



3.6. Proportion MRSA and 3GC/4GC I/R *Escherichia coli* in acute care hospitals (QS-7, QS-8)

3.6.1. Documentation sheet

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| Description | Proportion of methicillin-resistant <i>Staphylococcus aureus</i> (MRSA) and proportion of <i>Escherichia coli</i> with reduced susceptibility to 3 rd or 4 th generation cephalosporins (3GC/4GC I/R <i>E. coli</i>) in acute care hospitals |
| Calculation | Numerator: Number of MRSA and 3GC/4GC I/R <i>E. coli</i> infections in acute care hospitals in the reporting period. Denominator: Number of <i>S. aureus</i> and <i>E. coli</i> infections in acute care hospitals in the reporting period. |
| Rationale | <p><i>Staphylococcus aureus</i> is an important cause of infections of the skin and mucosae, of postoperative wound infections, catheter infections, pneumonias, bacteraemia and infections of articulations.¹ Since its first description,² MRSA was a major source of nosocomial infections in European countries and abroad.</p> <p>Third-generation cephalosporins (3GC) are extended-spectrum antimicrobial agents useful in a variety of clinical situations. Their proven record of clinical efficacy, favourable pharmacokinetics, and low frequency of adverse effects make 3GC the preferred antibiotic in many clinical situations. Fourth-generation cephalosporins (4GC) have true broad-spectrum activity, and are also active against β-lactamase producing <i>Enterobacteriaceae</i> which may inactivate third-generation cephalosporins.</p> <p>Monitoring <i>S. aureus</i> (a skin bacterium) can inform about the effectiveness of infection prevention and control measures (including hand hygiene), while monitoring <i>E. coli</i> (a gut bacterium), additionally informs about antibiotic consumption.</p> <p>By Royal Decree, Belgian acute care hospitals mandatorily have to participate (at least one semester/year) in the surveillance of MRSA (since 2006) and multi-resistant Gram-negative bacteria (since 2015).³</p> <p>MRSA and 3GCR <i>E. coli</i> are considered by ECDC primary indicators of antimicrobial resistance in bacteria from humans.</p> |
| Primary data source | Sciensano, Service healthcare-associated infections & antimicrobial resistance (www.nsih.be) International comparisons are based on EARS-Net data (https://ecdc.europa.eu/en/about-us/partnerships-and-networks/disease-and-laboratory-networks/ears-net) |
| Source of results | National Surveillance of Infections in Hospitals: http://www.nsih.be/surv_mrsa/introduction_nl.asp Surveillance of antimicrobial resistant bacteria in Belgian hospitals: Report 2016 ⁴ Surveillance of antimicrobial resistance in Europe: Annual report of the European Antimicrobial Resistance Surveillance Network (EARS-Net) 2017 ⁵ |
| Technical definitions | <p>MRSA is defined as <i>Staphylococcus aureus</i> (<i>S. aureus</i>) resistant to methicillin/oxacillin.</p> <p>3GC/4GC I/R <i>E. coli</i> is defined as <i>Escherichia coli</i> (<i>E. coli</i>) resistant to 3rd and/or 4th generation cephalosporins (3GC/4GC I/R), and specifically as reduced susceptibility (intermediate susceptibility [I] or resistance [R]) to:</p> <ul style="list-style-type: none"> • cephalosporins of the 3rd generation (cefotaxime ceftriaxone, ceftazidime); and/or • 4th generation cephalosporins (cefepime), <p>according to EUCAST or CLSI criteria.</p> |



| | |
|------------------------------------|---|
| | <p>The resistance proportion (crude, mean, median, range [minimum - maximum]) 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 order to compare resistance and incidences across regions, Kruskal-Wallis tests were performed. Differences were considered significant if $p \leq 0.05$.</p> |
| International comparability | <p>The only source of information for international comparisons is the European Antimicrobial Resistance Surveillance Network (EARS-Net). EARS-Net is a program managed and coordinated by the European Centre for Disease Prevention and Control (ECDC), and is the largest publicly funded system for antimicrobial resistance surveillance in Europe.</p> <p>The results of EARS-Net should however be interpreted with caution:</p> <ul style="list-style-type: none">• EARS-Net only considers invasive isolates (from blood cultures, cerebrospinal fluid, and urine), while the national surveillance includes all isolates.• EARS-Net is a voluntary programme, and estimates are therefore not nationally representative for Belgium. Differences between countries concerning the coverage and participation, the quality of the lab results, and the frequency of sampling are also possible. The national surveillance on the other hand is mandatory and does yield nationally representative estimates for Belgium.• EARS-Net considers 3GCR <i>E. coli</i> only, while the national surveillance considers 3GC/4GC I/R <i>E. coli</i>. |
| Periodicity | Both the national surveillance and EARS-Net have an annual periodicity. |
| Dimensions | Quality (safety) |
| Related indicators | Post-operative sepsis; Prevalence of healthcare-associated infections in acute care hospitals; Incidence of MRSA in nursing homes |



3.6.2. Results

Background

The service “Healthcare-associated infections and antimicrobial resistance” of Sciensano (previously known as the Belgian Scientific Institute of Public Health; WIV-ISP) closely monitors 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. By the end of the 1990s, resistance in a wide range of Gram-negative bacteria started to escalate. In 2005, the surveillance program was therefore extended to also include resistance in *Escherichia coli* and several other Gram-negative bacteria.

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 multi-resistant Gram-negative bacteria (since 2015).

Proportion of methicillin-resistant *Staphylococcus aureus*

In 2016, 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 16.

Table 16 – Resistance in *Staphylococcus aureus*: proportion of methicillin resistant *S. aureus* (MRSA) on the total number of reported *S. aureus* isolates by region, Belgian acute care hospitals, 2016

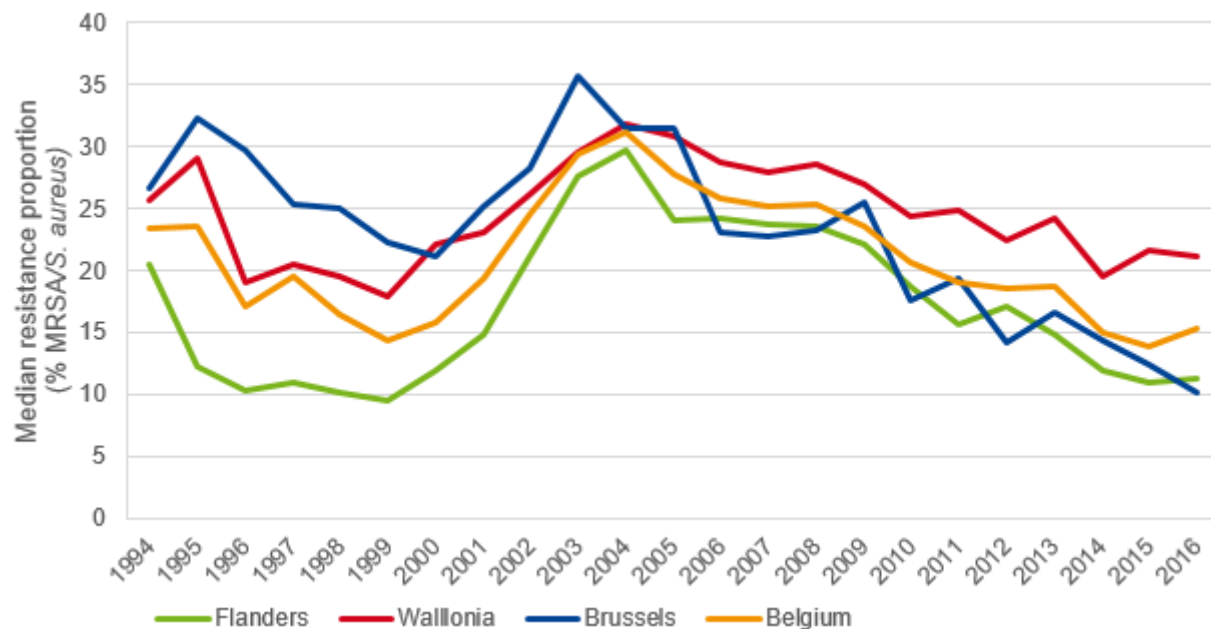
| | Number of participating hospitals | Proportion MRSA / <i>S. aureus</i> (%) | | | |
|-----------------|-----------------------------------|--|------|--------|----------|
| | | Crude | Mean | Median | Range |
| Belgium | 122 | 15.4 | 15.7 | 15.0 | 0.0-42.9 |
| Flanders | 60 | 12.3 | 12.1 | 10.9 | 1.3-32.1 |
| Wallonia | 45 | 21.5 | 21.4 | 21.2 | 0.0-42.9 |
| Brussels | 17 | 12.5 | 13.3 | 10.3 | 5.4-34.9 |

The overall median MRSA resistance proportion in a cohort of acute care hospitals with at least 5 participations between 1994 and 2016 peaked in 2004, and has shown an overall steady decrease afterwards. Between 2015 and 2016, however, it slightly increased (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 46).



Figure 46 – 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



Source: Latour et al., 2018⁴

Proportion of nosocomial methicillin-resistant *Staphylococcus aureus*

In total, 121 acute care hospitals reported 1554 clinical samples and 1560 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 differences between the proportions in the different regions (Table 17).



Table 17 – Resistance in nosocomial *Staphylococcus aureus*: proportion of methicillin resistant *S. aureus* (MRSA) on the total number of reported nosocomial *S. aureus* isolates by region, Belgian acute care hospitals, 2016

| | Number of participating hospitals | Proportion nosocomial MRSA / <i>S. aureus</i> (%) | | | |
|-----------------|-----------------------------------|---|-------------|---------------|--------------|
| | | <i>Crude</i> | <i>Mean</i> | <i>Median</i> | <i>Range</i> |
| Belgium | 121 | 26.3 | 30.4 | 27.3 | 0.0-100 |
| Flanders | 58 | 28.3 | 32.4 | 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 |

Proportion of 3GC/4GC I/R *Escherichia coli*

In 2016, the crude overall resistance proportion for 3GC/4GC I/R *E. coli* was 4.0% (n=5457/138,083) (Table 18). Large differences between the overall crude and median resistance proportion of 3GC/4GC I/R *E. coli* in acute care hospitals (clinical samples only) were seen in Brussels and therefore also overall. No statistically significant differences in median resistance proportion were observed between the regions.

Table 18 – Resistance proportion of *Escherichia coli* (clinical samples only) by region: reduced susceptibility for 3th and/or 4th generation cephalosporins, Belgian acute care hospitals, 2016

| | Number of participating hospitals | Proportion 3GC/4GC I/R (%) | | | |
|-----------------|-----------------------------------|----------------------------|-------------|---------------|--------------|
| | | <i>Crude</i> | <i>Mean</i> | <i>Median</i> | <i>Range</i> |
| Belgium | 73 | 4.0 | 9.1 | 9.1 | 0.1-18.1 |
| Flanders | 40 | 9.3 | 8.7 | 8.1 | 1.6-16.1 |
| Wallonia | 21 | 8.7 | 8.8 | 9.3 | 1.3-14.5 |
| Brussels | 12 | 0.9 | 10.7 | 10.9 | 0.1-18.1 |



In a cohort of acute care hospitals that participated at least three years in the surveillance the mean resistance proportion of 3GC/4GC I/R *E. coli* augmented from 8.1% in 2014 over 9.0% in 2015 to 9.8% in 2016.

International comparisons

The European Antimicrobial Resistance Surveillance Network (EARS-Net) is the main EU surveillance system for AMR in bacteria that cause serious infections. Data reported from the network serve as important indicators on the occurrence and spread of AMR in Europe. All 28 EU Member States and two EEA countries (Iceland and Norway) participate in EARS-Net. The vast majority of the countries regularly report data for all bacteria and antimicrobial groups under surveillance. The number of participating laboratories continuously increased since the initiation of the network, indicating a strengthening of national AMR surveillance systems in the EU/EEA. The widespread and continuing implementation of European Committee on Antimicrobial Susceptibility Testing (EUCAST) guidelines for antibacterial susceptibility testing in Europe, and the high proportion of laboratories that participate in the annual EARS-Net external quality

assessment (EQA) exercise, contribute to improved data quality and an increasing ability of EU/EEA countries to report comparable AMR data.

The results of EARS-Net should however be interpreted with caution:

- EARS-Net only considers invasive isolates (from blood cultures, cerebrospinal fluid, and urine), while the national surveillance includes all isolates.
- EARS-Net is a voluntary program, and estimates are therefore not nationally representative for Belgium. Differences between countries concerning the coverage and participation, the quality of the lab results, and the frequency of sampling are also possible. The national surveillance on the other hand is mandatory and does yield nationally representative estimates for Belgium.
- EARS-Net considers 3GCR *E. coli* only, while the national surveillance considers 3GC/4GC I/R *E. coli*.

Based on the EARS-Net data, the resistance proportion of both MRSA and 3GC *E. coli* in Belgium has an intermediate position across EU-15 countries (Figure 47).



Figure 47 – International comparison of the percentage of invasive *S. aureus* isolates with resistance to methicillin and the percentage of invasive *E. coli* isolates with resistance to third-generation cephalosporins, 2012-2017

Figure 7. *Staphylococcus aureus*: percentage of invasive isolates with resistance to methicillin (MRSA), EU/EEA, 2012 (left), 2015 (right)

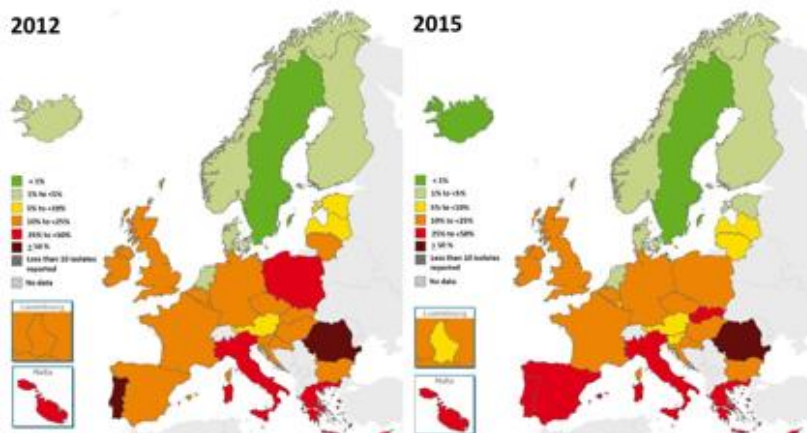


Figure 3-25. *Staphylococcus aureus*. Percentage (%) of invasive isolates with resistance to methicillin (MRSA), by country, EU/EEA countries, 2017

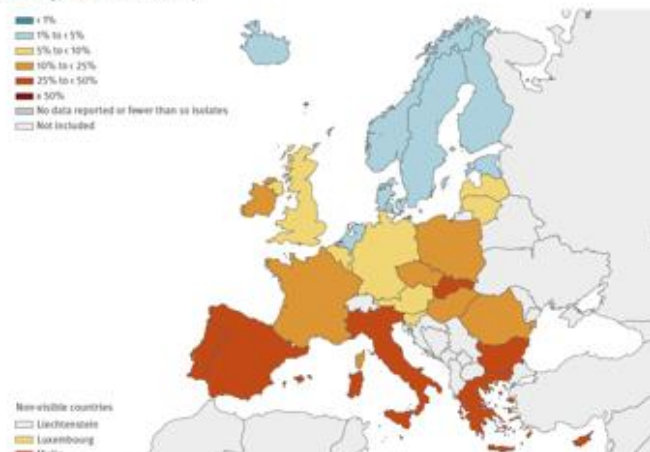


Figure 4. *Escherichia coli*: percentage of invasive isolates with resistance to third-generation cephalosporins, EU/EEA, 2012 (left), 2015 (right)

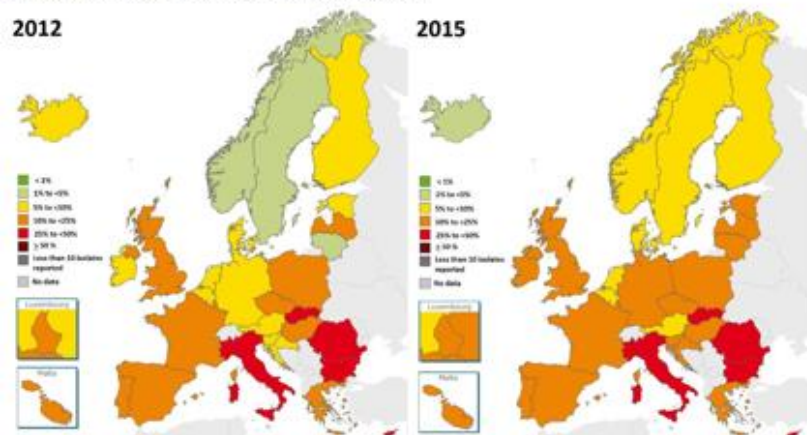
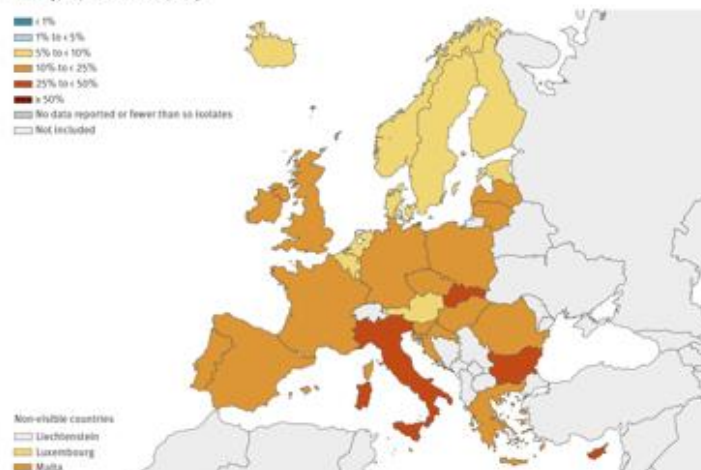


Figure 3.3. *Escherichia coli*. Percentage (%) of invasive isolates with resistance to third-generation cephalosporins, by country, EU/EEA countries, 2017



Source: EARS-Net⁵



Key points

- In 2016, the median MRSA proportion in Belgian acute care hospitals was 15.0%. The resistance proportion was significantly higher in the Walloon Region compared to the other two regions.
- The median resistance proportion of MRSA in Belgium has been decreasing since 2004.
- In 2016, the median 3GC/4GC I/R *E. coli* proportion in Belgian acute care hospitals was 9.1%. No statistically significant differences in median resistance proportion were observed between the regions.
- The mean resistance proportion of 3GC/4GC I/R *E. coli* augmented from 8.1% in 2014 over 9.0% in 2015 to 9.8% in 2016.
- Based on EARS-Net data, which include invasive isolates only, the resistance proportion of both MRSA and 3GC *E. coli* in Belgium has an intermediate position across EU-15 countries.

References

1. Superior Health Council. Richtlijnen voor de beheersing en preventie van overdracht van methicilline-resistente *Staphylococcus aureus* (MRSA) in Belgische ziekenhuizen. 2005.
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5. European Centre for Disease Prevention and Control. Surveillance of antimicrobial resistance in Europe – Annual report of the European Antimicrobial Resistance Surveillance Network (EARS-Net) 2017. Stockholm: ECDC; 2018.