveillance of (1) methicillin resistant *Staphylococcus aureus* (MRSA), (2) multiresistant Gram-negative bacteria (MRGN), and (3) vancomycin and linezolid resistant enterococci.
These surveillance programs aim to monitor the epidemiology and evolution of resistant bacteria in Belgian acute and/or chronic care hospitals. Only for MRSA nosocomiality is explored. Nosocomial MRSA was defined as colonization or infection with MRSA, acquired in the hospital and not present on admission or known in the patient's history (past 12 months). The first sample had to be positive for MRSA more than 48 hours after admission.

Surveillance results were collected and reported by the microbiological laboratories and/or infection control teams of the participating hospitals to the service "Healthcare-associated infections and antimicrobial resistance" of Sciensano.

Data were collected retrospectively (year 2016) and aggregated at hospital level. Hospitals could either provide annual figures or data for one semester, except for the surveillance of resistant enterococci for which only annual data were allowed.

Only samples originating from hospitalized patients were included. Samples taken from patients seen in outpatient departments or in the emergency room had to be excluded as well as samples from patients undergoing same day treatment or surgery.

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

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

All samples taken for diagnostic purposes could be considered as clinical samples. A screening sample was defined as a sample taken - in the absence of clinical signs/symptoms - to detect early colonization with resistant bacteria.
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.

In the different surveillance programs resistance was defined as follows:

- **MRSA** *Staphylococcus aureus (S. aureus)* resistant to methicillin/oxacillin

- **MRGN** **1) *Enterobacteriaceae*: *Enterobacter cloacae (E. cloacae), Escherichia coli* (*E. coli*) and *Klebsiella pneumoniae* (*K. pneumoniae*)**

  ESBL+: Extended Spectrum Beta-lactamase production

  Resistance to 3th and/or 4th generation cephalosporins (3GC/4GC I/R):
  reduced susceptibility (intermediate susceptibility [I] or resistance [R]) to:
  - cephalosporins of the 3th generation (cefotaxime ceftriaxone, ceftazidime)
  and/or
  - 4th generation cephalosporins (cefepime)
  according to EUCAST or CLSI criteria.

CPE+: carbapenemase production

Resistance to meropenem (meropenem I/R):
reduced susceptibility (intermediate susceptibility [I] or resistance [R]) to meropenem according to EUCAST or CLSI criteria.

2) Meropenem I/R *Acinetobacter baumannii* (*A. baumannii*):
reduced susceptibility (intermediate susceptibility [I] or resistance [R]) to meropenem

3) Multidrug-resistant (MDR) *Pseudomonas aeruginosa* (*P. aeruginosa*):
reduced susceptibility (intermediate susceptibility [I] or resistance [R]) to at least one antibiotic in four out of the five following antibiotic classes:
- penicillins: ticarcillin +/- clavulanic acid, piperacillin +/- tazobactam
- 3th and/or 4th generation cephalosporins: ceftazidime, cefepime
- carbapenems: meropenem, imipenem
- fluoroquinolones: ciprofloxacin, levofloxacin
- aminoglycosides: gentamicin, tobramycin, amikacin

- **Resistant enterococci:** *Enterococcus faecalis* (*E. faecalis*) and *Enterococcus faecium* (*E. faecium*)

Vancomycin resistant enterococci (vanco-R):
E. faecium or *E. faecalis* resistant to vancomycin
EUCAST criteria:
Vanco-R: MIC (minimal inhibitory concentration) breakpoint: > 4 mg/L, zone diameter: < 12 mm
CLSI criteria:
Vanco-R: MIC breakpoint: ≥ 32 µg/ml, zone diameter: ≤ 14 mm

Linezolid resistant enterococci (linezolid-R):
E. faecium or *E. faecalis* resistant to linezolid
EUCAST criteria:
Linezolid-R: MIC breakpoint: > 4 mg/L, zone diameter: < 19 mm
CLSI criteria:
Linezolid-R: MIC breakpoint: ≥ 8 µg/ml, zone diameter: ≤ 20 mm

The resistance proportion [crude, mean, median, minimum (min) and maximum (max)] was calculated for each resistant bacterium by dividing the number of resistant bacterial species by the total number of isolated species in the hospital during the surveillance period. In addition, the incidence (number of cases per 1 000 hospital admissions) and incidence density (cases per 1 000 patient days) were calculated for each resistant bacteria under surveillance.
In order to compare resistance and incidences across regions Kruskal-Wallis tests were performed. Differences were considered significant if p≤0.05.

Hospitals that were part of an administrative hospital group could choose to participate as one hospital or to collect data by hospital site. Results of the MRSA and MRGN surveillances were presented separately for acute care hospitals and for 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 wish to modify or correct their data after publication of this report.

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

In 2016, 141 hospital sites participated in the surveillance of methicillin resistant *S. aureus* (MRSA): 124 acute care hospitals and 17 chronic care hospitals. One acute care hospital was excluded from further analyses because it did not provide Type D data.

The majority (95.9%) of the 123 participating acute care hospitals (48 992 beds) provided annual data. Five acute care hospitals (4.1%) participated in only one semester. Of the 17 chronic care hospitals (2 673 beds), 12 (70.6%) provided annual data while 5 hospitals (29.4%) participated in one semester. Table 1 presents the participation in the MRSA surveillance by hospital type, region and hospital size.

Table 1. Participation in the surveillance of methicillin resistant *Staphylococcus aureus* by type of hospital, region and hospital size, Belgian acute and chronic care hospitals, 2016

	Flanders	Wallonia	Brussels	Belgium
N of acute care hospitals (%)	**60 (48.8)**	**46 (37.4)**	**17 (13.8)**	**123**
< 200 beds	38 (63.3)	29 (63.0)	6 (35.3)	73 (59.4)
200 - 399 beds	18 (30.0)	10 (21.7)	7 (41.2)	35 (28.5)
≥ 400 beds	4 (6.7)	7 (15.2)	4 (23.5)	15 (12.2)
N of chronic care hospitals (%)	**6 (35.3)**	**9 (52.9)**	**2 (11.8)**	**17**
< 200 beds	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
200 - 399 beds	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
≥ 400 beds	6 (100)	9 (100)	2 (100)	17 (100)

N = number

1. MRSA in acute care hospitals

1.1 RESISTANCE IN *STAPHYLOCOCCUS AUREUS*

The crude proportion of MRSA on the total number of *S. aureus* isolates was 15.4% (n=5 744/37 220) in all 122 participating acute care hospitals. The median ratio significantly differed between Wallonia and Brussels (p<0.001) and between Wallonia and Flanders (p<0.001). More details on the resistance proportion by region can be found in Table 2.

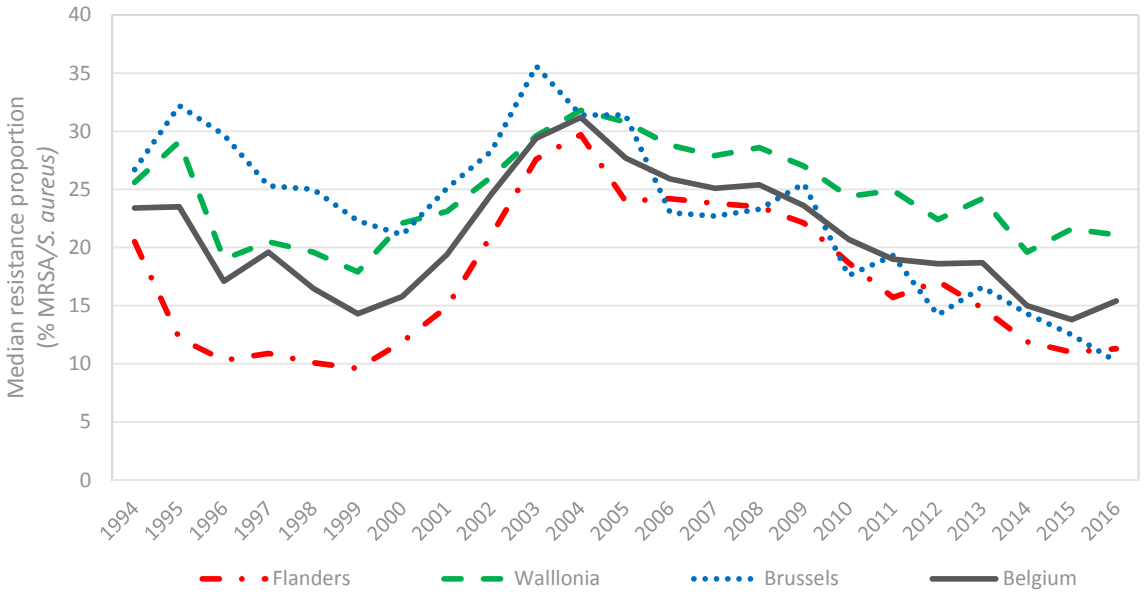
Table 2. Resistance in *Staphylococcus aureus* (*S. aureus*): proportion of methicillin resistant *S. aureus* (MRSA) on the total number of reported *S. aureus* isolates by region, Belgian acute care hospitals, 2016

		MRSA / *S. aureus* (%)			
	N of hospitals	Crude	Mean	Median	Min-Max
Belgium	122	**15.4**	15.7	15.0	0.0-42.9
Flanders	60	**12.3**	12.1	10.9	1.3-32.1
Wallonia	45	**21.5**	21.4	21.2	0.0-42.9
Brussels	17	**12.5**	13.3	10.3	5.4-34.9

N = number, min = minimum, max = maximum

The overall median MRSA resistance proportion in a cohort of acute care hospitals with at least 5 participations between 1994 and 2016 slightly increased between 2015 and 2016 (13.8% and 15.4%, respectively), but decreased in Brussels (12.5% versus 10.2%) and remained more or less stable in Flanders (11.0% versus 11.3%) and in Wallonia (21.6% versus 21.1%) (Figure 1).

Figure 1. Evolution of the median proportion of methicillin resistant *Staphylococcus aureus* (MRSA) on the total number of reported *S. aureus* by region, Belgian acute care hospitals with at least 5 years of participation in the surveillance, 1994-2016



1.2 MRSA PRESENT AT ADMISSION

Only 26 hospitals provided complete data to calculate the incidence of patients who were MRSA positive on admission. Both clinical samples and screening samples testing positive for MRSA within 48 hours after admission were taken into account.

A total of 2 528 patients were MRSA positive on admission (n=450 145) to these hospitals. A considerable proportion of these patients (35.2%; n=891/2 528) were known to have been MRSA colonized/infected in the previous 12 months.
The crude incidence of MRSA positive patients on admission was 5.6 cases per 1 000 admissions (n=2 528/450 145 admissions). The median incidence was 5.0 patients per 1 000 admissions, respectively (min-max: 1.6 – 12.6 per 1 000 admissions). The crude incidence of MRSA positive patients on admission dropped to 3.6 cases per 1 000 admissions when excluding known MRSA colonized/infected patients (n=1 637/450 145 admissions).

1.3 NOSOCOMIAL MRSA

In total, 121 acute care hospitals reported 1 554 clinical samples and 1 560 screening samples as MRSA positive more than 48 hours after admission. These MRSA cases can therefore be considered as hospital acquired or nosocomial. The proportion of clinical samples tested MRSA positive more than 48 hours after admission (nosocomial MRSA) on the total number of clinical samples tested positive for *S. aureus* was 26.3%. There were no statistically significant difference between the proportions in the different regions (Table 3).

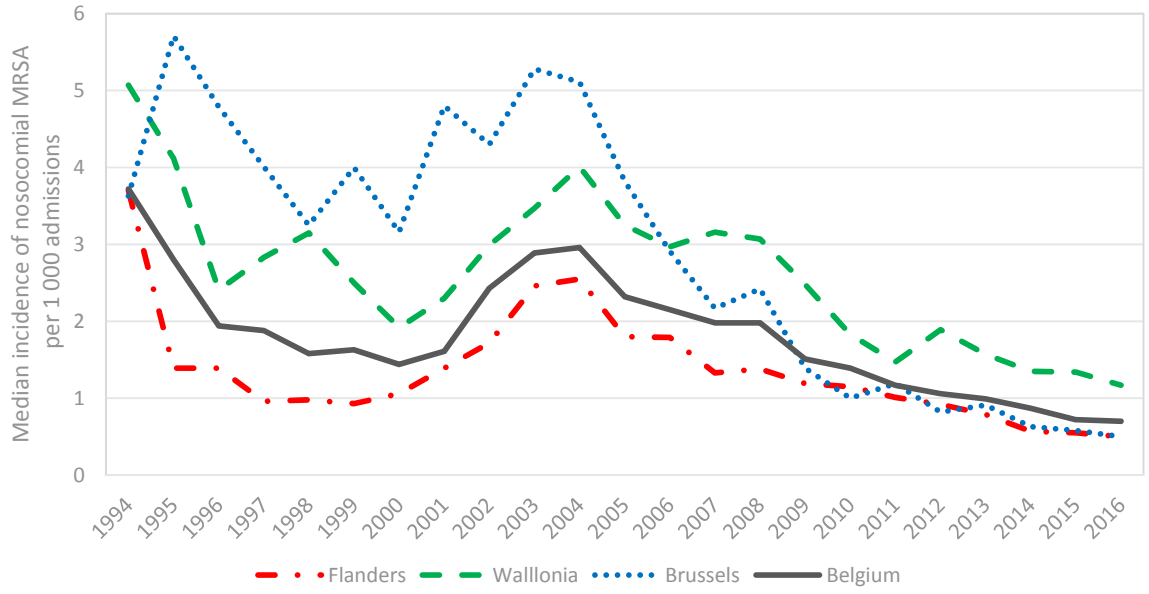
The crude incidence of nosocomial MRSA was 0.83 cases per 1 000 admissions or 0.13 cases per 1 000 patient days. The median incidence and incidence density of nosocomial MRSA in Wallonia statistically differed from the other two regions (all p≤0.001). More details on the incidence and incidence density of nosocomial MRSA overall and by region can be found in Table 3.

Table 3. **Proportion, incidence and incidence density of nosocomial methicillin resistant *Staphylococcus aureus* (MRSA) (clinical samples only) by region, Belgian acute care hospitals, 2016**

	Nosocomial MRSA (clinical samples only)				
	N of hospitals	Crude	Mean	Median	Min-Max
Proportion (%)					
Belgium	121	**26.3**	30.4	27.3	0.0-100
Flanders	58	**28.3**	32.3	29.5	0.0-100
Wallonia	46	**26.8**	29.7	25.6	0.0-100
Brussels	17	**18.4**	25.7	23.6	0.0-71.4
Incidence per 1 000 admissions					
Belgium	121	**0.83**	0.93	0.69	0.00-5.18
Flanders	58	**0.61**	0.63	0.49	0.00-1.82
Wallonia	46	**1.37**	1.43	1.17	0.00-5.18
Brussels	17	**0.56**	0.64	0.50	0.24-1.76
Incidence density per 1 000 patient days					
Belgium	121	**0.13**	0.14	0.11	0.00-0.57
Flanders	58	**0.10**	0.09	0.07	0.00-0.31
Wallonia	46	**0.21**	0.21	0.17	0.00-0.57
Brussels	17	**0.08**	0.08	0.06	0.04-0.18

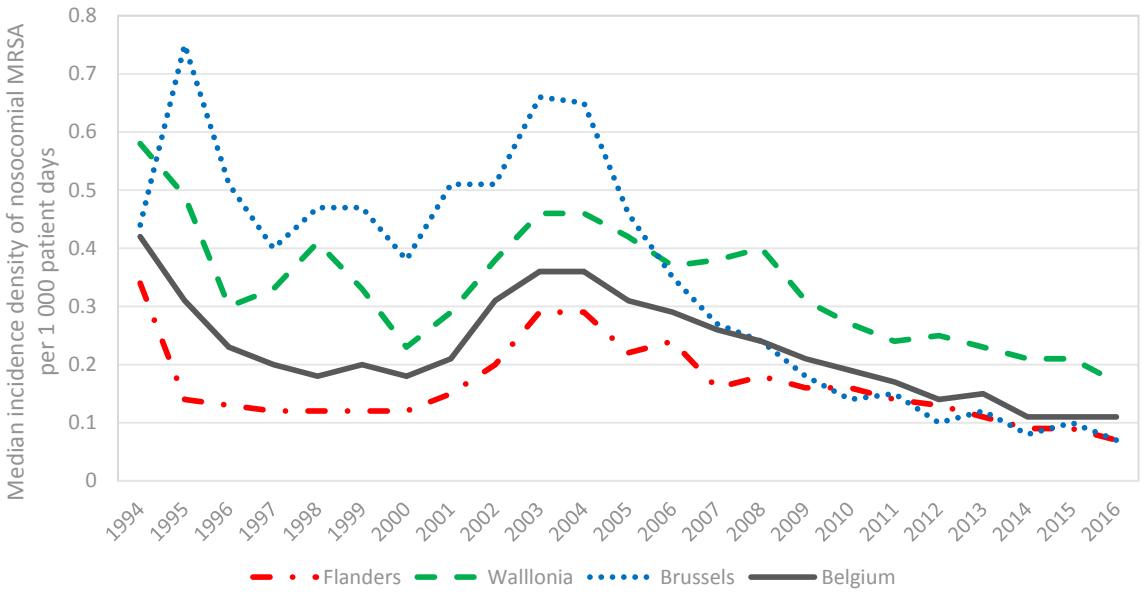
N = number, min = minimum, max = maximum

Figure 2. **Evolution of the median incidence of nosocomial methicillin resistant *Staphylococcus aureus* (MRSA) per 1000 admissions by region, Belgian acute care hospitals with at least 5 years of participation in the surveillance, 1994-2016**



Compared with 2015 the median incidence of nosocomial MRSA per 1 000 admissions continued to decrease overall (from 0.72 to 0.70 cases per 1 000 admissions) and by region (Figure 2). The median incidence density of nosocomial MRSA remained stable overall (0.11 cases per 1 000 patient days in 2015 and 2016), but slightly decreased in all regions (Figure 3).
We observe a statistically significant decrease in both the incidence and incidence density of nosocomial MRSA in Belgium and in the different regions (all p<0.001) since 2003.

Figure 3. Evolution of the median incidence density of nosocomial methicillin resistant *Staphylococcus aureus* (MRSA) per 1 000 patient days by region, Belgian acute care hospitals with at least 5 years of participation in the surveillance, 1994-2016



1.4 MRSA SCREENING

Table 4 presents MRSA screening practices on admission and during the hospital stay in the participating acute care hospitals overall and by region.

Screening on admission depended most commonly on where the patient stayed prior to admission (e.g. another hospital or a nursing home; 90.2%). Acute care hospitals also frequently screened patients when admitted to specific wards (e.g. intensive care unites; 82.1%). In most hospitals (87.3%) MRSA screening was routinely performed in specific wards during hospital stay.

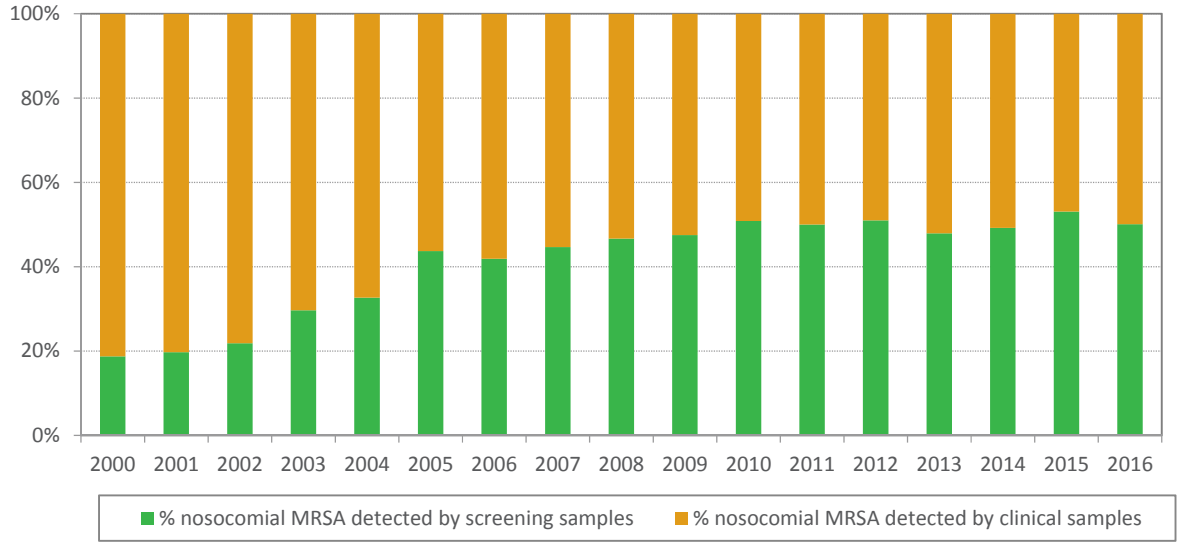
On average, 14.2% and 6.1% of hospitalised patients were screened on admission or during their hospital stay, respectively. The figures should however be carefully interpreted as the number of reporting hospitals was very low (37 and 36 hospitals, respectively).

Half of all nosocomial MRSA cases (50.1%) were detected through screening. This proportion remained more or less stable in the past years (Figure 4).

Table 4. Screening for methicillin resistant *Staphylococcus aureus* (MRSA) on admission and during the hospital stay: hospital practices by region, Belgian acute care hospitals, 2016

	Flanders	Wallonia	Brussels	Belgium
Screening on admission (% hospitals with these indications)	**n=60**	**n=46**	**n=17**	**n=123**
Systematic: all patients, all wards	8.3	4.4	0.0	5.7
In case of an outbreak in the referral centre	45.0	65.2	76.5	56.9
Ward specific screening	73.3	87.0	100	82.1
Depending on where the patient stayed prior to admission	96.7	78.3	100	90.2
Depending on the patient's risk	81.7	50.0	64.7	67.5
No screening on admission	0.0	0.0	0.0	0.0
Screening during the hospital stay (% hospitals with these indications)	**n=60**	**n=41**	**n=17**	**n=118**
In case of an outbreak	83.3	80.5	82.4	82.2
Routinely in specific wards	85.0	85.4	100	87.3
Depending on the patient's risk	73.3	53.6	58.8	64.4
No screening during the hospital stay	0.0	0.0	0.0	0.0

Figure 4. Evolution of the crude proportion of nosocomial methicillin resistant *Staphylococcus aureus* (MRSA) detected by clinical samples or by screening samples, Belgian acute care hospitals, 2000-2016



2. MRSA in chronic care hospitals

2.1 RESISTANCE IN *STAPHYLOCOCCUS AUREUS*

All together, 17 participating chronic care hospitals reported 756 clinical samples positive for *S. aureus* in 2016. Of these *S. aureus*, 27.1% were MRSA (n=205). The crude percentage varied considerably between the participating hospitals, i.e. from 0.0% upto 75.0% in one facility. No significant differences were found between the median resistance proportions in the different regions (Table 5).

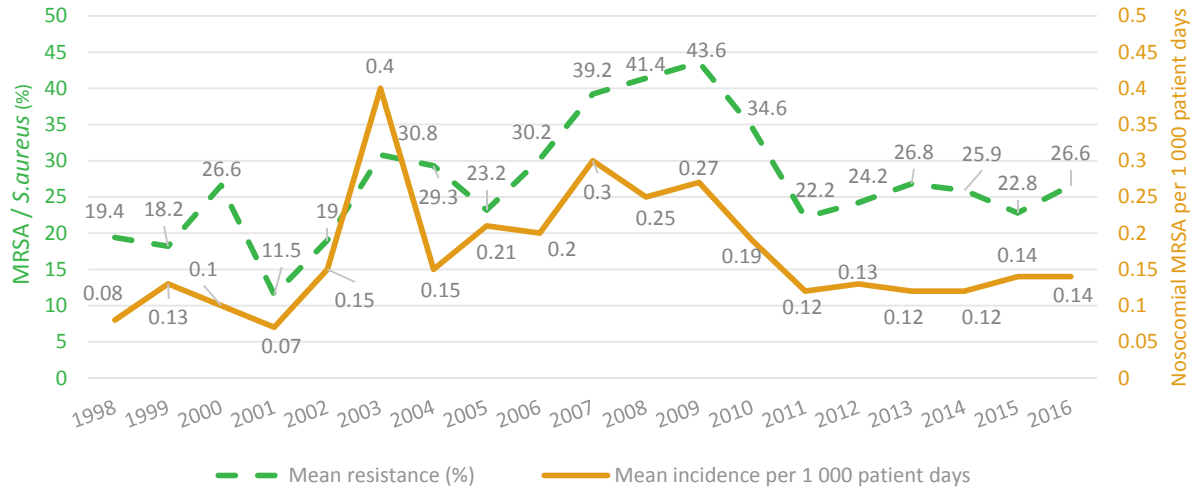
Table 5. Resistance in *Staphylococcus aureus* (*S. aureus*): proportion of methicillin resistant *S. aureus* (MRSA) on the total number of reported *S. aureus* by region, Belgian chronic care hospitals, 2016

		MRSA / *S. aureus* (%)			
	N of hospitals	Crude	Mean	Median	Min-Max
Belgium	17	**27.1**	29.1	23.1	0.0-75.0
Flanders	6	**24.8**	22.2	18.7	0.0-72.5
Wallonia	9	**28.3**	34.5	26.3	0.0-75.0
Brussels	2	**26.8**	25.2	25.2	12.9-37.5

N = number, min = minimum, max = maximum

The overall mean MRSA resistance (cohort of chronic care hospitals with at least 5 participations) increased from 22.8% in 2015 to 26.6% in 2016 (Figure 1).

Figure 5. Methicillin resistant *Staphylococcus aureus* (MRSA): resistance proportion and incidence density in a cohort of chronic care hospitals with at least 5 years of participation in the surveillance, 1998-2016



2.2 MRSA PRESENT AT ADMISSION

Only three hospitals provided complete data on the presence of MRSA on admission. These three hospitals reported 35 patients positive for MRSA on admission. Twelve of these patients (34.2%) had a history of MRSA colonization or infection in the past 12 months. The numbers were too small to calculate the incidence of patients who were MRSA positive on admission.

2.3 NOSOCOMIAL MRSA

In total, 143 cases of nosocomial MRSA were reported by the participating chronic care hospitals, i.e. 84 clinical samples and 59 screening samples tested positive for MRSA more than 48 hours after admission. Forty-one percent of all MRSA found in clinical samples were hospital acquired (nosocomial) MRSA.

The crude incidence of nosocomial MRSA was 4.20 cases per 1 000 admissions or 0.12 cases per 1 000 patient days. More details on the resistance proportion, incidence and incidence density of nosocomial MRSA in chronic care hospitals are shown in Table 6. No statistically significant differences were found between the different regions.

Table 6. Proportion, incidence and incidence density of nosocomial methicillin resistant *Staphylococcus aureus* (MRSA) (clinical samples only) by region, Belgian chronic care hospitals, 2016

	Nosocomial MRSA (clinical samples only)				
	N of hospitals	Crude	Mean	Median	Min-Max
Proportion (%)					
Belgium	17	**41.0**	36.9	25.0	0.0-100
Flanders	6	**32.1**	29.5	8.6	0.0-100
Wallonia	9	**48.5**	47.7	52.0	0.0-87.5
Brussels	2	**15.8**	10.0	10.0	0.0-20.0
Incidence per 1 000 admissions					
Belgium	17	**4.20**	4.36	3.24	0.00-12.74
Flanders	6	**4.23**	4.17	3.37	0.00-11.42
Wallonia	9	**4.32**	5.13	4.67	0.00-12.74
Brussels	2	**2.64**	1.47	1.47	0.00-2.95
Incidence density per 1 000 patient days					
Belgium	17	**0.12**	0.12	0.08	0.00-0.36
Flanders	6	**0.09**	0.10	0.06	0.00-0.26
Wallonia	9	**0.14**	0.16	0.16	0.00-0.36
Brussels	2	**0.05**	0.04	0.04	0.00-0.08

N = number, min = minimum, max = maximum

The evolution (1998-2016) of the mean incidence density of nosocomial MRSA in a cohort of chronic care hospitals with at least 5 participations can be found in Figure 5. The mean 2016 incidence density remained at the same level as in 2015.

2.4 MRSA SCREENING

Table 7 presents MRSA screening practices on admission and during the hospital stay in the participating chronic care hospitals overall and by region.

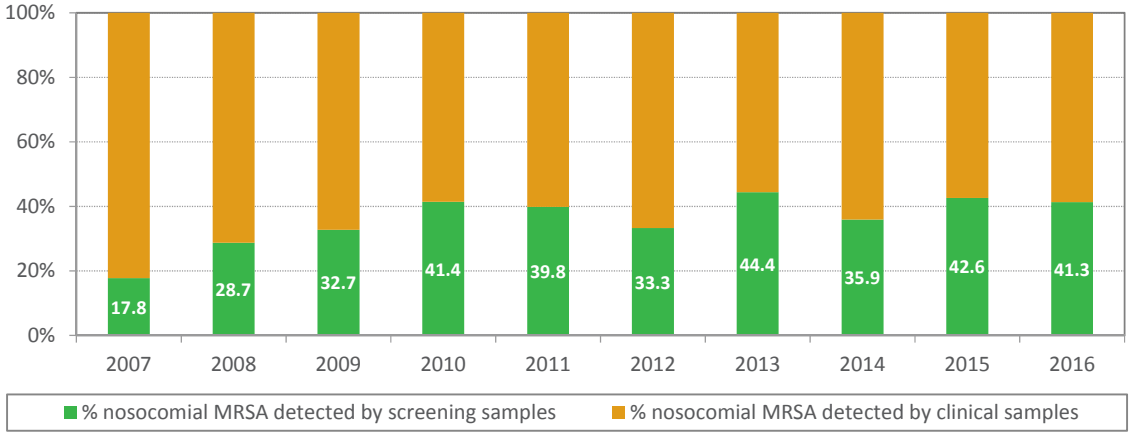
Table 7. Screening for methicillin resistant *Staphylococcus aureus* (MRSA) on admission and during the hospital stay: hospital practices by region, Belgian chronic care hospitals, 2016

	Flanders n=6	Wallonia n=9	Brussels n=2	Belgium n=17
Screening on admission (% hospitals with these indications)				
Systematic: all patients, all wards	50.0	11.1	50.0	29.4
In case of an outbreak in the referral centre	50.0	33.3	100	47.1
Ward specific screening	33.3	33.3	0.0	29.4
Depending on where the patient stayed prior to admission	33.3	66.7	100	58.8
Depending on the patient's risk	50.0	22.2	50.0	35.3
No screening on admission	0.0	0.0	0.0	0.0
Screening during the hospital stay (% hospitals with theses indications)				
In case of an outbreak	83.3	55.6	100	70.6
Routinely in specific wards	66.7	22.2	0.0	35.3
Depending on the patient's risk	66.7	100	100	52.9
No screening during the hospital stay	0.0	0.0	0.0	11.8

Despite of having a screening policy for MRSA during the patient's hospital stay, six hospital reported zero screening samples testing positive for this resistant bacteria more than 48 hours after admission. Two other hospitals reported not to screen during the patient's hospital stay and consequently also reported no cases of nosocomial MRSA found by screening samples.

Less than half of all nosocomial MRSA (41.3%) were detected through screening (Figure 6).

Figure 6. Evolution of the crude proportion of nosocomial methicillin resistant *Staphylococcus aureus* (MRSA) detected by clinical samples or by screening samples, Belgian acute care hospitals, 2007-2016



PART 2. RESISTANCE IN ENTEROCOCCI

In total, 107 hospitals participated in the optional surveillance of resistance in enterococci, but only 105 hospitals delivered type D data.

The data presented hereafter originate from 49 Flemish hospitals (46.7%; 22 026 beds), 41 Walloon hospitals (39.1%; 12 844 beds) and 15 hospitals in Brussels (14.3%; 5 128 beds). Because of the small numbers data from acute and chronic care hospitals were combined. Table 8 gives an overview of participation by hospital type, region and hospital size.

Table 8. Participation in the surveillance of resistant enterococci by type of hospital, region and hospital size, Belgian acute and chronic care hospitals, 2016

	Flanders	Wallonia	Brussels	Belgium
N of acute care hospitals (%)	**43 (44.8)**	**39 (40.6)**	**14 (14.6)**	**96**
< 200 beds	5 (11.6)	12 (30.8)	7 (50.0)	24 (25.0)
200 - 399 beds	19 (44.2)	18 (46.2)	2 (14.3)	39 (40.6)
≥ 400 beds	19 (44.2)	9 (23.1)	5 (35.7)	33 (34.4)
N of chronic care hospitals (%)	**6 (66.7)**	**2 (22.2)**	**1 (11.1)**	**9**
< 200 beds	6 (100)	1 (50.0)	1 (100)	8 (88.9)
200 - 399 beds	0 (0.0)	1 (50.0)	0 (0.0)	1 (11.1)
≥ 400 beds	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)

N = number

In 2016, 105 participating hospitals reported 6 395 *E. faecium* isolated in clinical and/or screening samples (mean: 60.9; min-max: 1-428). In addition, 21 805 *E. faecalis* were reported (mean: 207.6; min-max: 0- 1 787).

Table 9 shows the resistance proportion and incidences for the different resistance mechanisms in *E. faecium* (clinical samples only) by region.

Resistance to vancomycin (vanco-R) occurred in 3.55% of all *E. faecium* isolated in clinical samples. Resistance to linezolid (linezolid-R) was rare (0.24%) (Table 9). Vancomycin and linezolid resistance in *E. faecalis* was 0.09% and 0.09%, respectively.
The crude incidence of vanco-R and linezolid-R *E. faecium* was 0.148 and 0.010 cases per 1 000 admissions, respectively (Table 9). For *E. faecalis* the crude incidence of vanco-R and linezolid-R was 0.013 and 0.014 per 1 000 admissions, respectively.

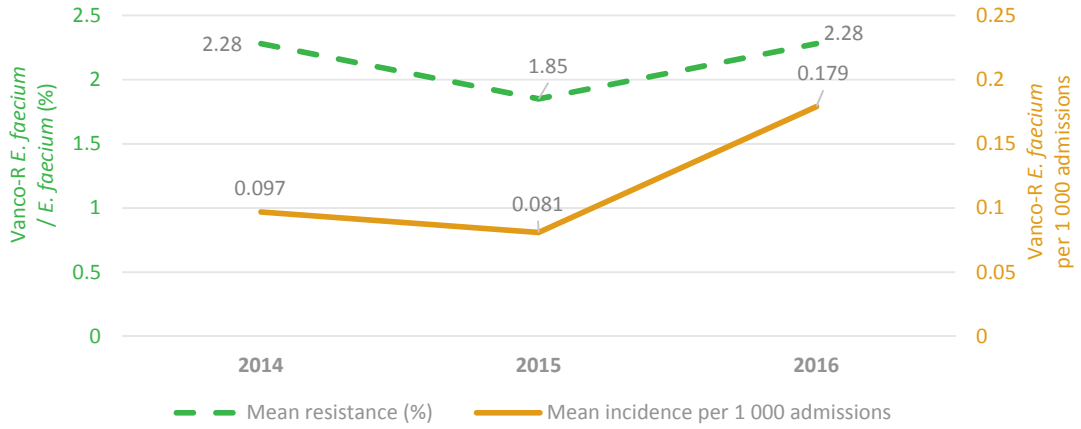
Table 9. **Resistance proportion and incidence of *Enterococcus faecium* (clinical samples only) by region, Belgian acute and chronic care hospitals, 2016**

	Vancomycin resistance				Linezolid resistance			
	N hosp	Crude	Mean	Min-Max	N hosp	Crude	Mean	Min-Max
Resistance (%)								
Belgium	104	**3.55**	2.25	0.0-27.88	94	**0.24**	0.28	0.00-8.33
Flanders	48	**2.50**	1.63	0.0-27.88	41	**0.17**	0.09	0.00-1.56
Wallonia	41	**3.42**	2.37	0.0-25.00	39	**0.29**	0.30	0.00-6.67
Brussels	15	**7.51**	3.89	0.0-14.85	14	**0.33**	0.78	0.00-8.33
Incidence								
Belgium (per 1 000 pd)	104	**0.022**	0.021	0.00-0.427	94	**0.001**	0.001	0.000-0.036
Belgium (per 1 000 adm)	104	**0.148**	0.140	0.00-2.831	94	**0.010**	0.009	0.000-0.236
Flanders (per 1 000 adm)	48	**0.096**	0.095	0.00-1.548	41	**0.007**	0.005	0.000-0.066
Wallonia (per 1 000 adm)	41	**0.150**	0.148	0.00-2.831	39	**0.013**	0.012	0.000-0.236
Brussels (per 1 000 adm)	15	**0.386**	0.265	0.00-1.233	14	**0.018**	0.012	0.000-0.079

N = number, min = minimum, max = maximum, pd = patient days, adm = admissions; median omitted from table as 0 for all categories.

The evolution of the resistance proportion and incidence of vanco-R *E. faecium* in a cohort of hospitals that participated at least three time in the surveillance can be seen in Figure 7, respectively. Because of the recent character of the surveillance it is too early to see clear trends in the evolution graph.

Figure 7. **Vancomycin resistance in *Enterococcus faecium*: resistance proportion and incidence in a cohort of acute and chronic care hospitals with at least 3 years of participation in the surveillance, 2014-2016**



PART 3. RESISTANCE IN GRAM-NEGATIVE BACTERIA

In total, 140 hospital sites participated in the mandatory MRGN surveillance: 124 acute care and 16 chronic care hospitals. Two acute care hospitals were excluded from further analyses as they did not provide Type D data.

The majority of the hospitals (94.9%) provided annual data, while 7 hospitals (5 acute care and 2 chronic care hospitals) provided data for only one semester.
Table 10 presents the participation in the MRGN surveillance by hospital type, region and hospital size.

Table 10. Participation in the surveillance of multiresistant Gram-negative bacteria by type of hospital, region and hospital size, Belgian acute and chronic care hospitals, 2016

	Flanders	Wallonia	Brussels	Belgium
N of acute care hospitals (%)	**59 (48.4)**	**46 (37.7)**	**17 (13.9)**	**122**
< 200 beds	37 (62.7)	30 (65.2)	6 (35.3)	73 (59.8)
200 - 399 beds	18 (30.5)	10 (21.7)	7 (41.2)	35 (28.7)
≥ 400 beds	4 (6.8)	6 (13.0)	4 (23.5)	14 (11.5)
N of chronic care hospitals (%)	**6 (37.5)**	**8 (50.0)**	**2 (12.5)**	**16**
< 200 beds	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
200 - 399 beds	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
≥ 400 beds	6 (100)	8 (100)	2 (100)	16 (100)

N = number

1. Resistant Gram-negative bacteria in acute care hospitals

1.1 RESISTANCE IN *ENTEROBACTER CLOACAE*

Table 11a presents the resistance proportion and incidence of *E. cloacae* producing ESBL or with a reduced susceptibility for 3th and/or 4th generation cephalosporins (3GC/4GC I/R), while table 11b shows carbapenemase production or reduced susceptibility to meropenem (meropenem I/R) in *E. cloacae*.

In 2016, the crude resistance proportion of ESBL+ *E. cloacae* was 12.4% (n=1 068/8 591). The median resistance proportion and incidence were lower in Flanders compared to Wallonia (p=0.008 and p<0.001, respectively) and Brussels (p<0.001 and p=0.002, respectively).

The crude resistance proportion of 3GC/4GC I/R *E. cloacae* was 28.4% (n=1 855/6 526) overall. Brussels had a significant higher median resistance proportion (47.6%) compared to Flanders (24.7%; p=0.001) and Wallonia (25.0%; p=0.007). The incidence was however only significantly different between Flanders and Brussels (p=0.006).

Overall, 34.6% (n=37/107) of the hospitals reported a total of 150 CPE+ *E. cloacae*. Moreover, 50.4% (n=59/117) reported 292 cases of meropenem I/R *E. cloacae* in total. The crude resistance proportion of CPE+ and meropenem I/R *E. cloacae* was 1.6% (n=150/9 461) and 2.7% (n=292/10 651), respectively. For both, the median proportion was highest in Brussels, but only for meropenem I/R *E. cloacae* the differences in median resistance and incidence were significant between Flanders and Brussels (p=0.002 and 0.001, respectively).

Table 11a. Resistance proportion and incidence of *Enterobacter cloacae* (clinical samples and screening samples) by region: extended beta-lactamase production and reduced susceptibility for 3th and/or 4th generation cephalosporins, Belgian acute care hospitals, 2016

	ESBL+					3GC/4GC I/R				
	N hosp	Crude	Mean	Md	Min-max	N hosp	Crude	Mean	Md	Min-max
Proportion (%)										
Belgium	101	**12.4**	12.2	10.0	0.0-50.0	81	**28.4**	29.1	25.7	0.0-91.3
Flanders	45	**8.4**	9.5	6.8	0.0-50.0	43	**25.5**	25.4	24.7	3.9-71.2
Wallonia	39	**15.0**	13.6	9.3	0.0-40.0	25	**29.3**	26.1	25.0	0.0-71.3
Brussels	17	**17.0**	16.2	15.2	4.5-36.8	13	**43.0**	46.9	47.6	10.9-91.3
Incidence										
Belgium (per 1 000 pd)	102	**0.11**	0.11	0.07	0.00-0.60	82	**0.23**	0.20	0.15	0.00-1.01
Belgium (per 1 000 adm)	102	**0.75**	0.79	0.44	0.00-5.05	82	**1.50**	1.35	1.04	0.00-7.11
Flanders (per 1 000 adm)	45	**0.45**	0.44	0.25	0.00-1.92	43	**1.31**	1.03	0.92	0.14-3.77
Wallonia (per 1 000 adm)	39	**1.02**	1.10	0.54	0.00-5.05	25	**1.66**	1.52	1.40	0.00-7.11
Brussels (per 1 000 adm)	17	**1.12**	1.00	0.76	0.08-3.12	13	**2.07**	2.13	1.95	0.47-4.56

N = number, Md = median, min = minimum, max = maximum, pd = patient days, adm = admissions, ESBL+ = extended beta-lactamase production, 3GC/4GC = 3th or 4th generation cephalosporins, I/R = intermediate susceptibility or resistant

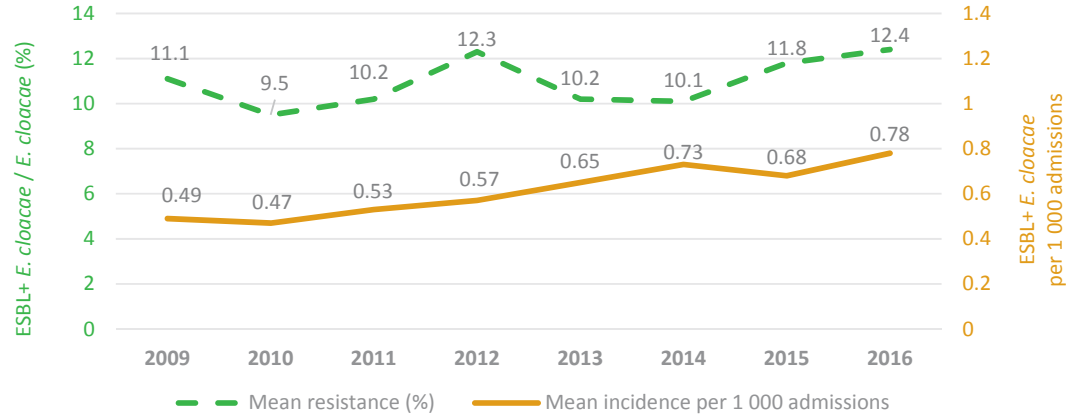
Table 11b. Resistance proportion and incidence of *Enterobacter cloacae* (clinical samples and screening samples) by region: carbapenemase production (CPE+) and reduced susceptibility for meropenem, Belgian acute care hospitals, 2016

	CPE+					Meropenem I/R				
	N hosp	Crude	Mean	Md	Min-max	N hosp	Crude	Mean	Md	Min-max
Proportion (%)										
Belgium	107	**1.6**	1.5	0.0	0.0-36.8	107	**2.7**	3.6	0.4	0.0-80.0
Flanders	51	**1.2**	1.3	0.0	0.0-15.0	57	**1.3**	1.4	0.0	0.0-11.8
Wallonia	40	**1.6**	1.2	0.0	0.0-13.8	45	**4.0**	5.6	0.4	0.0-80.0
Brussels	16	**2.8**	3.3	0.0	0.0-36.8	15	**6.0**	6.3	5.4	0.0-31.6
Incidence										
Belgium (per 1 000 pd)	108	**0.01**	0.01	0.00	0.00-0.24	117	**0.03**	0.03	0.00	0.00-0.51
Belgium (per 1 000 adm)	108	**0.10**	0.11	0.00	0.00-2.28	117	**0.17**	0.21	0.01	0.00-2.52
Flanders (per 1 000 adm)	51	**0.07**	0.08	0.00	0.00-1.41	57	**0.07**	0.06	0.00	0.00-0.61
Wallonia (per 1 000 adm)	40	**0.10**	0.10	0.00	0.00-1.32	45	**0.26**	0.33	0.05	0.00-2.52
Brussels (per 1 000 adm)	16	**0.18**	0.22	0.00	0.00-2.28	15	**0.39**	0.39	0.27	0.00-1.95

N = number, Md = median, min = minimum, max = maximum, pd = patient days, adm = admissions, CPE+ = carbapenemase production, I/R = intermediate susceptibility or resistant

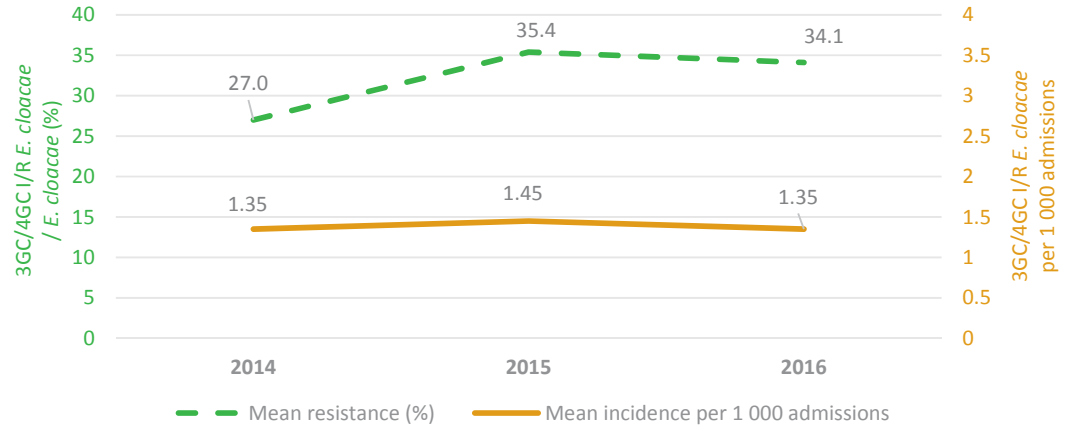
Since the introduction of *E. cloacae* into the MRGN surveillance (2009) the mean incidence of ESBL+ *E. cloacae* isolated in clinical samples and screening samples slowly increased in acute care hospitals, while the mean resistance proportion fluctuated more in time (Figure 8).

Figure 8. Extended spectrum beta-lactamase producing (ESBL+) *Enterobacter cloacae* (clinical samples and screening samples): resistance proportion and incidence in a cohort of acute care hospitals with at least 3 years of participation in the surveillance, 2009-2016



In the same cohort of acute care hospitals with at least 3 years of participation in the surveillance, the mean resistance proportion of 3GC/4GC I/R *E. cloacae* increased between 2014 and 2015 from 27.0% to 35.4%, but decreased again to 34.1% in 2016. The mean incidence per 1 000 admissions remained stable (Figure 9).

Figure 9. *Enterobacter cloacae* with reduced susceptibility for 3th and/or 4th generation cephalosporins (clinical samples and screening samples): resistance proportion and incidence in a cohort of acute care hospitals with at least 3 years of participation in the surveillance, 2014-2016

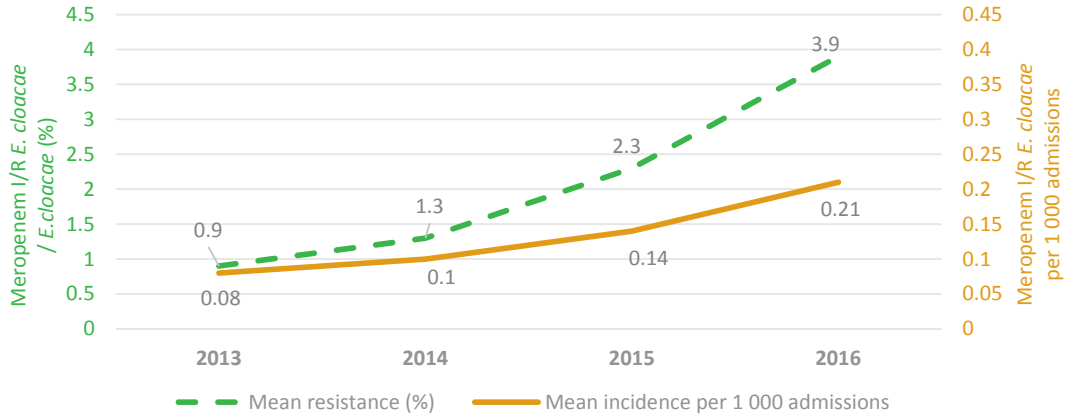


3GC/4GC = 3th and/or 4th generation cephalosporins, I/R = intermediate susceptibility or resistant

Both the mean resistance proportion and incidence of meropenem I/R *E. cloacae* increased between 2013 and 2016 (Figure 10).

Data collection on presencse of CPE was added to the surveillance in 2015, therefore it is too early to present the evolution of this resistance mechanism (i.e. the production of carbapenemase) in *E. cloacae.* In a cohort of hospitals participating in both surveillance years, the mean resistance proportion increased from 1.1% in 2015 to 1.5% in 2016. The mean incidence also increased from 0.07 cases per 1 000 admissions in 2015 to 0.11 cases per 1 000 admissions in 2016.

Figure 10. *Enterobacter cloacae* with reduced susceptibility for meropenem (clinical samples and screening samples): resistance proportion and incidence in a cohort of acute care hospitals with at least 3 years of participation in the surveillance, 2013-2016



I/R = intermediate susceptibility or resistant

1.2 RESISTANCE IN *ESCHERICHIA COLI*

Table 12a and 12b present the resistance proportion and incidence of the different resistance mechanisms in *E. coli* overall and by region.

Large differences between the overall crude and median resistance proportion of ESBL+ and 3GC/4GC I/R *E. coli* in acute care hospitals (clinical samples only) were seen in Brussels and therefore also overall. For both parameters, no statistically significant differences in median resistance proportion and incidence were observed between the regions (Table 12a). The crude overall resistance proportion was 3.7% (n=5 998/161 784) for ESBL+ *E. coli* and 4.0% (n=5 457/138 083) for 3GC/4GC I/R *E. coli.*

Twenty-five acute care hospitals (26.0%; n=25/96) reported 40 CPE+ *E. coli* that were found on a total of 166 143 *E. coli* isolated from clinical samples (0.02%). The crude incidence of CPE+ *E. coli* was 0.03 cases per 1 000 admissions.
Overall, 38 hospitals (33.6%) reported a total of 82 meropenem I/R *E. coli*. The crude resistance proportion was 0.05% (n= 82/177 510). For meropenem I/R *E. coli* the overall crude incidence was 0.05 per 1 000 admissions.
Again, no significant differences in median resistance proportion and in incidence were seen between the regions for these two resistance parameters.

Table 12a. Resistance proportion and incidence of *Escherichia coli* (clinical samples only) by region: extended beta-lactamase production and reduced susceptibility for 3th and/or 4th generation cephalosporins, Belgian acute care hospitals, 2016

	ESBL+					3GC/4GC I/R				
	N hosp	Crude	Mean	Md	Min-max	N hosp	Crude	Mean	Md	Min-max
Proportion (%)										
Belgium	99	**3.7**	7.7	7.5	0.1-20.2	73	**4.0**	9.1	9.1	0.1-18.1
Flanders	46	**7.6**	7.9	7.3	3.0-18.2	40	**9.3**	8.7	8.1	1.6-16.1
Wallonia	38	**6.3**	7.1	7.0	0.5-14.4	21	**8.7**	8.8	9.3	1.3-14.5
Brussels	15	**0.9**	9.0	8.9	0.1-20.2	12	**0.9**	10.7	10.9	0.1-18.1
Incidence										
Belgium (per 1 000 pd)	100	**0.66**	0.68	0.65	0.04-2.66	74	**0.76**	0.76	0.68	0.09-2.03
Belgium (per 1 000 adm)	100	**4.42**	4.69	4.15	0.29-19.03	74	**5.01**	5.08	4.64	0.59-12.95
Flanders (per 1 000 adm)	46	**4.45**	4.74	4.21	1.66-19.03	40	**5.14**	5.10	4.94	0.59-11.47
Wallonia (per 1 000 adm)	38	**4.16**	4.65	4.10	0.29-11.78	21	**4.50**	4.62	4.42	0.93-11.33
Brussels (per 1 000 adm)	15	**4.57**	4.62	5.03	1.77-7.80	12	**5.44**	5.85	5.19	2.12-12.95

N = number, Md = median, min = minimum, max = maximum, pd = patient days, adm = admissions, ESBL+ = extended beta-lactamase production, 3GC/4GC = 3th or 4th generation cephalosporins, I/R = intermediate susceptibility or resistant

Table 12b. Resistance proportion and incidence of *Escherichia coli* (clinical samples only) by region: carbapenemase production (CPE+) and reduced susceptibility for meropenem, Belgian acute care hospitals, 2016

	CPE+					Meropenem I/R				
	N hosp	Crude	Mean	Md	Min-max	N hosp	Crude	Mean	Md	Min-max
Proportion (%)										
Belgium	96	**0.02**	0.05	0.00	0.00-0.39	113	**0.05**	0.11	0.00	0.00-4.55
Flanders	47	**0.03**	0.04	0.00	0.00-0.39	57	**0.07**	0.07	0.00	0.00-0.63
Wallonia	37	**0.05**	0.04	0.00	0.00-0.25	44	**0.13**	0.17	0.00	0.00-4.55
Brussels	12	**0.01**	0.08	0.00	0.00-0.36	12	**0.00**	0.03	0.00	0.00-0.36
Incidence										
Belgium (per 1 000 pd)	97	**0.00**	0.00	0.00	0.00-0.03	114	**0.01**	0.01	0.00	0.00-0.61
Belgium (per 1 000 adm)	97	**0.03**	0.03	0.00	0.00-0.19	114	**0.05**	0.07	0.00	0.00-3.74
Flanders (per 1 000 adm)	47	**0.02**	0.02	0.00	0.00-0.16	57	**0.04**	0.04	0.00	0.00-0.47
Wallonia (per 1 000 adm)	38	**0.03**	0.03	0.00	0.00-0.19	45	**0.08**	0.13	0.00	0.00-3.74
Brussels (per 1 000 adm)	12	**0.06**	0.04	0.00	0.00-0.15	12	**0.02**	0.02	0.00	0.00-0.09

N = number, Md = median, min = minimum, max = maximum, pd = patient days, adm = admissions, CPE+ = carbapenemase production, I/R = intermediate susceptibility or resistant

In a cohort of acute care hospitals that participated at least three years in the surveillance the mean resistance proportion of ESBL+ *E. coli* in acute care hospitals slightly decreased to 7.9% in 2016 after an increase between 2013 and 2015. The mean incidence of ESBL+ *E. coli* however continued to gradually increase: from 1.96 cases per 1 000 admissions in 2005 to 4.70 cases per 1 000 admissions in 2016 (Figure 11). For 3GC/4GC I/R *E. coli* both indicators (mean resistance proportion and incidence) augmented (Figure 12).

Figure 11. Extended spectrum beta-lactamase producing (ESBL+) *Escherichia coli* (clinical samples only): resistance proportion and incidence in a cohort of acute care hospitals with at least 3 years of participation in the surveillance, 2005-2016

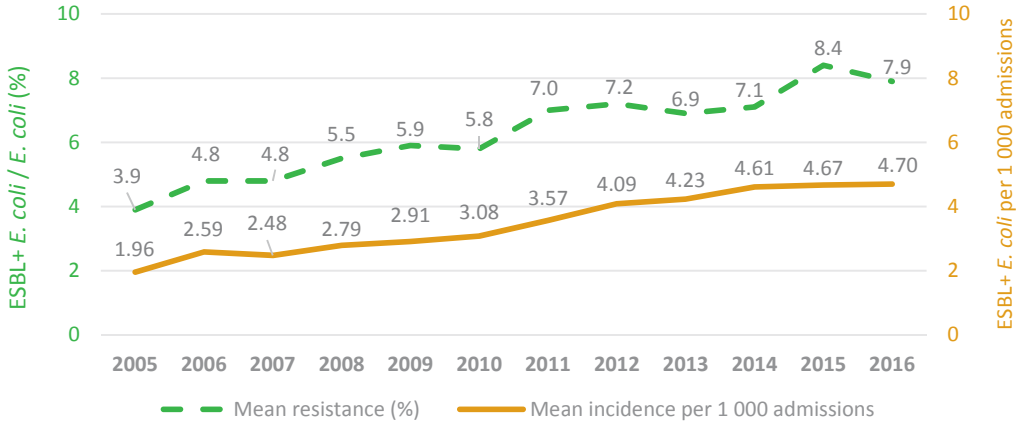
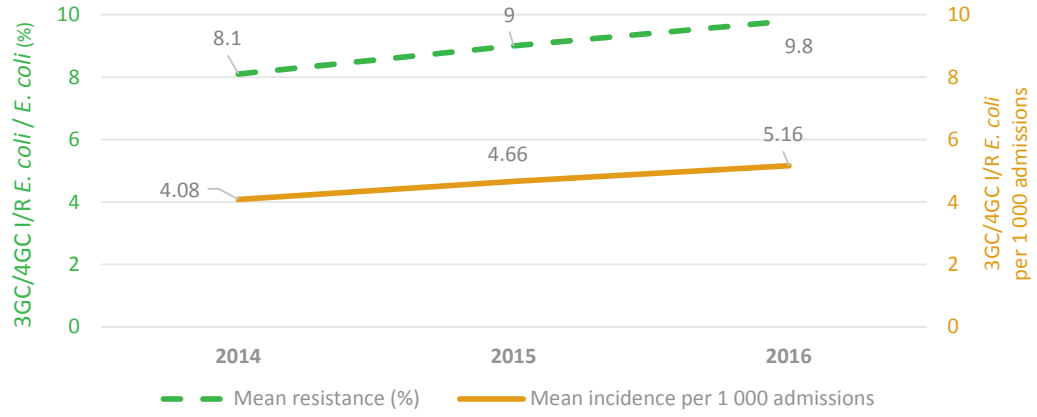


Figure 12. *Escherichia coli* with reduced susceptibility for 3th and/or 4th generation cephalosporins (clinical samples only): resistance proportion and incidence in a cohort of acute care hospitals with at least 3 years of participation in the surveillance, 2014-2016

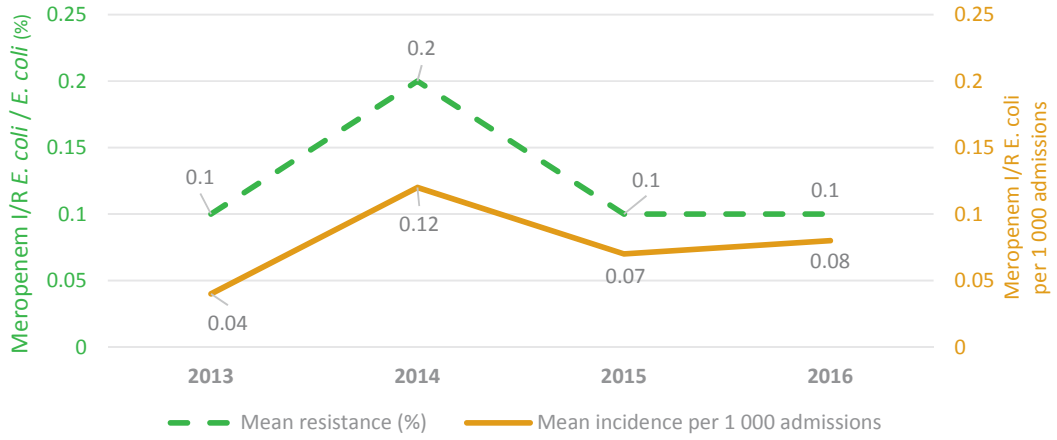


3GC/4GC = 3th or 4th generation cephalosporins, I/R = intermediate susceptibility or resistant

Figure 13 presents the evolution of the mean resistance proportion and incidence of meropenem I/R *E. coli* in a cohort of acute care hospitals that participated at least three times in the surveillance. In contrast to the numbers reported in Table 12b, both clinical samples and screening samples were taken into account. Prior to 2015 no distinction was made between these two types of samples. After a peak in 2014, both the mean resistance proportion and mean incidence of meropenem I/R *E. coli* decreased and stabilised between 2015 and 2016.

The mean CPE resistance proportion (under surveillance since 2015) increased from 0.03% in 2015 to 0.05% in 2016 in a cohort of hospitals participating in both surveillance years (n=71). The mean incidence also increased from 0.018 cases per 1 000 admissions in 2015 to 0.026 cases per 1 000 admissions in 2016.

Figure 13. *Escherichia coli* with reduced susceptibility for meropenem (clinical samples and screening samples): resistance proportion and incidence in a cohort of acute care hospitals with at least 3 years of participation in the surveillance, 2013-2016



I/R = intermediate susceptibility or resistant

1.3 RESISTANCE IN *KLEBSIELLA PNEUMONIAE*

The resistance proportion and incidence of EBSL+ and 3GC/4GC I/R *K. pneumoniae* and of CPE+ and meropenem I/R *K. pneumoniae* can be found in Table 13a and 13b, respectively.

The crude resistance proportion was 17.0% for ESBL+ *K. pneumoniae* (n=2 840/16 684), 20.2% for 3GC/4GC I/R *K. pneumoniae* (n=2 289/11 347), 1.4% for CPE+ *K. pneumoniae* (n=245/17 594) and 1.7% for meropenem I/R *K. pneumoniae* (n=314/18 838).

The median resistance proportion of ESBL+ *K. pneumoniae* was significantly lower in Flanders compared to Wallonia (p<0.001) and to Brussels (p=0.04). The median incidence was however only significantly different between Wallonia and Brussels (p=0.02).

Both the median resistance proportion and incidence of 3GC/4GC I/R *K. pneumoniae* were lower in Flanders compared to Wallonia (p=0.001 and p<0.001, respectively) and to Brussels (p=0.02 and p=0.03, respectively).

No statistically significant differences were seen between the regions with regard to the median resistance proportion and incidence of CPE+ and meropenem I/R *Klebsiella pneumoniae.*

Table 13a. Resistance proportion and incidence of *Klebsiella pneumoniae* (clinical samples only) by region: extended beta-lactamase production and reduced susceptibility for 3th and/or 4th generation cephalosporins, Belgian acute care hospitals, 2016

	ESBL+					3GC/4GC I/R				
	N hosp	Crude	Mean	Md	Min-max	N hosp	Crude	Mean	Md	Min-max
Proportion (%)										
Belgium	98	**17.0**	18.5	16.1	0.0-50.0	72	**20.2**	19.2	17.3	0.0-48.9
Flanders	45	**13.1**	14.2	12.6	3.2-50.0	39	**16.9**	15.3	14.0	0.0-38.2
Wallonia	38	**20.7**	23.4	23.6	0.0-48.3	21	**24.7**	25.3	23.0	2.6-48.9
Brussels	15	**19.0**	18.7	16.7	6.6-37.5	12	**20.8**	21.5	24.8	4.9-30.1
Incidence										
Belgium (per 1 000 pd)	99	**0.31**	0.36	0.27	0.00-1.54	73	**0.33**	0.35	0.25	0.00-1.50
Belgium (per 1 000 adm)	99	**2.11**	2.53	1.82	0.00-15.69	73	**2.14**	2.38	1.63	0.00-14.74
Flanders (per 1 000 adm)	45	**1.38**	1.51	1.13	0.14-7.75	39	**1.49**	1.52	1.09	0.00-7.34
Wallonia (per 1 000 adm)	39	**3.20**	3.82	3.07	0.00-15.69	22	**3.30**	3.75	2.40	0.38-14.74
Brussels (per 1 000 adm)	15	**2.24**	2.29	1.69	0.65-5.02	12	**2.71**	2.68	2.60	0.49-5.27

N = number, Md = median, min = minimum, max = maximum, pd = patient days, adm = admissions, ESBL+ = extended beta-lactamase production, 3GC/4GC = 3th or 4th generation cephalosporins, I/R = intermediate susceptibility or resistant

Table 13b. Resistance proportion and incidence of *Klebsiella pneumoniae* (clinical samples only) by region: carbapenemase production (CPE+) and reduced susceptibility for meropenem, Belgian acute care hospitals, 2016

	CPE+					Meropenem I/R				
	N hosp	Crude	Mean	Md	Min-max	N hosp	Crude	Mean	Md	Min-max
Proportion (%)										
Belgium	97	**1.4**	1.1	0.5	0.0-13.5	108	**1.7**	1.7	0.7	0.0-23.1
Flanders	48	**0.9**	0.8	0.0	0.0-4.2	55	**1.1**	1.1	0.6	0.0-5.2
Wallonia	37	**1.7**	1.4	0.6	0.0-13.5	43	**2.4**	2.5	0.5	0.0-23.1
Brussels	12	**2.4**	1.5	1.1	0.0-5.3	10	**1.1**	1.1	1.0	0.0-3.8
Incidence										
Belgium (per 1 000 pd)	98	**0.03**	0.02	0.01	0.00-0.29	109	**0.03**	0.04	0.01	0.00-0.60
Belgium (per 1 000 adm)	98	**0.17**	0.15	0.06	0.00-1.28	109	**0.20**	0.24	0.07	0.00-3.79
Flanders (per 1 000 adm)	48	**0.09**	0.09	0.00	0.00-0.50	55	**0.10**	0.11	0.06	0.00-0.84
Wallonia (per 1 000 adm)	38	**0.27**	0.20	0.11	0.00-1.28	44	**0.40**	0.41	0.10	0.00-3.79
Brussels (per 1 000 adm)	12	**0.29**	0.21	0.13	0.00-1.12	10	**0.13**	0.12	0.10	0.00-0.44

N = number, Md = median, min = minimum, max = maximum, pd = patient days, adm = admissions, CPE+ = carbapenemase production, I/R = intermediate susceptibility or resistant

Figure 14 shows the evolution of the mean resistance proportion and incidence of ESBL+ *K. pneumoniae* in a cohort of acute care hospitals that participated at least three years in the surveillance (2005-2016). Both indicators are steadily increasing since 2008. The same can be concluded for 3GC/4GC I/R *K. pneumonia*e, under surveillance since 2014 (Figure 15).

Figure 14. Extended spectrum beta-lactamase producing (ESBL+) *Klebsiella pneumoniae* (clinical samples only): resistance proportion and incidence in a cohort of acute care hospitals with at least 3 years of participation in the surveillance, 2005-2016

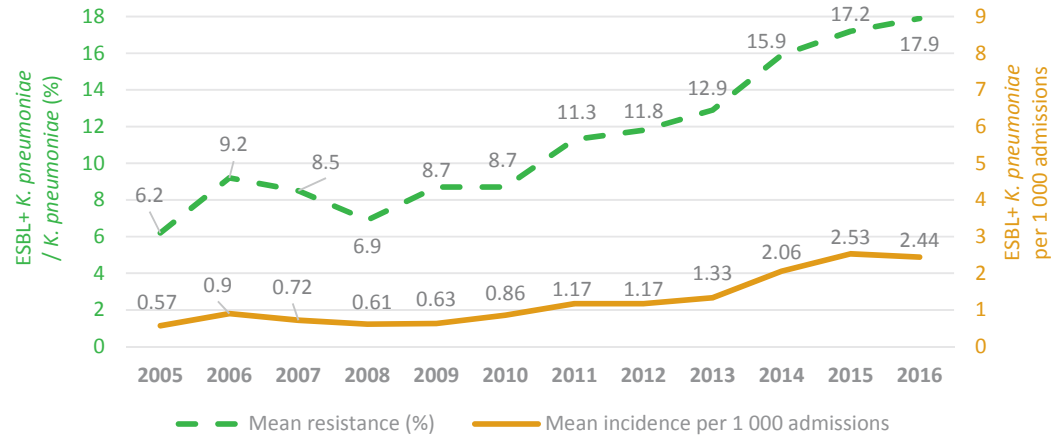
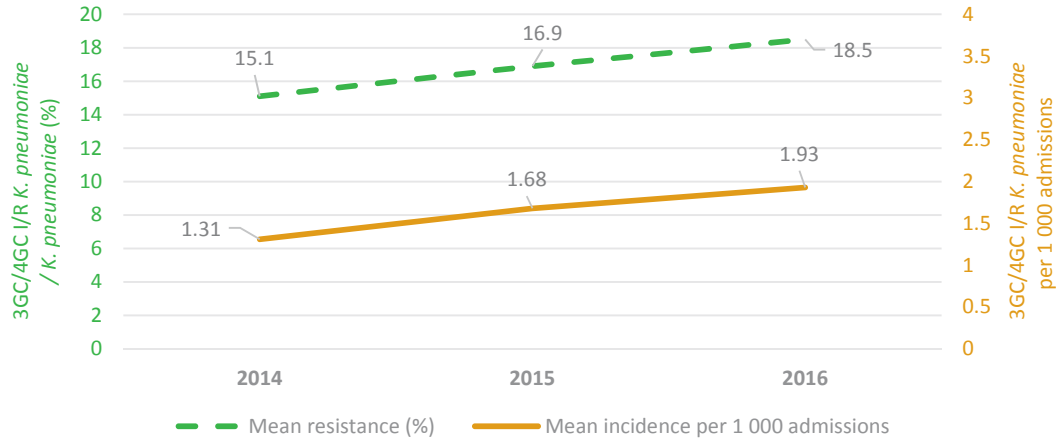


Figure 15. *Klebsiella pneumoniae* with reduced susceptibility for 3th and/or 4th generation cephalosporins (clinical samples only): resistance proportion and incidence in a cohort of acute care hospitals with at least 3 years of participation in the surveillance, 2014-2016

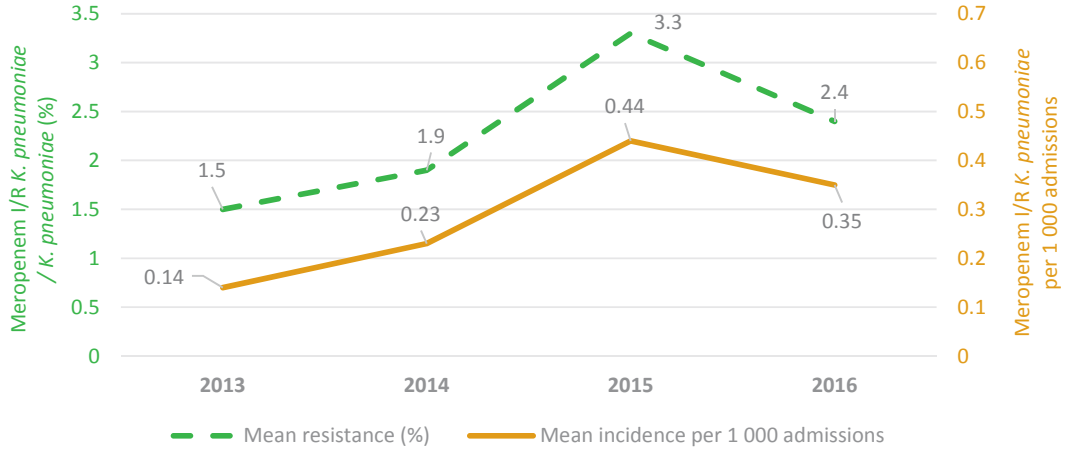


3GC/4GC = 3th or 4th generation cephalosporins, I/R = intermediate susceptibility or resistant

Similar to the evolution of meropenem I/R *E. coli,* Figure 16 presents the evolution of the mean resistance proportion and incidence of meropenem I/R *K. pneumoniae* taking into account both clinical samples and screening samples (no distinction between both prior to 2015). After an increase between 2013 and 2015 both the mean resistance proportion and mean incidence of meropenem I/R *K. pneumoniae* decreased.

The CPE resistance proportion of *K. pneumoniae* (under surveillance since 2015) remained stable: 1.13% in 2015 and 1.12% in 2016. The mean incidence also stayed at the same level, i.e. 0.15 cases per 1 000 admissions.

Figure 16. *Klebsiella pneumoniae* with reduced susceptibility for meropenem (clinical samples and screening samples): resistance proportion and incidence in a cohort of acute care hospitals with at least 3 years of participation in the surveillance, 2013-2016



I/R = intermediate susceptibility or resistant

1.4 RESISTANCE IN *ACINETOBACTER BAUMANNII*

Table 14 presents the 2016 resistance proportion and incidence of *A. baumannii* with a reduced susceptibility for meropenem. Twenty-nine hospitals (24.4%; n=29/119) reported a total of 61 meropenem I/R *A. baumannii*. The crude resistance proportion of meropenem I/R *A. baumannii* in clinical samples was 5.0% (n=61/1 212).
The median resistance proportion was higher in Brussels compared to Wallonia (p=0.05) and Flanders (p=0.02). The median incidence only significantly differed between Flanders and Brussels (p=0.02).

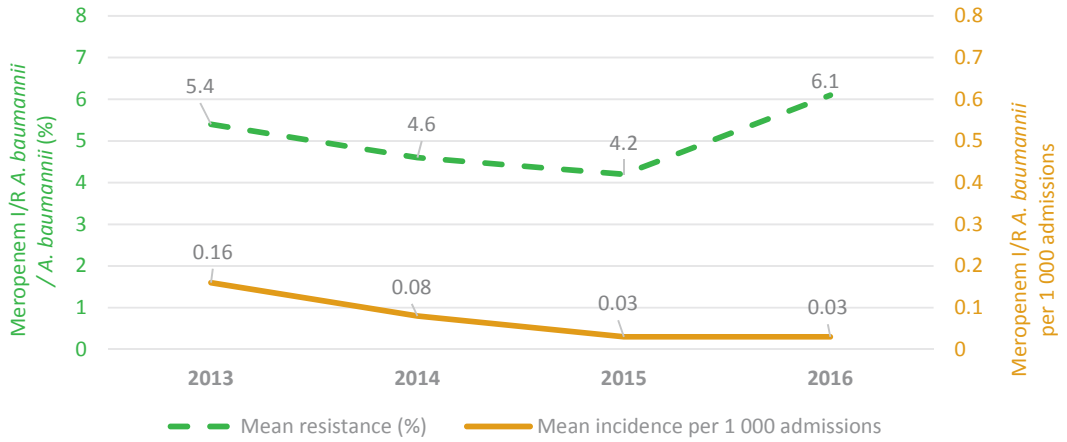
Table 14. Resistance proportion and incidence of *Acinetobacter baumannii* with reduced susceptibility for meropenem (clinical samples only) by region, Belgian acute care hospitals, 2016

	N hosp	Crude	Mean	Median	Min-max
Proportion (%)					
Belgium	119	**5.0**	5.7	0.0	0.0-100
Flanders	57	**3.4**	2.6	0.0	0.0-40.0
Wallonia	45	**4.7**	5.6	0.0	0.0-100
Brussels	17	**11.6**	16.2	5.3	0.0-100
Incidence					
Belgium (per 1 000 pd)	121	**0.005**	0.004	0.000	0.000-0.051
Belgium (per 1 000 adm)	121	**0.035**	0.029	0.000	0.000-0.363
Flanders (per 1 000 adm)	58	**0.024**	0.019	0.000	0.000-0.309
Wallonia (per 1 000 adm)	46	**0.031**	0.027	0.000	0.000-0.258
Brussels (per 1 000 adm)	17	**0.087**	0.070	0.033	0.000-0.363

N = number, min = minimum, max = maximum, pd = patient days, adm = admissions

Between 2013 and 2015 the mean resistance proportion of meropenem I/R *A. baumannii* decreased, but again increased between 2015 and 2016 when looking at a cohort of acute care hospitals that participated at least three times in the surveillance. The resistance proportion is now higher than at the start of this specific surveillance. The incidence per 1 000 admissions however remained stable between 2015 and 2016 (Figure 17).

Figure 17. *Acinetobacter baumannii* with reduced susceptibility for meropenem (clinical samples only): resistance proportion and incidence in a cohort of acute care hospitals with at least 3 years of participation in the surveillance, 2013-2016



I/R = intermediate susceptibility or resistant

1.5 RESISTANCE IN *PSEUDOMONAS AERUGINOSA*

Since 2012 a new definition for multidrug-resistant (MDR) *P. aeruginosa* is used (see methods). In total, 6.0% of all reported *P. aeruginosa* (n=1 312/22 065) were cases of MDR *P. aeruginosa* (clinical samples only).
The resistance proportion and incidence of MDR *P. aeruginosa* for Belgium and its three regions can be found in Table 15. The median resistance proportion did not differ significantly between regions. However, the median incidence per 1 000 admissions was lower in Flanders compared to Wallonia (p=0.04).

In a cohort of acute care hospitals that participated at least three years in the surveillance, the mean resistance proportion MDR *P. aeruginosa* remained more or less stable between 2013 and 2016. After an increase of the incidence per 1 000 admission between 2013 and 2014 the incidence continued to decrease (Figure 18).

Figure 18. Multidrug-resistant (MDR) *Pseudomonas aeruginosa* (clinical samples only): resistance proportion and incidence in a cohort of acute care hospitals with at least 3 years of participation in the surveillance, 2013-2016

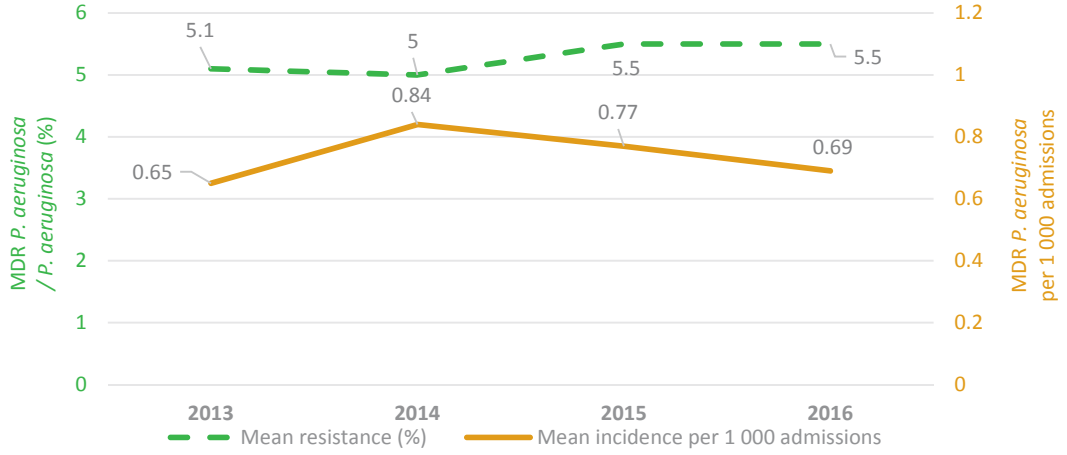


Table 15. Resistance proportion and incidence of multidrug-resistant (MDR) *Pseudomonas aeruginosa* (clinical samples only) by region, Belgian acute care hospitals, 2016

	N hosp	Crude	Mean	Median	Min-max
Proportion (%)					
Belgium	119	**6.0**	6.1	4.3	0.0-59.6
Flanders	58	**4.4**	4.9	4.0	0.0-17.8
Wallonia	45	**7.4**	7.7	5.3	0.0-59.6
Brussels	16	**7.6**	6.0	5.0	1.3-16.5
Incidence					
Belgium (per 1 000 pd)	120	**0.11**	0.12	0.06	0.00-1.04
Belgium (per 1 000 adm)	120	**0.75**	0.81	0.43	0.00-9.68
Flanders (per 1 000 adm)	58	**0.50**	0.54	0.38	0.00-3.65
Wallonia (per 1 000 adm)	46	**1.11**	1.19	0.61	0.00-9.68
Brussels (per 1 000 adm)	16	**0.95**	0.73	0.44	0.13-2.67

N = number, min = minimum, max = maximum, pd = patient days, adm = admissions

2. Resistant Gram-negative bacteria in chronic care hospitals

2.1 RESISTANCE IN *ENTEROBACTER CLOACAE*

Table 16 present the resistance proportion and incidence densitiy of ESBL+ and 3GC/4GC I/R *E. cloacae* in the participating chronic care hospitals overall and by region. The crude resistance proportion was 16.2% for ESBL+ *E. cloacae* (n=25/154) and 26.6% for 3GC/4GC I/R *E. cloacae* (n=38/143).

None of the participating chronic care hospitals reported a CPE+ *E. cloacae* in their clinical samples or screening samples. One meropenem I/R *E. cloacae* was reported by a Walloon chronic care hospital.

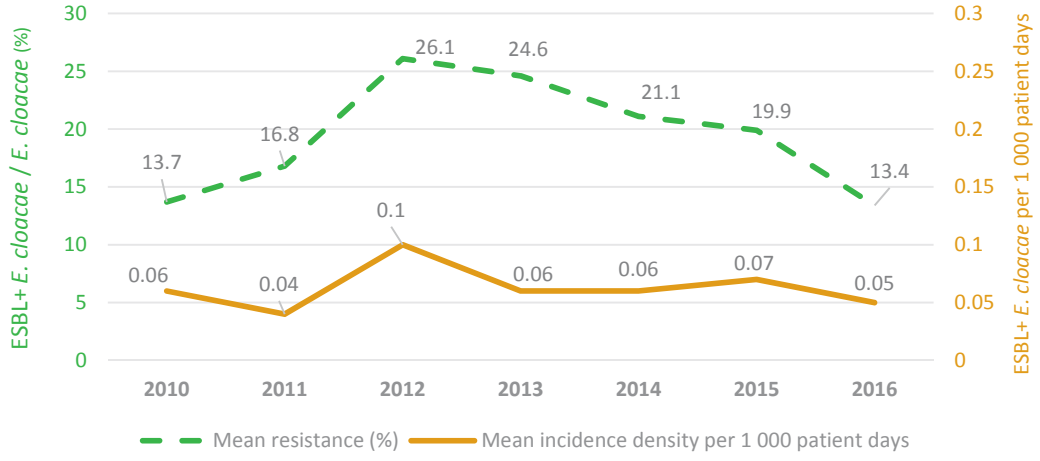
In a cohort of chronic care hospitals that participated at least three years in the surveillance the mean resistance proportion of ESBL+ *E. cloacae* increased between 2010 and 2012 to again decrease until more or less the same level as at the start of the surveillance (13.4% in 2016). The incidence density remained stable throughout the years, except for a small peak in 2012 (Figure 19).

Table 16. Resistance proportion and incidence density of *Enterobacter cloacae* (clinical samples and screening samples) by region: extended beta-lactamase production and reduced susceptibility for 3th and/or 4th generation cephalosporins, Belgian chronic care hospitals, 2016

	ESBL+					3GC/4GC I/R				
	N hosp	Crude	Mean	Md	Min-max	N hosp	Crude	Mean	Md	Min-max
Proportion (%)										
Belgium	13	**16.2**	13.4	9.1	0.0-40.0	12	**26.6**	28.7	24.3	0.0-100
Flanders	5	**19.4**	13.6	5.3	0.0-33.3	4	**29.5**	36.6	23.1	0.0-100
Wallonia	6	**13.6**	12.9	9.9	0.0-40.0	7	**24.5**	22.6	20.0	0.0-60.0
Brussels	2	**12.5**	14.5	14.5	9.1-20.0	1	**40.0**	40.0	40.0	40.0-40.0
Incidence density (per 1 000 patient days)										
Belgium	13	**0.04**	0.05	0.03	0.00-0.18	12	**0.07**	0.08	0.06	0.00-0.20
Flanders	5	**0.07**	0.07	0.02	0.00-0.18	4	**0.08**	0.09	0.09	0.00-0.18
Wallonia	6	**0.03**	0.03	0.03	0.00-0.09	7	**0.07**	0.08	0.07	0.00-0.20
Brussels	2	**0.03**	0.03	0.03	0.03-0.03	1	**0.06**	0.06	0.06	0.06-0.06

N = number, Md = median, min = minimum, max = maximum, ESBL+ = extended beta-lactamase production, 3GC/4GC = 3th or 4th generation cephalosporins, I/R = intermediate susceptibility or resistant

Figure 19. Extended spectrum beta-lactamase producing (ESBL+) *Enterobacter cloacae* (clinical samples and screening samples): resistance proportion and incidence density in a cohort of chronic care hospitals with at least 3 years of participation in the surveillance, 2010-2016



2.2 RESISTANCE IN *ESCHERICHIA COLI*

The resistance proportion and incidence density of EBSL+ and 3GC/4GC I/R *E. coli* and of CPE+ and meropenem I/R *E. coli* can be consulted in Table 17a and 17b, respectively.

The crude resistance proportion was 8.0% for ESBL+ *E. coli* (n=153/1 919), 11.3% for 3GC/4GC I/R *E. coli* (n=164/1 452), 0.11% for CPE+ *E. coli* (n=2/1 760) and 0.04% for meropenem I/R *E. coli* (n=1/2 273).

Table 17a. Resistance proportion and incidence density of *Escherichia coli* (clinical samples only) by region: extended beta-lactamase production and reduced susceptibility for 3th and/or 4th generation cephalosporins, Belgian chronic care hospitals, 2016

	ESBL+					3GC/4GC I/R				
	N hosp	Crude	Mean	Md	Min-max	N hosp	Crude	Mean	Md	Min-max
Proportion (%)										
Belgium	13	**8.0**	7.5	9.3	0.0-14.6	10	**11.3**	10.3	11.4	0.0-17.5
Flanders	5	**7.7**	6.8	7.5	1.5-11.5	4	**9.5**	10.0	8.9	4.7-17.5
Wallonia	6	**7.1**	6.7	6.9	0.0-14.6	5	**12.9**	10.2	13.0	0.0-14.6
Brussels	2	**11.5**	11.5	11.5	11.4-11.6	1	**11.6**	11.6	11.6	11.6-11.6
Incidence density per 1 000 patient days										
Belgium	13	**0.26**	0.27	0.26	0.00-0.64	10	**0.43**	0.39	0.39	0.00-0.79
Flanders	5	**0.34**	0.32	0.32	0.07-0.64	4	**0.39**	0.37	0.39	0.23-0.45
Wallonia	6	**0.18**	0.19	0.19	0.00-0.44	5	**0.50**	0.44	0.44	0.00-0.79
Brussels	2	**0.42**	0.41	0.41	0.23-0.58	1	**0.23**	0.23	0.23	0.23-0.23

N = number, Md = median, min = minimum, max = maximum, ESBL+ = extended beta-lactamase production, 3GC/4GC = 3th or 4th generation cephalosporins, I/R = intermediate susceptibility or resistant

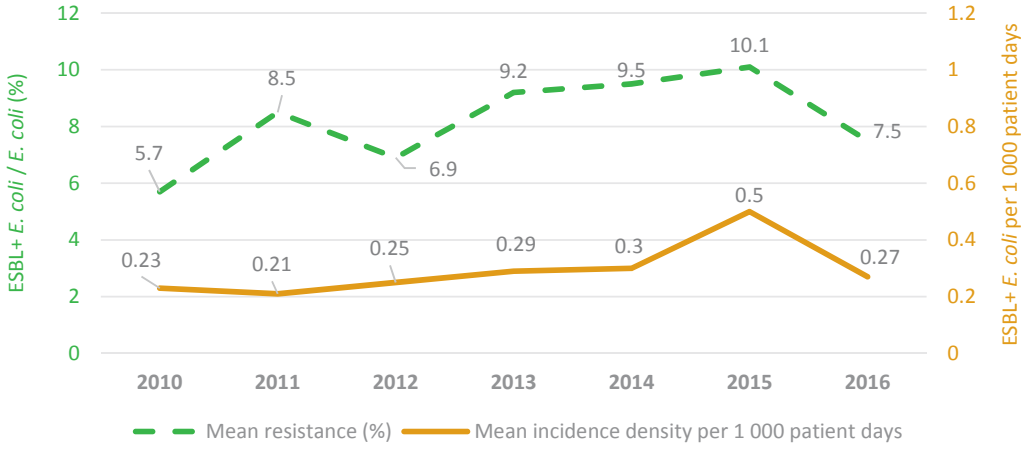
Table 17b. Resistance proportion and incidence density of *Escherichia coli* (clinical samples only) by region: carbapenemase production (CPE+) and reduced susceptibility for meropenem, Belgian chronic care hospitals, 2016

	CPE+					Meropenem I/R				
	N hosp	Crude	Mean	Md	Min-max	N hosp	Crude	Mean	Md	Min-max
Proportion (%)										
Belgium	12	**0.11**	0.08	0.00	0.00-1.00	14	**0.04**	0.03	0.00	0.00-0.36
Flanders	5	**0.00**	0.00	0.00	0.00-0.00	6	**0.00**	0.00	0.00	0.00-0.00
Wallonia	6	**0.00**	0.00	0.00	0.00-0.00	7	**0.09**	0.05	0.00	0.00-0.36
Brussels	1	**1.00**	1.00	1.00	1.00-1.00	1	**0.00**	0.00	0.00	0.00-0.00
Incidence density per 1 000 patient days										
Belgium	12	**0.004**	0.004	0.000	0.000-0.051	14	**0.000**	0.001	0.000	0.000-0.019
Flanders	5	**0.000**	0.000	0.000	0.000-0.000	6	**0.000**	0.000	0.000	0.000-0.000
Wallonia	6	**0.000**	0.000	0.000	0.000-0.000	7	**0.003**	0.003	0.000	0.000-0.019
Brussels	1	**0.051**	0.051	0.051	0.051-0.051	1	**0.000**	0.000	0.000	0.000-0.000

N = number, Md = median, min = minimum, max = maximum, CPE+ = carbapenemase production, I/R = intermediate susceptibility or resistant

Figure 20 shows the evolution of ESBL+ *E. coli* in a cohort of chronic care hospitals that participated at least three years in the surveillance. The resistance proportion has a fluctuating course, but decreased between 2015 and 2016. The incidence density remained stable throughout the years, except for a small peak in 2015.

Figure 20. Extended spectrum beta-lactamase producing (ESBL+) *Escherichia coli* (clinical samples only): resistance proportion and incidence density in a cohort of chronic care hospitals with at least 3 years of participation in the surveillance, 2010-2016



2.3 RESISTANCE IN *KLEBSIELLA PNEUMONIAE*

Table 18a and 18b show the resistance proportion and incidence density of the different resistance mechanisms in *K. pneumoniae* overall and by region.
The crude resistance proportion was 20.1% for ESBL+ *K. pneumoniae* (n=98/487), 37.4% for 3GC/4GC I/R *K. pneumoniae* (n=175/468), 1.8% for CPE+ *K. pneumoniae* (n=8/434) and 0.8% for meropenem I/R *K. pneumoniae* (n=5/631).

Table 18a. Resistance proportion and incidence density of *Klebsiella pneumoniae* (clinical samples only) by region: extended beta-lactamase production and reduced susceptibility for 3th and/or 4th generation cephalosporins, Belgian chronic care hospitals, 2016

	ESBL+					3GC/4GC I/R				
	N hosp	Crude	Mean	Md	Min-max	N hosp	Crude	Mean	Md	Min-max
Proportion (%)										
Belgium	13	**20.1**	19.9	17.6	0.0-34.8	10	**37.4**	26.9	30.3	0.0-66.7
Flanders	5	**18.3**	17.2	14.8	6.9-32.0	4	**22.0**	18.3	15.9	8.8-32.8
Wallonia	6	**19.3**	19.0	18.3	0.0-34.8	5	**44.4**	33.0	33.3	0.0-66.7
Brussels	2	**26.9**	29.2	29.2	23.6-34.8	1	**30.4**	30.4	30.4	30.4-30.4
Incidence density per 1 000 patient days										
Belgium	13	**0.17**	0.17	0.18	0.00-0.33	10	**0.46**	0.39	0.20	0.00-1.45
Flanders	5	**0.18**	0.16	0.17	0.07-0.25	4	**0.18**	0.16	0.10	0.07-0.38
Wallonia	6	**0.14**	0.15	0.18	0.00-0.32	5	**0.73**	0.61	0.32	0.00-1.45
Brussels	2	**0.28**	0.28	0.28	0.23-0.33	1	**0.20**	0.20	0.20	0.20-0.20

N = number, Md = median, min = minimum, max = maximum, ESBL+ = extended beta-lactamase production, 3GC/4GC = 3th or 4th generation cephalosporins, I/R = intermediate susceptibility or resistant

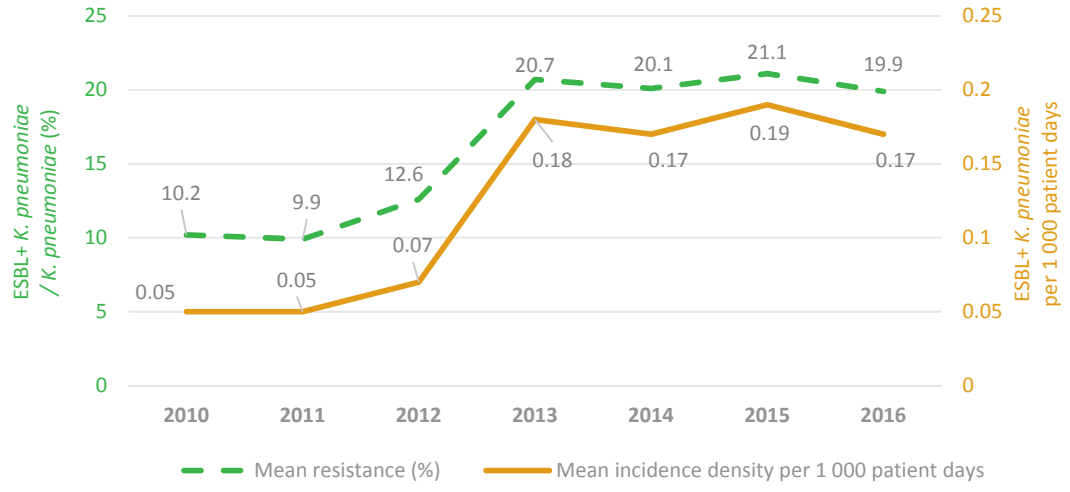
Table 18b. Resistance proportion and incidence density of *Klebsiella pneumoniae* (clinical samples only) by region: carbapenemase production (CPE+) and reduced susceptibility for meropenem, Belgian chronic care hospitals, 2016

	CPE+					Meropenem I/R				
	N hosp	Crude	Mean	Md	Min-max	N hosp	Crude	Mean	Md	Min-max
Proportion (%)										
Belgium	12	**1.8**	1.4	0.0	0.0-5.5	13	**0.8**	1.0	0.0	0.0-5.9
Flanders	5	**0.6**	0.3	0.0	0.0-1.6	6	**0.9**	1.3	0.0	0.0-5.9
Wallonia	6	**1.8**	1.6	1.0	0.0-4.3	7	**0.7**	0.7	0.0	0.0-3.0
Brussels	1	**5.5**	5.5	5.5	5.5-5.5	0	**-**	-	-	-
Incidence density per 1 000 patient days										
Belgium	12	**0.015**	0.016	0.000	0.000-0.076	13	**0.009**	0.010	0.000	0.000-0.046
Flanders	5	**0.005**	0.004	0.000	0.000-0.019	6	**0.008**	0.011	0.000	0.000-0.046
Wallonia	6	**0.013**	0.016	0.012	0.000-0.040	7	**0.009**	0.010	0.000	0.000-0.040
Brussels	1	**0.076**	0.076	0.076	0.076-0.076	0	**-**	-	-	-

N = number, Md = median, min = minimum, max = maximum, CPE+ = carbapenemase production, I/R = intermediate susceptibility or resistant

After a steady increase both the resistance proportion and incidence density of ESBL+ *K. pneumoniae* remain more less stable since 2013 when looking at a cohort of chronic care hospitals that participated at least three times in the surveillance (Figure 21).

Figure 21. Extended spectrum beta-lactamase producing (ESBL+) *Klebsiella pneumoniae* (clinical samples only): resistance proportion and incidence density in a cohort of chronic care hospitals with at least 3 years of participation in the surveillance, 2010-2016



2.4 RESISTANCE IN *ACINETOBACTER BAUMANNII*

Table 19 presents the resistance proportion and incidence density of meropenem I/R *A. baumannii* in chronic care hospitals. None of the participating hospitals in Flanders and Brussels reported a meropenem I/R *A. baumannii*. Three chronic care hospitals in Wallonia each reported one meropenem I/R *A. baumannii* (n=3/13). The crude resistance proportion was 11.1% overall (n=3/27).

Table 19. Resistance proportion and incidence of *Acinetobacter baumannii* with reduced susceptibility for meropenem (clinical samples only) by region, Belgian chronic care hospitals, 2016

	N hosp	Crude	Mean	Median	Min-max
Proportion (%)					
Belgium	16	**11.1**	10.1	0.0	0.0-100
Flanders	6	**0.0**	0.0	0.0	0.0-0.0
Wallonia	8	**23.1**	20.1	0.0	0.0-100
Brussels	2	**0.0**	0.0	0.0	0.0-0.0
Incidence density per 1 000 patient days					
Belgium	16	**0.004**	0.005	0.000	0.000-0.029
Flanders	6	**0.000**	0.000	0.000	0.000-0.000
Wallonia	8	**0.007**	0.009	0.000	0.000-0.029
Brussels	2	**0.000**	0.000	0.000	0.000-0.000

N = number, min = minimum, max = maximum, I/R = intermediate susceptibility or resistant

2.5 RESISTANCE IN *PSEUDOMONAS AERUGINOSA*

Details on the resistance proportion and incidence density of MDR *P. aeruginosa* overall and by region can be found in Table 20. In total, 12.2% of all reported *P. aeruginosa* were cases of MDR *P. aeruginosa* (n=94/764; clinical samples only). These cases were reported by nine hospitals (56.3%; n=9/16).

Table 20. Resistance proportion and incidence density of multidrug-resistant *Pseudomonas aeruginosa* (clinical samples only) by region, Belgian chronic care hospitals, 2016

	N hosp	Crude	Mean	Median	Min-max
Proportion (%)					
Belgium	16	**12.3**	8.7	3.5	0.0-48.3
Flanders	6	**21.2**	10.1	2.0	0.0-48.3
Wallonia	8	**6.4**	6.9	1.5	0.0-37.5
Brussels	2	**11.1**	11.7	11.7	9.1-14.3
Incidence density per 1 000 patient days					
Belgium	16	**0.13**	0.13	0.03	0.00-1.07
Flanders	6	**0.24**	0.21	0.04	0.00-1.07
Wallonia	8	**0.06**	0.09	0.01	0.00-0.36
Brussels	2	**0.11**	0.11	0.11	0.10-0.12

N = number, min = minimum, max = maximum, I/R = intermediate susceptibility or resistant

CONCLUSION

This report presents the 2016 results of three national surveillances of antimicrobial resistance, i.e. the surveillance of (1) MRSA, (2) MRGN and (3) vancomycin and linezolid resistant enterococci. Both acute and chronic care hospitals could participated. Acute care hospitals with a length of stay of ≥ 16 days were classified as chronic care hospitals.
Acute care hospitals mandatorily have to participate in the surveillance of MRSA and MRGN. Participation in the surveillance of resistant enterococci is optional. Data were collected retrospectively (past 12 months) and were aggregated at hospital level.
For the MRSA and MRGN surveillance data originating from acute and chronic care hospitals were presented separately, but were combined for the surveillance of resistant enterococci. The numbers and figures presented in this report for chronic care hospitals should be interpreted with caution as the number of participating chronic care hospitals is low.

The incidence of nosocomial MRSA continues to decrease in Belgian acute care hospitals. The median incidence dropped from 2.96 nosocomial cases per 1 000 hospital admissions in 2004 to 0.70 cases per 1 000 admissions in 2016, the lowest level since the start of the surveillance in 1994. The incidence density in chronic care hospitals remained stable over the last few years (0.14 nosocomial MRSA cases per 1 000 patient days in 2016).

Despite the optional character of the surveillance of resistant enterococci an increasing number of hospitals participate: from 46 hospitals in 2014 to 107 hospitals in 2016. Nevertheless, underreporting for these organisms is a possibility.
Given the recent character of the surveillance and the low number of reported resistant enterococci, it is too early to see clear trends in the evolution graphs of *E. faecium*. The mean incidence of vanco-R and linezolid-R *E. faecium* remains low: 0.140 and 0.009 cases per 1 000 admissions in 2016, respectively. These enterococci will however be carefully monitored over the next few years as frequent outbreaks with these resistant bacteria have been reported in both hospitals and nursing homes and because linezolid is increasingly being used.

The MRGN surveillance shows an unfavorable evolution in the incidence of resistant *Enterobacteriaceae*, especially in acute care hospitals. In a cohort of hospitals with at least three years of participation in the surveillance, the mean incidence of ESBL+ *E. coli* increased from 1.96 cases per 1 000 hospital admissions in 2005 to 4.70 cases per 1 000 admissions in 2016. For ESBL+ *K. pneumoniae* the incidence went from 0.57 cases per 1 000 admissions in 2005 to 2.44 cases per 1 000 admissions in 2016. In chronic care hospitals the mean incidence of ESBL+ *E. coli* and ESBL+ *K. pneumoniae* remained stable throughout the years: 0.27 and 0.17 cases per 1 000 patient days in 2016, respectively.
CPE resistance was added to the MRGN surveillance in 2015. Therefore, no clear trends in the evolution of this resistance mechanism can be seen. Between 2012 and 2015 CPE resistance in *Enterobacteriaceae* was monitored by an active surveillance program. Both private microbiological laboratories and hospital laboratories were invited to send any sample suspected with CPE to the national reference centre for resistant Gram-negative bacteria (CHU UCL Namur, Mont-Godinne) for confirmation of the CPE resistance mechanism and for identification of the underlying carbapenemase. This microbiological information was combined with epidemiological data (patient information). Each year the number of reported CPE cases increased. At the end of 2015, the active surveillance was stopped as most hospitals gained the expertise and capacity to diagnose CPE types themselves. Consequently, less CPE cases were notified through this surveillance programme leading to a decrease in data quality (for example much missing information). Details of the results of this active surveillance program can be found in the 2015 AMR report which is available online [1].

The mean incidence of meropenem I/R *A. baumannii* in acute care hospitals remained the same compared to 2015 (0.03 cases per 1 000 admissions in 2016), while for MDR *P. aeruginosa* it slowly decreased (0.69 cases per 1 000 admissions). In chronic care hospitals the mean incidence of meropenem I/R *A. baumannii* (0.005 cases per 1 000 patient days) was lower than the mean incidence of MDR *P. aeruginosa* (0.13 cases per 1 000 patient days).

CONCLUSION

Currently, the surveillance period of one year only allows to describe secular trends and evolution in time but it does not allow a fast estimation and follow-up of the burden of resistance in Belgium. In the future, with the transition of the surveillances to healthdata.be [2], a more automated data collection with faster feedback is envisioned. It should also provide an answer to the changing landscape of healthcare were hospitals are regrouping their activities and entities. Presently, hospitals either participate as one administrative hospital group or transmit data by hospital site.

This national surveillance of antimicrobial resistance is an important step in understanding the magnitude of multidrug resistant bacteria in Belgian hospitals, in identifying trends and in increasing awareness for this problem.

STANDPOINT OF THE GENERAL DIRECTORATE HEALTH CARE OF THE FPS HEALTH, FOOD CHAIN SAFETY AND ENVIRONMENT

At the end of this report on the national surveillances of multidrug-resistant organisms (MDRO) in hospitals, the General Directorate Health care of the Federal Public Service (FPS) Health, Food Chain Safety and Environment would like, first of all, to highlight the crucial roles played by the infection prevention and control (IPC) teams within the hospitals, the National Reference Centers (NRC) and Sciensano in the battle against these multiresistant germs.

The results presented in this report with regard to the carbapenem-resistant/carbapenemase producing *Enterobacteriaceae* (CRE/CPE) situation suggest an increasing trend of the problem. Other monitoring systems provide data supporting this appraisal. The national surveillance of bloodstream infections in Belgian hospitals indicates increasing trends of resistances to third-generation cephalosporins and to carbapenems in *Klebsiella pneumoniae* but not in other *Enterobacteriaceae* species [3]. *Klebsiella pneumoniae* is known to be an important pathogen in both community- and healthcare-associated infections and is prone to disseminate resistance genes and to cause outbreaks. Along the same line, a study assessing the CPE situation in Europe identified Belgium in 2015 as a country “with inter-regional spread of CPE”, which is the stage preceding an endemic situation [4]. Based on these findings, the European Center for Disease Prevention and Control (ECDC) formulated several advices for our health authorities in order to improve the containment of CRE and CPE [5].

In 2013, an inter-federal memorandum of understanding was signed following the increasing number of CRE/CPE cases detected within our health care system. This agreement enabled the set up of mechanisms addressing the emerging threat. These mechanisms included, among others, the creation of a Technical Committee on multidrug-resistant organisms (TC-MDRO) and of the Outbreak Support Team (OST), which is working in collaboration with the inspection services of the federated entities. The current legislation will establish within the Interministrial Conference on Public Health a working group dedicated to the control of antimicrobial resistance according to the ‘One Health’ approach. The FPS Health, Food Chain Safety and Environment will coordinate the activities of this working group.

In what follows, the General Directorate Health care would like to point out and highlight specific aspects of the fight against CRE/CPE in healthcare settings.

Strict compliance to hand hygiene measures is the first component of any proper multimodal infection prevention and control (IPC) strategy to combat antimicrobial resistance. It needs to be promoted and stimulated, without disruption, including through observing practices, monitoring and reporting results to the hospital staff. This substantive core task of health professionals must not be limited to periods when national campaign are organized but, under the leadership of the IPC teams, should also be extended beyond those biennial observation periods [6]. Obviously, additional elements of the standard precautions must be implemented systematically and in an adequate manner. Standard precautions will however not suffice for the containment of CRE/CPE.

In several recently published documents, both ECDC and the World Health Organization (WHO) stressed the importance of early recognition of CRE/CPE colonization and the improvement of detection capacities of medical microbiology laboratories [7,8].

Routine detection of CRE/CPE carriage must be improved in hospitals. The need for screening increases even further in epidemic situations or when the risk of transmission is high. In specific wards, such as intensive care units, the spread of CRE/CPE must be prevented and thus carefully monitored, according to the recommendations and conditions that international bodies have identified as risk factors associated with CRE/CPE colonization [9]. Additionally, the IPC team should determine which further criteria should be integrated in their screening policy, depending on their local epidemiological context.

In case of positive (screening or clinical) samples, laboratories should ensure a timely feedback to clinical teams and to IPC teams. In case of transfer to another health institution, adequate pieces of information including the patient's (MDRO) carrier status should be transmitted.

As far as the public health policies are concerned, identification and treatment of CRE and CPE are two of the challenges that will be addressed within the 'One Health' national action plan against antimicrobial resistance.

The General Directorate Health care emphasizes that for the sake of the patients and the deployment of appropriate containment measures, the correct determination of an outbreak situation is of utmost importance as is the notification of outbreaks to the competent health authorities.

The surveillance of CRE/CPE, of which the results are presented in the current report, does not collect all relevant parameters needed to give a clear picture of the situation of these pathogens in Belgium. The bodies that supervise surveillances of MDROs in Belgian hospitals have already agreed to review the current surveillance protocol and future reports in order to design tools that are more useful for hospitals, experts and policy-makers. In the meantime, each healthcare facility is encouraged to have a detailed local monitoring that includes epidemiological data on the characteristics of the patient and of the (current/previous) hospital stay. It should distinguish results of clinical samples from those of screenings on admission and from screenings carried out during the hospital stay which could highlight the occurrence of secondary CRE/CPE cases.

Health professionals leading the local antimicrobial stewardship policy groups within hospitals are expected to closely collaborate with their local laboratory and IPC teams. The Belgian Antibiotic Policy Coordination Commission (BAPCOC) provides free of charge an electronic version of a full set of therapeutic guidelines dedicated to hospital settings [10]. These guidelines were developed by the Belgian Society for Infectiology and Clinical Microbiology. Additionally, all Belgian hospitals should restrict prescription of last resort antimicrobials. Similarly, it is advised to change the way laboratories report results to clinicians by adopting a selective reporting of antibiotic susceptibility rather than reporting results in alphabetical order. This way, clinicians are supported and guided toward a correct antimicrobial choice.

Finally, the Superior Health Council will soon finalize the updated version of its recommendations on the prevention, control and treatment of MDRO in healthcare settings (9277) [11]. This document will provide hospital teams with a national reference for a comprehensive approach to tackle these pathogens.

STANDPUNT VAN HET DIRECTORAAT-GENERAAL GEZONDHEIDSZORG VAN DE FOD VOLKSGEZONDHEID, VEILIGHEID VAN DE VOEDSELKETEN EN LEEFMILIEU

Op het einde van dit rapport over de nationale surveillances van multidrug resistente organismen (MDRO's) in ziekenhuizen wenst het Directoraat-Generaal Gezondheidszorg van de Federale Overheidsdienst (FOD) Volksgezondheid, Veiligheid van de Voedselketen en Leefmilieu de cruciale rol die de teams voor ziekenhuishygiëne, de nationale referentiecentra (NRC) en Sciensano in de strijd tegen deze multiresistente kiemen hebben gespeeld, allereerst te belichten.

De resultaten met betrekking tot carbapenem resistente/carbapenemase producerende *Enterobacteriaceae* (CRE/CPE) in dit rapport suggeren een toename van het probleem. Gegevens afkomstige van andere monitoringsystemen ondersteunen deze veronderstelling. De nationale surveillance van bloedstroominfecties in Belgische ziekenhuizen toont een stijgende trend voor *Klebsiella pneumoniae* resistent tegen cefalosporines van de derde generatie en tegen carbapenems aan, maar niet voor andere *Enterobacteriaceae* [3]. *Klebsiella pneumoniae* is een belangrijke pathogeen die infecties in zowel zorginstellingen (zorginfecties) als in de gemeenschap kan veroorzaken. Bovendien kan deze bacterie resistentiegenen verspreiden en uitbraken veroorzaken. In dezelfde lijn ligt een studie die de CPE situatie in Europa onderzocht en daarbij België in 2015 zag als een land "met interregionale verspreiding van CPE", een situatie die één stap verwijderd is van een endemie [4]. Gebaseerd op deze bevindingen formuleerde het Europees Centrum voor Ziektepreventie en –bestrijding (ECDC) voor onze gezondheidsautoriteiten een aantal aanbevelingen voor de beheersing van CRE en CPE [5].

Naar aanleiding van het toenemende aantal CRE/CPE gevallen binnen onze gezondheidszorg werd in 2013 een interfederaal protocolakkoord getekend. Deze overeenkomst maakte het mogelijk om mechanismen in te stellen die de opkomende bedreiging, veroorzaakt door deze multiresistente bacteriën, kunnen aanpakken. Deze mechanismen omvatten onder meer de oprichting van een Technisch Comité voor multiresistente organismen (TC-MDRO) en van het 'Outbreak Support Team (OST)' dat samenwerkt met de inspectiediensten van de gefedereerde entiteiten. Binnen de Interministriële Conferentie Volksgezondheid zal de huidige legislatuur een werkgroep voor de beheersing van antimicrobiële resistentie volgens het 'One Health'-principe oprichten. De FOD Volksgezondheid, Veiligheid van de Voedselketen en Leefmilieu zal de activiteiten van deze werkgroep coördineren.

In wat volgt, wil het Directoraat-Generaal Gezondheidszorg graag enkele specifiek aspecten in de strijd tegen CRE/CPE in zorginstellingen toelichten en aanbevelen.

Strikte naleving van handhygiëne is de eerste maatregel van elke multimodale infectiepreventie en -controlestrategie ter bestrijding van antimicrobiële resistentie. Handhygiëne moet continue bevorderd en gestimuleerd worden en dit ook via observatie, monitoring en rapportering van de resultaten aan het ziekenhuispersoneel. Deze belangrijke basistaak van gezondheidsmedewerkers mag niet beperkt zijn tot periodes waarin nationale campagnes georganiseerd worden, maar moet, onder leiding van de infectiebeheersingteams, ook naast de tweejaarlijkse campagnes plaatsvinden [6]. Uiteraard moeten aanvulllend op de standaard voorzorgsmaatregelen bijkomende maatregelen systematisch en op een adequate manier geïmplementeerd worden. De standaard voorzorgsmaatregelen volstaan immers niet voor de beheersing van CRE/CPE.

In enkele recent gepubliceerde documenten beklemtonen ECDC en de Wereldgezondheidsorganisatie het belang van een tijdige detectie van kolonisatie met CRE/CPE en van een verbetering van de detectiecapaciteit van de medische microbiologische laboratoria [7,8].

Het routinematig detecteren van CRE/CPE dragerschap in ziekenhuizen moet verbeteren. De nood aan screening neemt bovendien toe in epidemische situaties of bij hoog risico op overdracht van deze kiemen. Op bepaalde afdelingen, zoals op intensieve zorgen, moet de verspreiding van CRE/CPE te allen tijde voorkomen en bijgevolg ook zorgvuldig gemonitord worden. Dit dient te gebeuren volgens de aanbevelingen en voorwaarden die internationale instanties geïdentificeerd hebben als risicofactoren voor CRE/CPE-kolonisatie [9]. Daarnaast moeten de teams voor ziekenhuishygiëne bepalen welke criteria bijkomend in hun screeningsbeleid opgenomen moeten worden, rekening houdend met hun eigen epidemiologische context.

In geval van positieve klinische stalen of screeningsstalen moeten laboratoria voor tijdige feedback aan de klinische teams en aan het team voor ziekenhuishygiëne zorgen. Bij transfer van patiënten naar andere zorginstellingen moeten voldoende gegevens, waaronder het MDRO-status van de patiënt, verstrekt worden.

Voor wat betreft het volksgezondheidsbeleid, zijn de identificatie en behandeling van CRE en CPE gevallen twee van de uitdagingen die in het nationale ‘One Health’ actieplan tegen antimicrobiële resistentie behandeld zullen worden.

Het Directoraat-Generaal wil benadrukken dat, in het belang van de patiënt en het inzetten van passende inperkingsmaatregelen, de juiste vaststelling van een uitbraak evenals de melding van deze uitbraken aan de bevoegde gezondheidsautoriteiten van het grootste belang zijn.

De surveillance van CRE/CPE, waarvan de resultaten in het huidige rapport worden gepresenteerd, verzamelt niet alle parameters die nodig zijn om een duidelijk beeld te krijgen van de situatie van deze pathogenen in België. De instanties die toezicht houden op de surveillances van MDRO’s in Belgische ziekenhuizen zijn daarom reeds overeengekomen om het huidige surveillanceprotocol alsook toekomstige rapporten te herzien teneinde hulpmiddelen te ontwerpen die voor ziekenhuizen, experts en beleidsmakers nuttiger zijn. In afwachting hiervan wordt elke zorginstelling aangemoedigd om een gedetailleerd lokaal surveillanceprogramma te hebben dat epidemiologische gegevens over de patiënt en zijn/haar (huidig/vorig) ziekenhuisverblijf verzameld. De lokale surveillance moet bovendien duidelijk de resultaten van klinische stalen kunnen onderscheiden van deze van screening bij opname of deze bemonsterd tijdens het verblijf in het ziekenhuis, wat het optreden van secundaire CRE/CPE gevallen kan benadrukken.

Van gezondheidswerkers die leiding geven aan de lokale antibioticabeleidsgroepen binnen de ziekenhuizen wordt verwacht dat zij nauw samenwerken met hun lokaal laboratorium en team voor ziekenhuishygiëne. De Belgische Commissie voor de Coördinatie van het Antibioticabeleid (BAPCOC) stelt een elektronische versie van de therapeutische richtlijnen voor ziekenhuizen gratis ter beschikking [10]. Deze richtlijnen werden ontwikkeld door de Belgische Vereniging voor Infectiologie en Klinische Microbiologie. Bovendien zouden alle Belgische ziekenhuizen maatregelen moeten nemen om het voorschrijven van “laatste lijn” antimicrobiële middelen in te perken. Evenzo wordt aan laboratoria geadviseerd om de manier waarop ze resultaten aan clinici rapporteren te wijzigen. Dit kan door het selectief rapporteren van de gevoeligheid van antibiotica in plaats van het rapporteren van alle resultaten in alfabetische volgorde. Op deze manier worden clinici ondersteund en begeleid in hun keuze van het juiste antimicrobieel middel.

Tenslotte zal de Hoge Gezondheidsraad binnenkort de bijgewerkte versie van zijn aanbevelingen inzake de preventie, beheersing en behandeling van MDRO in zorginstellingen (HGR 9277) finaliseren [11]. Dit document zal voor ziekenhuisteams een leidraad vormen voor een alomvattende aanpak van deze pathogenen.

POINT DE VUE DE LA DIRECTION GÉNÉRALE DES SOINS DE SANTÉ DU SPF SANTÉ PUBLIQUE, SÉCURITÉ DE LA CHAÎNE ALIMENTAIRE ET ENVIRONNEMENT

A la fin de ce rapport des surveillances nationales des organismes multi-résistants (MDRO) en milieu hospitalier, la Direction générale des Soins de santé du Service Public Fédéral (SPF) Santé publique, Sécurité de la Chaîne alimentaire et Environnement souhaite tout d'abord mettre en valeur les rôles cruciaux que jouent les équipes de prévention et de contrôle des infections (IPC) dans leurs hôpitaux, les centres nationaux de référence (NRC) et Sciensano dans la lutte contre ces bactéries multi-résistantes.

Les résultats relatifs à la situation des entérobactéries résistantes aux carbapénèmes (CRE) ou productrices de carbapénémases (CPE) suggèrent une tendance à l'aggravation de la problématique. D'autres systèmes de surveillance fournissent des données qui étayent cette appréciation. La surveillance nationale des septicémies dans les hôpitaux belges indique des tendances croissantes pour les résistances aux céphalosporines de 3e génération et aux carbapénèmes chez *Klebsiella pneumoniae*, mais pas chez d'autres espèces d'entérobactéries [3]. *Klebsiella pneumoniae* est connue pour être un pathogène considérable, tant au regard des infections acquises dans la communauté que de celles qui sont associées aux soins. Elle est prompte à disséminer des gènes de résistance et à causer des épidémies. Dans la même lignée, une étude évaluant la situation des CPE en Europe identifiait en 2015 la Belgique comme étant un pays où a lieu une « propagation inter-régionale des CPE », ce qui constitue le stade précédant une situation endémique [4]. Sur la base de ces constatations, le Centre européen de Prévention et de Contrôle des Maladies (ECDC) a formulé plusieurs avis à destination des autorités de la santé, en vue de mieux endiguer les CRE et les CPE [5].

En 2013, un protocole d'accord interfédéral avait été signé suite à la détection d'un nombre croissant de CRE/CPE au sein de notre système de santé. Cet accord a instauré un dispositif permettant de faire face à la menace émergente. Le dispositif repose notamment sur un comité technique relatif aux organismes multi-résistants (TC-MDRO) et sur une équipe de soutien en cas d'épidémie (Outbreak Support Team), œuvrant en collaboration avec les services d'inspection des entités fédérées. Dans le cadre de la conférence interministérielle santé publique, la législature actuelle va établir un groupe de travail dédié au contrôle des résistances aux agents antimicrobiens, selon l'approche « One Health ». Le SPF Santé publique, Sécurité de la Chaîne alimentaire et Environnement coordonnera les activités du groupe de travail.

Ci-dessous, la Direction générale des Soins de santé voudrait rappeler et souligner certains aspects particuliers de la lutte contre les CRE/CPE qui relèvent des établissements de soins de santé.

La stricte adhérence aux règles d'hygiène des mains est l'attitude première de toute stratégie multimodale visant à combattre l'antibiorésistance. Il convient encore et toujours de la promouvoir et de la stimuler sans interruption, notamment au moyen d'observations des pratiques, de suivi et de restitution des résultats au personnel hospitalier. Ce travail de fond des professionnels de la santé ne doit pas se limiter aux campagnes nationales mais, sous l'impulsion des équipes IPC, doit être prolongé au-delà de ces périodes d'intervention bisannuelles [6]. De toute évidence, les mesures qui, avec l'hygiène des mains, constituent les précautions standard doivent être mises en œuvre de façon systématique et adéquate. Mais les précautions standard ne permettent pas, à elles seules, de maîtriser les CRE/CPE.

POINT DE VUE DE LA DIRECTION GÉNÉRALE DES SOINS DE SANTÉ DU SPF SANTÉ PUBLIQUE, SÉCURITÉ DE LA CHAÎNE ALIMENTAIRE ET ENVIRONNEMENT

Dans plusieurs documents publiés récemment, tant l'ECDC que l'Organisation mondiale de la Santé (OMS) soulignent l'importance de la détection précoce du portage de CRE/CPE et le développement des capacités d'identification des laboratoires de microbiologie medicaux [7,8].

La détection en routine du portage des CRE/CPE doit donc être améliorée dans nos hôpitaux. La nécessité du dépistage augmente davantage encore dans les situations d'épidémie ou lorsque le risque de transmission est élevé. Dans certains services en particulier, tels que les soins intensifs, la propagation des CRE/CPE doit être prévenue et donc attentivement surveillée, en tenant compte des conditions que les instances internationales ont identifiées comme étant des facteurs de risque associés au portage de CRE/CPE [9]. Les équipes IPC détermineront en outre les critères complémentaires qui devront être intégrés dans leur stratégie de dépistage, en fonction du contexte épidémiologique local.

En cas de positivité des échantillons (de dépistage ou cliniques) les laboratoires doivent assurer un retour d'information rapide aux équipes cliniques et à l'équipe IPC. En cas de nécessité de transfert vers une autre institution de soins de santé, toutes les informations requises, ainsi que le statut de portage du patient doivent être transmises.

Quant à la politique nationale de santé, l'identification et la prise en charge des CRE et CPE sont deux des défis qui seront attentivement considérés dans le cadre de l'élaboration du nouveau plan d'action national « One Health » contre la résistance aux antimicrobiens.

La Direction générale des Soins de santé met en exergue le fait que pour la sécurité des patients et le déploiement des mesures de contrôle appropriées, il est capital de correctement déterminer les situations d'épidémie ainsi que de notifier les épidémies aux autorités de santé compétentes.

La surveillance des CRE/CPE, dont les résultats sont présentés dans ce rapport, ne collecte pas tous les paramètres nécessaires pour former une image précise de la situation de ces pathogènes en Belgique. Les organes qui encadrent les surveillances des MDRO dans les hôpitaux belges ont déjà convenu de revoir le protocole actuel de la surveillance ainsi que les prochains rapports sur les CRE/CPE, de manière à composer des outils qui soient plus utiles pour les hôpitaux, pour les experts et pour les décideurs politiques. D'ici là, chaque institution de soins de santé est encouragée à développer un suivi local détaillé, qui intègre les données épidémiologiques caractérisant le patient et le séjour hospitalier (actuel ou antérieur). Un tel suivi devrait faire la distinction entre les résultats issus d'échantillons cliniques, de dépistages à l'admission et de dépistages réalisés durant l'hospitalisation, ce qui pourrait mettre en évidence la survenue de cas secondaires de CRE/CPE.

Il est attendu des professionnels de la santé qui guident les groupes de gestion de l'antibiothérapie des hôpitaux qu'ils collaborent étroitement avec les équipes IPC et des laboratoires. La Commission de Coordination de la Politique antibiotique (BAPCOC) fournit gracieusement une version électronique de l'ensemble des recommandations de traitements anti-infectieux en milieu hospitalier [10]. Ces recommandations ont été élaborées par la Société belge d'Infectiologie et de Microbiologie clinique. Tous les hôpitaux belges devraient mettre en place des mesures restreignant la prescription des agents antimicrobiens utilisés en dernier recours thérapeutique. De même, il est conseillé de modifier la façon dont les laboratoires transmettent les résultats de leurs analyses aux cliniciens, en adoptant un mode de rapportage sélectif de la susceptibilité antibiotique, à la place d'une liste exhaustive des molécules testées suivant l'ordre alphabétique. Ainsi, les cliniciens seront soutenus et orientés vers le choix approprié d'un agent antimicrobien.

Enfin, le Conseil Supérieur de la Santé finalisera prochainement une version actualisée de ses recommandations en matière de prévention, maîtrise et prise en charge des patients porteurs de bactéries multi-résistantes aux antibiotiques dans les institutions de soins (CSS 9277) [11]. Ce document fournira aux équipes hospitalières une référence nationale pour une approche exhaustive du contrôle de ces pathogènes.

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