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Frequency of Occurrence and Antimicrobial Susceptibility of Bacteria Isolated from Patients Hospitalised with Bacterial Pneumonia in Western Europe and Eastern Europe: Results from the SENTRY Program (2018–2020)

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SENTRY ANTIMICROBIAL SURVEILLANCE

Introduction

- The SENTRY Antimicrobial Surveillance Program (SENTRY) monitors the frequency of occurrence and antimicrobial susceptibility of organisms from various infection types worldwide.
- Bacterial isolates are consecutively collected according to the infection type and sent to a central monitoring laboratory where they are tested for susceptibility.
- In this study, we evaluated the frequency and antimicrobial susceptibility patterns of pathogens collected by the SENTRY Program from patients hospitalized with bacterial pneumonia in Europe during 2018–2020.

Materials and Methods

Organism collection

- A total of 7,931 bacterial isolates were consecutively collected (1/patient) from 37 medical centres located in Western Europe (W-EU) and the Eastern Europe and Mediterranean region (designated here as E-EU), as follows:
  - W-EU: 5,787 isolates from 24 centres located in 10 countries, including: Belgium, France, Germany, Ireland, Italy, Portugal, Spain, Sweden, Switzerland, and the United Kingdom.
  - E-EU: 2,144 isolates from 13 centres located in 10 countries, including: Belarus, the Czech Republic, Greece, Hungary, Israel, Poland, Romania, Russia, Slovenia, and Turkey.
- Each participating centre was asked to collect consecutive bacterial isolates from lower respiratory tract specimens determined to be significant by local criteria as the reported probable cause of pneumonia.
- Qualified sputum samples and isolates from invasive sampling, such as transtracheal aspiration, bronchoalveolar lavage, and protected brush samples were accepted.
- Carbapenem-resistant *Enterobacterales* (CRE) were defined as any isolate displaying MIC values of >2 mg/L for meropenem or imipenem.
  - Imipenem was not applied for *Proteus mirabilis* or indole-positive Proteeae.

Susceptibility methods

- Organisms were tested for susceptibility by reference broth microdilution methods at JMI Laboratories.
- MIC panels were prepared at JMI Laboratories and broth microdilution tests were conducted according to the current Clinical and Laboratory Standards Institute (CLSI) documents.
- Susceptibility percentages and quality control validation were based on CLSI (M100) 2021 criteria.

Results

- The occurrence frequency of organisms in W-EU and E-EU is presented in Figure 1.
- Gram-negative bacilli represented 75.9% and 86.3% of organisms in W-EU and E-EU, respectively.
  - Non-fermentative (NF) GNB represented 26.3% and 48.6% of organisms in W-EU and E-EU, respectively (data not shown).
- The antimicrobial susceptibility of main organisms stratified by geographic region is shown in Table 1.
- Methicillin-resistant *Staphylococcus aureus* (MRSA) rates ranged from 30.7% in E-EU to 17.7% in W-EU, but varied over time in both regions (Table 1 and Figures 2, 3, and 4).
- Among Gram-negatives, susceptibility rates were generally lower in E-EU compared to W-EU (Table 1 and Figure 2).
- *P. aeruginosa* susceptibility to ceftazidime-avibactam and ceftolozane-tazobactam was 97.1% and 94.5% in W-EU and 87.9% and 84.5% in E-EU, respectively (Table 1 and Figure 2).
- Piperacillin-tazobactam and meropenem exhibited limited activity against *P. aeruginosa* from E-EU, with susceptibility rates of 60.0% and 53.3%, respectively (Table 1 and Figure 2).
- Only 12.1% of *A. baumannii* isolates from E-EU were meropenem-susceptible (Table 1 and Figure 2).
- The frequency of CRE, ceftazidime-avibactam-nonsusceptible CRE, and meropenem-nonsusceptible *K. pneumoniae* were markedly higher in E-EU compared to W-EU (Figure 2).
- Resistance rates among *A. baumannii* were also higher in E-EU than W-EU, while *S. maltophilia* susceptibility did not vary substantially between W-EU and E-EU (Table 1 and Figure 2).
- The yearly rates of some resistance phenotypes are presented in Figures 3 and 4.

Table 1. Antimicrobial susceptibility of main organisms isolated from patients hospitalized with pneumonia from Western Europe (W-EU) and Eastern Europe (E-EU)

Organism/Antimicrobial agent	% Susceptible (no. of isolates)[a] W-EU	E-EU
S. aureus	(1,196)	(238)
Oxacillin	82.3	69.3
Ceftaroline	97.2	93.7
Clindamycin	94.8	89.5
Doxycycline	99.2	99.2
Erythromycin	62.3	61.3
Levofloxacin	83.4	85.7
Linezolid	100.0	100.0
Minocycline	99.5	99.6
Tigecycline	100.0	100.0
TMP- SMX[b]	99.5	98.7
Vancomycin	100.0	100.0
P. aeruginosa	(1,183)	(570)
Ceftazidime	79.5	66.0
Ceftazidime-avibactam	97.1	87.9
Ceftolozane-tazobactam	94.5	84.5
Piperacillin-tazobactam	76.4	60.0
Meropenem	77.8	53.3
Levofloxacin	68.7	46.0
Tobramycin	91.5	73.2
K. pneumoniae	(512)	(409)
Ceftriaxone	72.1	35.7
Ceftazidime	72.9	36.9
Cefepime	73.4	37.4
Ceftazidime-avibactam	99.4	90.4
Ceftolozane-tazobactam	90.0	56.4
Piperacillin-tazobactam	81.4	46.1
Meropenem	92.0	70.6
Levofloxacin	74.6	38.1
Gentamicin	84.8	59.7
Amikacin	98.0	79.7
E. coli	(752)	(137)
Ceftriaxone	79.9	69.3
Ceftazidime	85.2	76.6
Cefepime	81.4	69.3
Ceftazidime-avibactam	99.7	100.0
Ceftolozane-tazobactam	98.7	98.5
Piperacillin-tazobactam	87.0	95.6
Meropenem	99.7	99.3
Levofloxacin	72.7	66.4
Gentamicin	89.6	85.4
Amikacin	99.3	99.3
E. cloacae species complex	(337)	(75)
Ceftriaxone	66.8	54.1
Ceftazidime	61.4	56.0
Cefepime	89.0	77.3
Ceftazidime-avibactam	99.4	97.3
Ceftolozane-tazobactam	77.3	74.7
Piperacillin-tazobactam	73.5	73.3
Meropenem	99.1	94.7
Levofloxacin	91.6	84.0
Gentamicin	95.5	82.7
Amikacin	99.7	94.7
A. baumannii	(114)	(331)
Ceftazidime	61.7	9.4
Cefepime	56.1	10.6
Piperacillin-tazobactam	52.2	8.5
Meropenem	60.9	12.1
Levofloxacin	60.9	8.5
Minocycline	72.2	43.8
Gentamicin	61.7	22.7
Tobramycin	68.7	33.8
Amikacin	73.9	19.6
Colistin	100.0	77.9
S. maltophilia	(156)	(105)
Ceftazidime	13.5	14.3
Levofloxacin	85.9	81.9
Minocycline	100.0	99.0
TMP-SMX[b]	96.1	95.1

[a] Criteria as published by CLSI (2021).
[b] TMP-SMX, trimethoprim-sulfamethoxazole.

Figure 1. Frequency of occurrence of organisms isolated from patients hospitalized with pneumonia in Western Europe (1.A) and Eastern Europe (1.B)

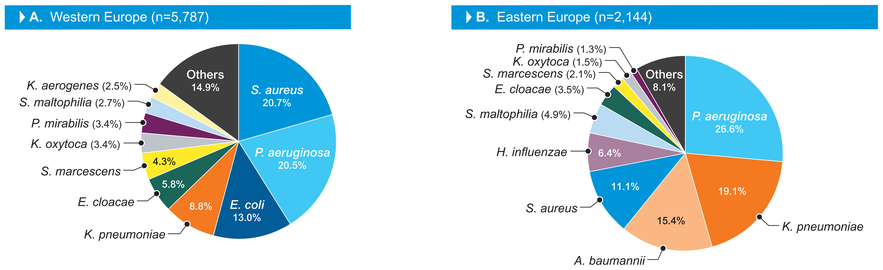
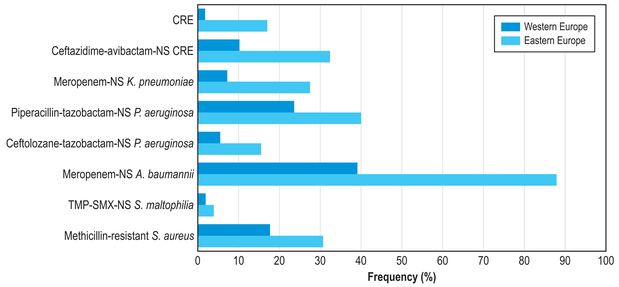
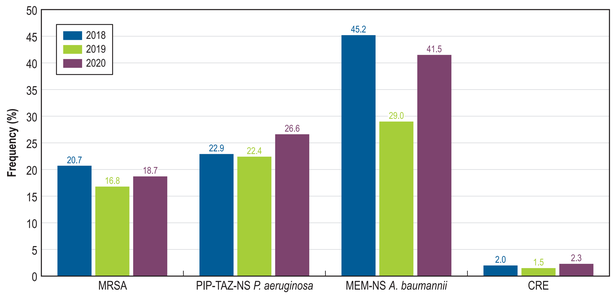


Figure 2. Frequency of key resistance phenotypes among organisms isolated from patients hospitalized with pneumonia stratified by geographic region (2018–2020)



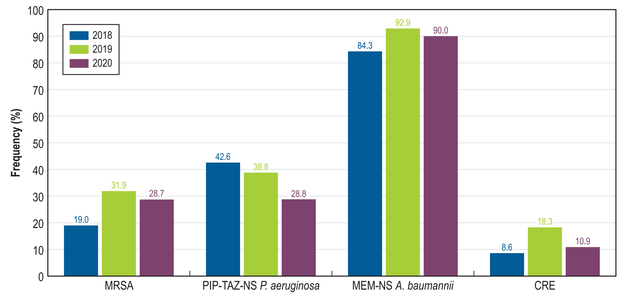
Abbreviations: CRE, carbapenem-resistant *Enterobacterales*; NS, nonsusceptible; TMP-SMX, trimethoprim-sulfamethoxazole.

Figure 3. Yearly rates of selected resistance phenotypes in Western Europe



Isolates from Belarus, Israel, Russia, and Switzerland were excluded from this analysis because these countries did not contribute isolates every year.
Abbreviations: MRSA, methicillin-resistant *S. aureus*; PIP-TAZ, piperacillin-tazobactam; NS, nonsusceptible; MEM, meropenem; CRE, carbapenem-resistant *Enterobacterales*

Figure 4. Yearly rates of selected resistance phenotypes in Eastern Europe



Isolates from Belarus, Israel, Russia, and Switzerland were excluded from this analysis because these countries did not contribute isolates every year.
Abbreviations: MRSA, methicillin-resistant *S. aureus*; PIP-TAZ, piperacillin-tazobactam; NS, nonsusceptible; MEM, meropenem; CRE, carbapenem-resistant *Enterobacterales*

Conclusions

- Rank order and antimicrobial susceptibility of bacteria isolated from patients hospitalized with pneumonia varied widely between W-EU and E-EU.
- Gram-negative organisms comprised most of the organisms isolated from patients with pneumonia in W-EU (75.9%) and E-EU (86.3%),
- Resistance rates were markedly higher in E-EU than W-EU among Gram-negative organisms.
- Multidrug-resistant non-fermentative GNB, such as *P. aeruginosa, A. baumannii, and S. maltophilia*, represented an important cause of pneumonia in Europe, especially in E-EU.

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