POINT PREVALENCE STUDY OF HEALTHCARE-ASSOCIATED INFECTIONS AND ANTIMICROBIAL USE IN BELGIAN ACUTE CARE HOSPITALS

Results of the ECDC PPS 2017

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Epidemiology and public health – Healthcare-associated infections and antimicrobial resistance

Point Prevalence Study of healthcare-associated infections and antimicrobial use in Belgian acute care hospitals

November 2018 • Brussels • Belgium
Internal reference number: D/2018/14.440/37

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With the financial support of / Partners:

federale overheidsdienst VOLKSGEZONDHEID, VEILIGHEID VAN DE VOEDSELKETEN EN LEEFMILIEU

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Please cite as: Vandael E, Catry B, Latour K. Point Prevalence Study of healthcare-associated infections and antimicrobial use in Belgian acute care hospitals: Results of the ECDC PPS 2017. Brussels, Belgium: Sciensano; 2018. 34p. Report Number: D/2018/14.440/37. Available from: http://www.nsih.be/

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ABBREVIATIONS

- ATC = Anatomical Therapeutic Chemical Classification
- BAPCOC = Belgian Antibiotic Policy Coordination Committee
- BSI = bloodstream infection
- CDI = *Clostridium difficile* infection
- CI = confidence interval
- DDD = defined daily dose
- ECDC = European Center for Disease Prevention and Control, Stockholm, SE
- EU = European Union
- ICU = intensive care unit
- IQR = interquartile range
- HAI = healthcare-associated infection
- HAP = healthcare-associated pneumonia
- SD = standard deviation
- SSI = surgical site infection
- UTI = urinary tract infection
- WHO = World Health Organisation

EXECUTIVE SUMMARY

Background

In 2011, the first European point prevalence study (PPS) of antimicrobial use and healthcare-associated infections (HAIs) was organised by the European Centre for Disease Prevention and Control (ECDC). In the participating Belgian acute care hospital sites (N=52, September-December 2011), the prevalence of patients with at least one antimicrobial and at least one HAI was 28.9% (95% confidence interval (CI): 26.8-31.1%) and 7.1% (95% CI: 6.1-8.3%), respectively. The objective of this report is to present the results of the second ECDC PPS conducted in 2017 in Belgian acute care hospitals.

Methods

All Belgian acute care hospitals were invited to participate in the ECDC PPS 2017. In addition, a representative random sample of hospitals was selected which received an individualized invitation to participate. Training was provided to the participating hospitals in September 2017, followed by the data collection between September and November 2017. Data were collected at hospital, ward and patient levels. All patients who were present on the ward at 8h00 a.m. on the day of the PPS and who were not discharged at the time of the survey had to be included. Data collection had to be performed on one single day per ward, within a maximum period of 2 to 3 weeks for each hospital.

Results

In total, 47 acute care hospital sites (33 mergers, of which 22 primary, 9 secondary and 2 tertiary hospitals, countrywide participation 32.4%) participated in the ECDC PPS (11800 patients included, mean age 60.2±25.3 year, 55.2% females). The crude prevalence of patients with at least one antimicrobial agent was 28.1% (95% CI: 27.3-29.0%). Medical prophylaxis, surgical prophylaxis and treatment of HAIs were reported as indication in 6.2%, 13.5% and 24.2% of the prescribed antimicrobial agents (N=4103), respectively. The top 3 of most used antimicrobial agents consisted of amoxicillin in combination with a beta-lactamase inhibitor (J01CR02, 19.7%), cefazolin (J01DB04, 9.7%) and piperacillin in combination with a beta-lactamase inhibitor (J01CR05, 7.7%). The most frequently reported diagnoses for medical antimicrobial treatment were pneumonia (22.2%) and urinary tract infections (11.2%). The reason for antimicrobial use was available in 80.8% of the medical notes.
A crude prevalence of patients with at least one HAI of 7.3% (95% CI: 6.8-7.7%) was detected. The most frequently reported HAIs (N=911) were pneumonia (21.6%), urinary tract infections (21.3%) and surgical site infections (16.9%). Microbiological results were available for 62.0% of the HAIs. A total of 721 microorganisms were reported. The most commonly isolated microorganism was *Escherichia coli* (17.8%).

Conclusions

In comparison with the Belgian results of the ECDC PPS in 2011, the prevalence of antimicrobial consumption and the prevalence of HAIs remained the same. The reasons for the high prevalence of HAIs should be further investigated and targets should be set to improve. It is recommended that hospitals participate regulary in a PPS.

SAMENVATTING

Achtergrond

In 2011 vond de eerste Europese puntprevalentiestudie (PPS) van antimicrobieel gebruik en zorginfecties georganiseerd door het Europees Centrum voor ziektepreventie en -bestrijding (ECDC) plaats. In de deelnemende Belgische acute ziekenhuizen (N=52 sites, september-december 2011) bedroeg de prevalentie van patiënten met minstens één antimicrobieel middel en minstens één zorginfectie destijds respectievelijk 28.9% (95% betrouwbaarheidsinterval (CI): 26.8-31.1%) en 7.1% (95% CI: 6.1-8.3%). Het doel van dit rapport is om de resultaten van de tweede ECDC PPS, die plaatvond in 2017 in Belgische acute ziekenhuizen, te presenteren.

Methoden

Alle Belgische acute ziekenhuizen werden uitgenodigd om deel te nemen aan de ECDC PPS 2017. Daarnaast werd een representatieve random subset van ziekenhuizen geselecteerd die een geïndividualiseerde uitnodiging ontvingen. In september 2017 werd training voor alle deelnemende ziekenhuizen voorzien, gevolgd door de datacollectie tussen september en november 2017. Data werden verzameld op het niveau van het ziekenhuis, de afdeling en de patiënt. Alle patiënten die aanwezig waren op de afdeling om 8h00 op de dag van de PPS en die niet ontslagen waren op het tijdstip van de studie, moesten geïncludeerd worden. De datacollectie in één afdeling moest op één dag gebeuren, met een maximum van twee tot drie weken voor het volledige ziekenhuis.

Resultaten

In totaal namen er 47 sites van Belgische acute ziekenhuizen deel aan de ECDC PPS 2017 (33 fusieziekenhuizen waarvan 22 primaire, 9 secundaire en 2 tertiaire ziekenhuizen, nationale participatiegraad: 32.4% - 11800 geïncludeerde patiënten, gemiddelde leeftijd 60.2±25.3 jaar, 55.2% vrouwen). De prevalentie van patiënten met minstens één antimicrobieel middel bedroeg 28.1% (95% CI: 27.3-29.0%). Medische profylaxe, chirurgische profylaxe en behandeling van zorginfecties werden gerapporteerd als indicatie in respectievelijk 6.2%, 13.5% en 24.2% van de voorgeschreven antimicrobiële middelen (N=4103). De top 3 van meest gebruikte antimicrobiële middelen bestond uit amoxicilline in combinatie met een beta-lactamase inhibitor (J01CR02, 19.7%), cefazoline (J01DB04, 9.7%) en piperacilline in combinatie met een beta-lactamase inhibitor (J01CR05, 7.7%). De meest gerapporteerde diagnoses voor medische antimicrobiële behandeling waren pneumonie (22.2%) en urineweginfecties (11.2%). De reden voor het antimicrobieel gebruik was beschikbaar in 80.8% van de medische dossiers.
Een prevalentie van patiënten met minstens één zorginfectie van 7.3% (95% CI: 6.8-7.7%) werd gedetecteerd. De meest frequent gerapporteerde zorginfecties (N=911) waren pneumonie (21.6%), urineweginfecties (21.3%) en post-operatieve wondinfecties (16.9%). Microbiologische testresultaten waren beschikbaar voor 62.0% van de zorginfecties. In totaal

werden er 721 micro-organismen gerapporteerd. Het frequentst geïsoleerde micro-organisme was *Escherichia coli* (17.8%).

Conclusies

In vergelijking met de Belgische resultaten van de ECDC PPS in 2011 blijft de prevalentie van antimicrobiële consumptie en de prevalentie van zorginfecties hetzelfde. De redenen voor de hoge prevalentie van zorginfecties zullen verder onderzocht moeten worden. Het is aangeraden dat ziekenhuizen regelmatig aan een PPS deelnemen.

RÉSUMÉ

Contexte

La première étude de prévalence ponctuelle européenne (PPS) sur l'usage d'agents antimicrobiens et sur les infections liées aux soins a été organisée en 2011 par le Centre européen de prévention et contrôle des maladies (ECDC). Dans les hôpitaux de soins aigus belges participants (N=52 sites, septembre-décembre 2011), la prévalence de patients recevant au moins un traitement antimicrobien et présentant au moins une infection liée aux soins était de 28.9% (intervalle de confiance 95% [IC]: 26.8-31.1%) et de 7.1% (IC 95%: 6.1-8.3%) respectivement. L'objectif du présent rapport est de présenter les résultats de la deuxième « ECDC PPS » qui s'est tenue en 2017 dans les hôpitaux belges aigus.

Méthodes

Tous les hôpitaux belges aigus ont été conviés à prendre part à l'ECDC PPS 2017. Un échantillon représentatif d'hôpitaux, sélectionnés de manière aléatoire, a également reçu une invitation individualisée. Une formation à l'intention de tous les établissements participants a été organisée en septembre 2017. Le recueil de données a eu lieu entre septembre et novembre 2017. Les données ont été collectées à différents niveaux: celui de l'hôpital, celui du service et celui du patient. Tous les patients qui étaient présents dans le service à 8h du matin le jour de la PPS et qui n'avaient pas quitté l'établissement au moment de l'étude devaient être inclus. Le recueil de données devait se faire en une seule et même journée dans un service donné et s'étaler sur deux à trois semaines au maximum pour l'ensemble de l'hôpital.

Résultats

Au total, 47 sites hospitaliers belges de soins aigus ont pris part à l'ECDC PPS 2017 (33 hôpitaux regroupés, dont 22 primaires, 9 secondaires et 2 tertiaires, ce qui représente un taux de participation de 32.4%). Ils ont inclus 11800 patients (moyenne d'âge 60.2±25.3 ans, sexe: 55.2% de femmes). La prévalence des patients recevant au minium un traitement antimicrobien s'élevait à 28.1% (IC 95%: 27.3-29.0%). Les traitements (N=4103) étaient prescrits en tant que prophylaxie médicale, prophylaxie chirurgicale et traitement d'infections nosocomiales dans respectivement 6.2%, 13.5% et 24.2% des cas. Sur le podium des agents les plus utilisés, on retrouve l'association de l'amoxicilline à un inhibiteur des bêta-lactamases (J01CR02, 19.7%), la céfazoline (J01DB04, 9.7%) et la combinaison de la pipéracilline à un inhibiteur des bêta-lactamases (J01CR05, 7.7%). Les diagnostics enregistrés le plus fréquemment (dans le cadre des traitements médicaux antimicrobiens) étaient les pneumonies (22.2%) et les infections des voies urinaires (11.2%). Le motif du recours aux antimicrobiens était spécifié dans 80.8% des dossiers médicaux.
La prévalence observée de patients présentant au moins une infection liée aux soins était de 7.3 % (IC 95%: 6.8-7.7 %). Les infections nosocomiales (N=911) les plus recensées étaient les pneumonies (21.6%), les infections des voies urinaires (21.3%) et les infections du site opératoire (16.9%). Des résultats de tests microbiologiques étaient disponibles dans 62.0%

des cas. Au total, 721 micro-organismes ont été retrouvés. Celui le plus fréquemment isolé était *Escherichia coli* (17.8%).

Conclusions

Si l'on établit une comparaison avec les résultats obtenus en Belgique lors de l'édition précédente (ECDC PPS 2011), on observe une stagnation de la prévalence de la consommation d'antimicrobiens et de la prévalence des infections liées aux soins. Il convient d'examiner de manière plus approfondie la cause de la prévalence élevée des infections nosocomiales. Il serait opportun que les hôpitaux prennent régulièrement part à des PPS.

INTRODUCTION

Healthcare-associated infections (HAIs) have become an important public health concern due to the increasing complexity of care. They lead to a considerable burden of disease with a significant morbidity and mortality (1). The European Centre for Disease Prevention and Control (ECDC) has estimated that especially the burden of the following six main types of HAIs are high in comparison with other infectious diseases: healthcare-associated pneumonia (HAP), healthcare-associated urinary tract infection (UTI), surgical site infection (SSI), healthcare-associated *Clostridium difficile* infection (CDI), healthcare-associated neonatal sepsis, and healthcare-associated primary bloodstream infection (BSI) (2). An important proportion of these HAIs is considered to be preventable (3).

Point prevalence surveys (PPS) are a well-established methodology to follow-up the risk of HAIs and to evaluate interventions to prevent these infections (4). ECDC developed a standardised protocol to measure the prevalence of HAIs and antimicrobial consumption in European acute care hospitals. In 2011, the first ECDC PPS was organised. Based on the results, the number of patients that develop a HAI every year in Europe was estimated at 3.2 million (5). A European Union (EU) prevalence of patients with at least one HAI of 6.0% (country range 2.3-10.8%) was reported. The EU prevalence of patients with at least one antimicrobial treatment was 35.0% (country range 21.4-54.7%). In Belgium, 70 acute care hospital sites participated in the ECDC PPS 2011 (September-December 2011), but due to country overrepresentativeness data of only 52 hospital sites were incorporated in the ECDC report. In these 52 sites, the prevalence of patients with at least one HAI was 7.1%, with HAP as most common HAI. The prevalence of antimicrobial use was 28.9% with most prescriptions for amoxicillin in combination with a beta-lactamase inhibitor (J01CR02) (5).

A second European PPS was organised by ECDC in 2016-2017 and Sciensano coordinated the participation of Belgian acute care hospitals in this PPS, in cooperation with the Belgian Antibiotic Policy Coordination Committee (BAPCOC).

The objective of this report is to present the Belgian results of the second ECDC PPS conducted in acute care hospitals in 2017 (September-November).

METHODOLOGY

STUDY DESIGN AND PARTICIPATION

The ECDC PPS in Belgian acute care hospitals was organised in line with the patient-based protocol of ECDC to measure the prevalence of HAIs and antimicrobial use in European acute care hospitals (6).

This cross-sectional study was organised in the same period as the Global PPS in Belgian acute care hopitals, coordinated by BAPCOC (7). All Belgian acute care hospitals were invited to participate in either the ECDC PPS or the Global PPS. Therefore, an invitation was sent by email to the members of the hospital infection control teams and antibiotic policy teams. Moreover, according to the protocol and in order to ensure that data were representative for the total Belgian hospital population, a representative sample of hospitals was specially encouraged to participate in the ECDC PPS with a personalized invitation. This sample was randomly selected using a systematic sampling design, based on a list of all Belgian hospitals received from the Federal Public Service Health, Food chain safety and Environment (8). In this list, all hospitals were listed according to hospital type, number of beds, region/province and ownership. The sampling interval was determined by dividing the total number of hospitals (N=102 mergers) by the number to be sampled (N=34 mergers). Two substitutions per selected hospital were foreseen in case of refusals.

The ECDC protocol and all study forms were slightly adapted to the Belgian setting and distributed to the hospitals in English. Hospitals that were part of a merger were encouraged to collect data per hospital site. In addition, it was recommended that the data were collected by members of the infection control and/or antibiotic policy teams. Due to the complex protocol and high workload, financial incentives (2 euros per included patient) were provided to all hospitals conducting the ECDC PPS.

All local surveys were performed between September and November 2017. In September, prior to the start of the data collection, training days were organised to explain the objectives and methodology of the study (including case studies to practice completion of forms and understanding of HAI definitions) in Dutch or French.

ETHICS

Approval of the study protocol had to be asked by the participating hospitals to their local ethics committee. A unique study number was used to code all hospital and patient data.

DATA COLLECTION

Data collection had to be performed on one single day per ward (exclusion of emergency departments), with a maximum of 2 to 3 weeks for one hospital. In the hospital and ward forms,

data were collected on hospital type, size, number of beds and patients, structure and process indicators. These indicators included the number of full-time equivalent (FTE) infection control nurses, the number of FTE infection control doctors and the number of FTE antimicrobial stewardship consultants. FTE antimicrobial stewardship needed to be interpreted as the time that a consultant/pharmacist has been especially employed and paid for antimicrobial stewardship tasks, not activities that were part of the daily practice of physicians (e.g. post-prescription review). In case antimicrobial stewardship activities were an integral part of the job of an infection control physician, the FTE spent on antimicrobial stewardship and infection control needed to be reported separately (deduced from the number of FTE infection control physicians) (6).

All patients present at the ward before or at 8h00 a.m. and not discharged from the ward at the time of the survey, were considered eligible and had to be included. Patients undergoing same day treatment or surgery and patients seen at outpatient departments (including dialysis patients) or in the emergency room had to be excluded.
In the patient form, demographic data and data on risk factors, use of antimicrobial agents and presence of active HAIs had to be filled out for all eligible patients. The following Anatomical Therapeutic Chemical (ATC) groups (9) were included as antimicrobial agents for systemic use: A07AA (intestinal antiinfectives), D01BA (antifungals for systemic use), J01 (antibacterials for systemic use), J02 (antimycotics for systemic use) and P01AB (nitroimidazole-derived antiprotozoals). Treatment for tuberculosis was excluded but antituberculosis drugs (J04AB02) were included when used for treatment of mycobacteria other than tuberculosis (MOTT) or as reserve treatment for multidrug-resistant bacteria. Antiviral agents (J05) were excluded. Data on type of antimicrobial, dose, administration route, indication and diagnosis were collected. In addition, if the antimicrobial (or administration route) was changed during the infection episode, the reason of change had to be registered. Possible reasons of change were escalation (i.e. the antimicrobial was escalated, another antimicrobial was added, the route was switched from oral to parental), de-escalation (i.e. the antimicrobial was de-escalated, switched to a more narrow-spectrum or first-line antimicrobial, other antimicrobials for the same indication were stopped), switch from intravenous to oral administration route, change because of observed or expected adverse effect of the antimicrobial and change for another of unknown reason (6).

All infections that met the criteria of an active HAI (associated to a stay in an acute care hospital) had to be included. The following definition of an active HAI was applied: an infection where signs and symptoms were present on the day of the PPS, or where signs and symptoms were present in the past and the patient was (still) receiving treatment for that infection on the day of the PPS. The symptoms had to appear on day 3 or later after admission (day of admission = day 1). It could also be earlier in case the patient was readmitted less than 48 hours after a previous admission to an acute care hospital. Exceptions to these criteria were also made for SSIs, infections with an invasive device and *Clostridium difficile* infections. In case of an active SSI, the onset of the symptoms had to be occurred within 30 days of the operation (or within 90 days in case of a surgery involving an implant). If an invasive device was placed on day 1 or 2 of the admission, a HAI could emerge before day 3. Finally, *Clostridium difficile* infections present on admission (or developped within two days) with an onset less than 28 days after the discharge from an acute care hospital also had to be included (6).

Microbiological test results available on the day of the PPS for a HAI had to be reported. In addition, available antimicrobial susceptibilty test results (susceptible, intermediate, resistant or unknown) for a selected group of bug-drug combinations (AMR markers) were collected: oxacillin and glycopeptides susceptibily for *Staphylococcus aureus*, glycopeptides susceptibily for *Enterococcus* species, third-generation cephalosporins and carbepenem susceptibility for *Enterobacteriaceae* (*Escherichia coli*, *Klebsiella* species, *Enterobacter* species, *Proteus* species, *Citrobacter* species, *Serratia* species, *Morganella* species), and carbapenem susceptibilty for *Pseudonomas aeruginosa* and *Acinetobacter* species (6).

All collected data had to be entered into ECDC's HelicsWin.Net software, followed by sending the database to Sciensano. Validation of the hospital databases was performed by Sciensano and data were subsequently transferred to ECDC.

DATA ANALYSIS

Hospital sites were classified per type (primary, secondary, tertiary) based on the list of hospitals of the Federal Public Service Health, Food chain safety and Environment and in line with the definitions of ECDC (6,8).

Crude prevalences of patients with at least one antimicrobial or at least one HAI were calculated by dividing the number of these patients by the total number of eligible patients. Consequently, patients with multiple HAIs or multiple antimicrobials on the day of the PPS were only counted once. Prevalences were presented together with their 95% confidence intervals (CI).

Based on the results of the abovementioned AMR markers, a composite index of AMR was calculated by dividing the number of microorganisms with a resistant result in the antimicrobial susceptibility test (first-line AMR markers combined per microorganism) with the total number of micro-organisms with a known result in the antimicrobial susceptibility test. In the same way, the percentage of carbapenem resistance in *Enterobacteriaceae* was calculated.

All statistical analyses were performed using SAS Enterprise Guide version 7.1. Where appropriate, means + standard deviation (SD), medians + interquartile ranges (IQR) and percentages (%) were calculated.

RESULTS

PARTICIPATION

In total, 47 Belgian acute care hospital sites (33 mergers, participation rate 32.4%) participated in the ECDC PPS 2017. In these hospitals, 11800 patients were included. More details on the participating hospitals and the included patients can be found in Table 1A and 1B, respectively.

Table 1A: Characteristics of the included acute care hospitals in the ECDC point prevalence survey (PPS) 2017, Belgium

Number of included	Sites	Mergers°	Participation rate*
Total	47	33	33/102=32.4%
Per type			
Primary hospitals	33	23	23/77=29.9%
Secondary hospitals	12	8	8/17=47.1%
Tertiary hospitals	2	2	2/7=28.6%
Specialised hospitals	0	0	0/1=0.0%
Per region			
Brussels	7	6	6/12=50.0%
Flanders	16	12	12/54=22.2%
Wallonia	24	15	15/36=41.7%
Per size			
Small (<400 beds)	25	15	15/49=30.6%
Medium (400-600 beds)	13	9	9/26=34.6%
Large (>600 beds)	9	9	9/27=33.3%

ECDC = European Centre for Disease Prevention and Control

° At least one site of the merger participated

* Based on the total number of hospital sites in Belgium in 2017 (8) (total merger hospitals: N=102; total hospital sites: N= 191)

Table 1B: Characteristics of the eligible patients of acute care hospitals participating in the ECDC point prevalence survey (PPS) 2017, Belgium

	ECDC PPS 2017
Total number of included patients	11800
Mean age ±SD	60.2 ±25.3
0-2 years	721 (6.1%)
3-17 years	353 (3.0%)
18-35 years	996 (8.4%)
35-65 years	3572 (30.3%)
>65 years	6158 (52.2%)
Number of males / females (%) *Missing*	5264 (44.7%) / 6512 (55.2%) *24 (0.2%)*
Median length of stay on the day of the PPS (IQR)	6 (2;16)
Patient specialty (%)	
Medicine	3600 (30.5%)
Surgery	2531 (21.4%)
ICU	583 (4.9%)
Geriatrics	1813 (15.4%)
Obstetrics / Maternity	583 (4.9%)
Healthy neonates	156 (1.3%)
Neonatology	121 (1.0%)
Pediatrics	464 (3.9%)
Psychiatry	823 (7.0%)
Rehabilitation	903 (7.7%)
Long-term care	33 (0.3%)
Mix	28 (0.2%)
Other	50 (0.4%)
Missing	*112 (1.0%)*
Distribution of the McCabe score (%)	
Non-fatal disease	7295 (61.8%)
Ultimately fatal disease	1873 (15.9%)
Rapidly fatal disease	689 (5.8%)
Missing	*1943 (16.5%)*
Surgery since admission (%) *Missing*	3350 (28.4%) 729 (6.2%)
Central vascular catheter on the day of PPS (%) *Missing*	1385 (11.7%) *319 (2.7%)*
Peripheral vascular catheter on the day of PPS (%) *Missing*	4210 (35.7%) *316 (2.7%)*
Urinary catheter on the day of PPS (%) *Missing*	1415 (12.0%) *327 (2.8%)*
Ventilation on the day of PPS (%) *Missing*	211 (1.8%) *308 (2.6%)*

ECDC = European Centre for Disease Prevention and Control, ICU = intensive care unit, IQR = interquartile range; SD = standard deviation

ANTIMICROBIAL CONSUMPTION

Of all included patients, 3320 patients (mean age 61.7 years ±24.0; 50.4% female) received at least one antimicrobial agent on the day of the PPS. This can be translated in a crude prevalence of 28.1% (95% CI 27.3-29.0%) of patients with at least one antimicrobial (patients ≥65 years: 29.6% (95% CI 28.5-30.7%), <65 years: 26.5% (95% CI 25.3-27.6%)). This crude prevalence varied between the participating hospitals, with a range from 2.2% to 43.3%. The highest prevalence of antimicrobial treatment was found in tertiary hospitals (30.8%, 95% CI 28.3-32.4%) and on the ICU department (52.7%, 95% CI 48.6-56.7%). In Table 2, the crude prevalence of patients with at least one antimicrobial treatment is presented per type of hospital and patient specialty.

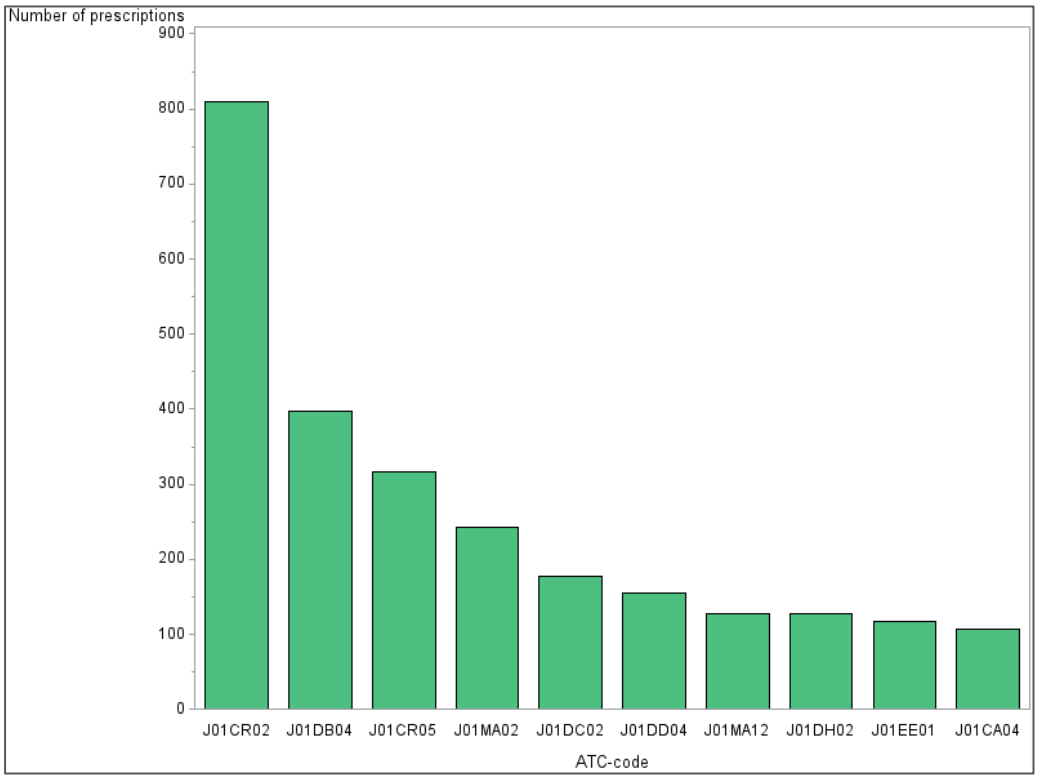
Table 2: Crude prevalence of patients with at least one antimicrobial, ECDC point prevalence survey (PPS) 2017, Belgium

	Total number of patients	Patients with at least one antimicrobial		
		N	Crude prevalence (%)	95% CI
Total prevalence	**11800**	**3320**	**28.1**	**27.3-29.0**
Prevalence by hospital type				
Primary	7214	1998	27.7	26.7-28.7
Secondary	3337	937	28.1	26.6-29.6
Tertiary	1249	385	30.8	28.3-32.4
Prevalence by patient specialty				
Medicine	3600	1200	33.3	31.8-34.9
Surgery	2531	916	36.2	34.3-38.1
Intensive care	583	307	52.7	48.6-56.7
Geriatrics	1813	502	27.7	25.6-29.8
Obstetrics/ Maternity	583	73	12.5	9.8-15.2
Healthy neonates	156	3	1.9	0.0-4.1
Neonatology	121	16	13.2	3.1-19.3
Pediatrics	464	153	33.0	28.7-37.3
Psychiatry	823	27	3.3	2.1-4.5
Rehabilitation	903	105	11.6	9.5-13.7
Long-term care	33	8	24.2	9.6-38.9
Mix	28	8	28.6	11.8-45.3
Other	50	2	4.0	0.0-9.4

ECDC = European Centre for Disease Prevention and Control, CI = confidence interval; N = number of patients with at least one antimicrobial

In total, 4103 antimicrobials (J01: N=3842, 93.6%) were prescribed on the day of the PPS. One-fifth (20.2%) of the patients were prescribed more than one antimicrobial (two antimicrobials: N=574 (17.3%); three antimicrobials: N=87 (2.6%); four antimicrobials: N=9 (0.3%), five antimicrobials: N=2 (0.1%)). The most used antimicrobials were 'amoxicillin and a beta-lactamase inhibitor' (J01CR02, N=809, 19.7%), cefazolin (J01DB04, N=398, 9.7%) and 'piperacillin and a beta-lactamase inhibitor' (J01CR05, N=317, 7.7%). The top 10 of most used products can be found in Figure 1. In Table 3, the distribution of the consumption of the different antibiotic subclasses is shown. Most of the antimicrobials (N=2693, 65.6%) were

administered parenterally (oral: N=1394, 34.0%; inhalation: N=8, 0.2%; rectal: N=2, 0.1%; unknown: N=6, 0.2%).



J01CR02: amoxicillin and a beta-lactamase inhibitor (19.7%)
J01DB04: cefazolin (9.7%)
J01CR05: piperacillin and a beta-lactamase inhibitor (7.7%)
J01MA02: ciprofloxacin (5.9%)
J01DC02: cefuroxime (4.3%)
J01DD04: ceftriaxone (3.8%)
J01MA12: levofloxacin (3.1%)
J01DH02: meropenem (3.1%)
J01EE01: sulfamethoxazole and trimethoprim (2.9%)
J01CA04: amoxicillin (2.6%)

Figure 1: Top 10 of the most commonly prescribed antimicrobials, ECDC point prevalence survey (PPS) 2017, Belgium

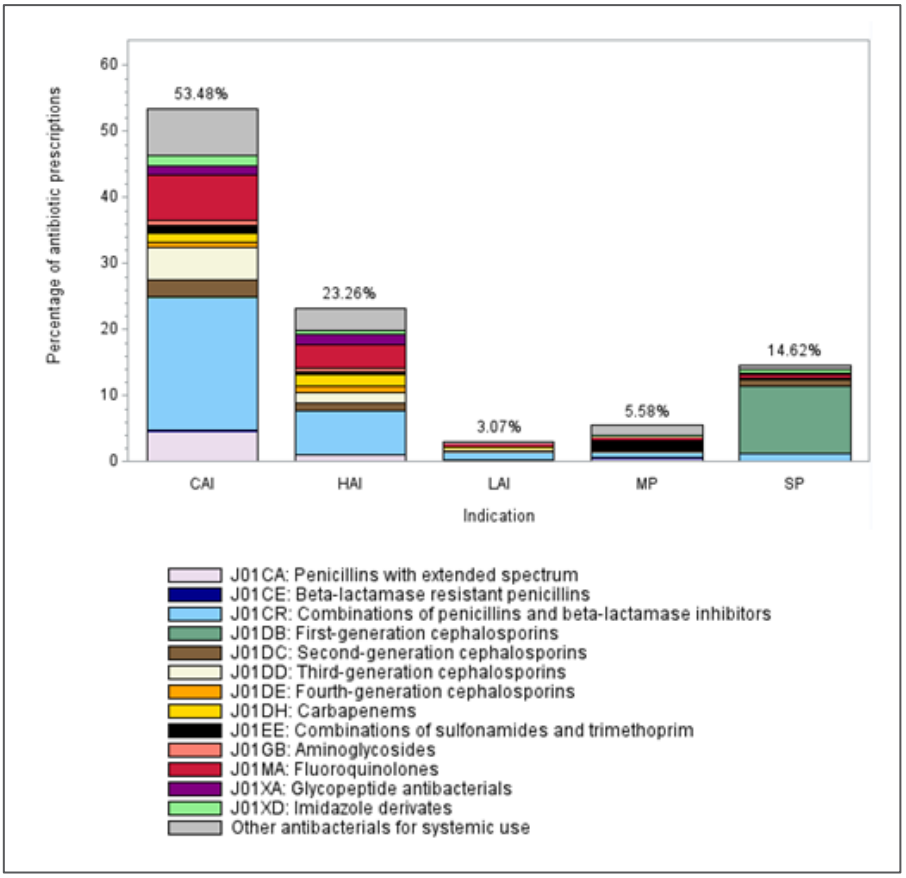
Table 3: Distribution of the consumption of antibiotic subclasses (ATC level 4), ECDC point prevalence survey (PPS) 2017, Belgium

ATC code (level 4)	Name	Number of agents (% J01)
J01	**Antibacterials for systemic use**	**3842**
J01AA	Tetracyclines	29 (0.8%)
J01BA	Amphenicols	0
J01CA	Penicillins with extended spectrum	247 (6.4%)
J01CE	Beta-lactamase sensitive penicillins	20 (0.5%)
J01CF	Beta-lactamase resistant penicillins	103 (2.7%)
J01CG	Beta-lactamase inhibitors	3 (0.1%)
J01CR	Combinations of penicillins, incl. beta-lactamase inhibitors	1134 (29.5%)
J01DB	First-generation cephalosporins	405 (10.5%)
J01DC	Second-generation cephalosporins	182 (4.7%)
J01DD	Third-generation cephalosporins	265 (6.9%)
J01DE	Fourth-generation cephalosporins	64 (1.7%)
J01DF	Monobactams	7 (0.2%)
J01DH	Carbapenems	127 (3.3%)
J01EA	Trimethoprim and derivates	6 (0.2%)
J01EB	Short-acting sulfonamides	1 (0.03%)
J01EC	Intermediate-acting sulfonamides	8 (0.2%)
J01EE	Combinations of sulfonamides and trimethoprim	128 (3.3%)
J01FA	Macrolides	149 (3.9%)
J01FF	Lincosamides	102 (2.7%)
J01GB	Aminoglycosides	62 (1.6%)
J01MA	Fluoroquinolones	460 (12.0%)
J01MB	Other quinolones	1 (0.03%)
J01RA	Combinations of antibacterials	20 (0.5%)
J01XA	Glycopeptide antibacterials	113 (2.9%)
J01XB	Polymyxins	10 (0.3%)
J01XD	Imidazole derivatives	112 (2.9%)
J01XE	Nitrofuran derivatives	60 (1.6%)
J01XX	Other antibacterials	24 (0.6%)

ECDC = European Centre for Disease Prevention and Control, ATC = Anatomic Therapeutic Chemical

The indication of the antimicrobial treatment was in 51.4% (N=2107) a community-acquired infection (CAI), in 24.2% (N=992) an acute hospital-acquired infection (HAI), in 13.5% (N=553) surgical prophylaxis (SP), in 6.2% (N=256) medical prophylaxis (MP), in 3.1% (N=129) an infection acquired in a long-term care facility or chronic-care hospital (LAI) and in 0.9% (N=37) another indication. The indication was unknown (checked during the PPS but not available) and missing (not checked during the PPS) in 0.6% (N=24) and 0.1% (N=5), respectively. The duration of SP was in 43.8% (N=242) one dose, in 32.4% (N=179) one day and in 23.9% (N=132) >1 day. The use of antibiotic subclasses (ATC level 4) per indication can be found in Figure 2. In case of treatment of CAIs, HAIs or LAIs, 'Combinations of penicillins and beta-lactamase inhibitors' (J01CR; 37.5%-28.3%-37.9% respectively) and 'Fluoroquinolones' (J01MA; 12.8%-14.7%-17.2% respectively) were the most frequently used antibiotic

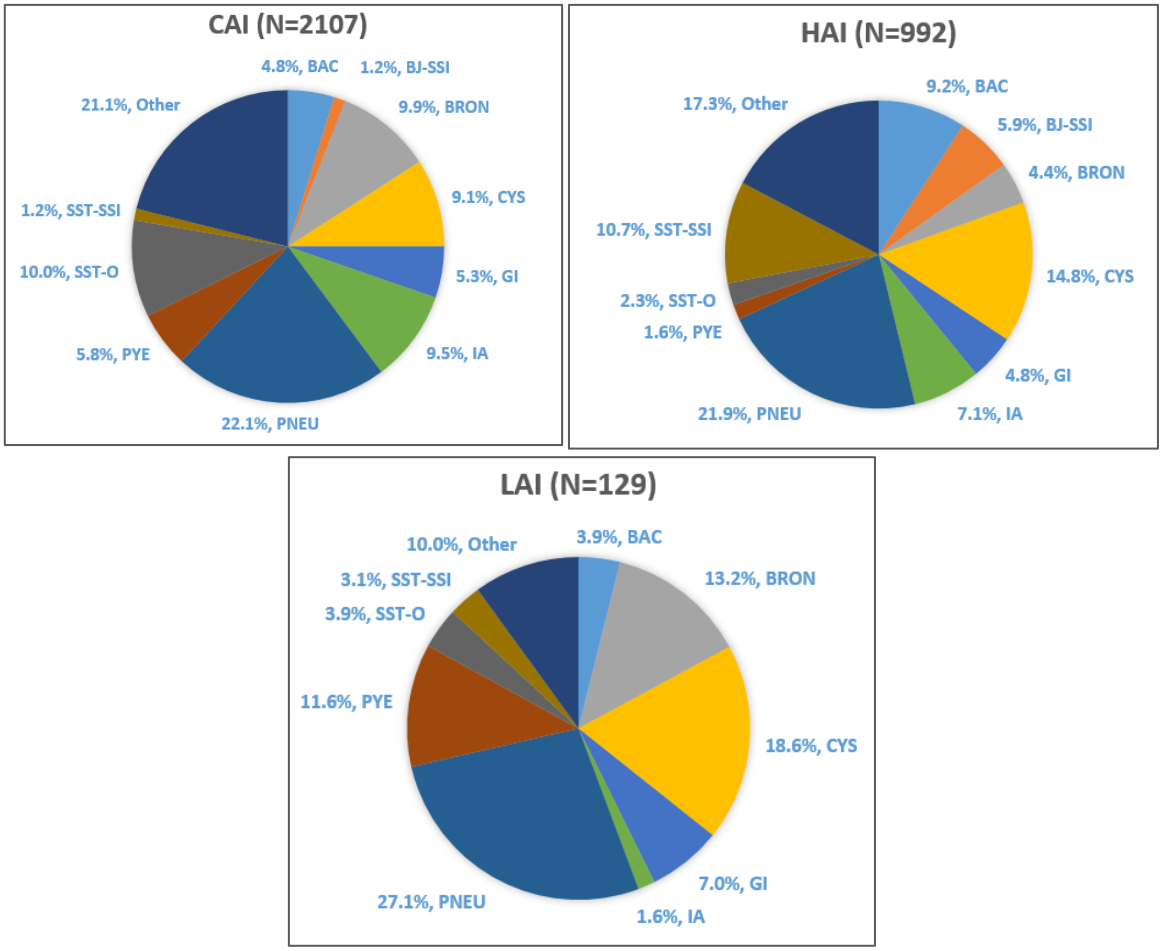
subclasses. For SP, 'First-generation cephalosporins' (J01DB; 70.5%) were most commonly prescribed. For MP, the most used antibiotic subclasses were 'Combinations of sulfonamides and trimethoprim' (J01EE; 24.6%) and 'Combinations of penicillins and beta-lactamase inhibitors' (J01CR; 14.7%).



ECDC = European Centre for Disease Prevention and Control, CAI = community-acquired infection, HAI: acute-hospital-acquired infection, LAI = infection acquired in long-term care facility or chronic-care hospital, MP = medical prophylaxis, SP = surgical prophylaxis
* sum of % prescriptions of CAI – HAI – LAI – MP – SP = 100%

Figure 2: Percentage of antibiotic (J01) prescriptions per antibiotic subclass (ATC level 4) and per indication, ECDC point prevalence survey (PPS) 2017, Belgium

In case of medical treatment with antimicrobials (CAI, HAI or LAI) the most frequently registered diagnoses were pneumonia (N=718, 22.2%), symptomatic lower urinary tract infection (N=362, 11.2%), intra-abdominal sepsis (N=362, 8.4%), acute bronchitis or exacerbations of chronic bronchitis (N=269, 8.3%) and cellulitis, wound, deep soft tissue infections not involving bone and not related to surgery (N=239, 7.4%). In Figure 3, the distribution of diagnoses per indication is displayed.



ECDC = European Centre for Disease Prevention and Control, CAI = community-acquired infection, HAI: acute-hospital-acquired infection, LAI = infection acquired in long-term care facility or chronic-care hospital
BAC = Laboratory-confirmed bacteraemia, BJ-SSI = Septic arthritis, osteomyelitis of surgical site, BRON = Acute bronchitis or exacerbations of chronic bronchitis, CYS = Symptomatic lower urinary tract infection, GI = Gastrointestinal infections, IA = Intra-abdominal sepsis, including hepatobiliary, PNEU = Pneumonia, PYE = Symptomatic upper urinary tract infection; SST-O = Cellulitis, wound, deep soft tissue not involving bone, not related to surgery, SST-SSI = Surgical site infection involving skin or soft tissue but not bone

Figure 3: Distribution of the reported diagnoses for antimicrobial use per indication, ECDC point prevalence survey (PPS) 2017, Belgium

For 80.8% (N=3317) of all antimicrobials, the reason for antimicrobial use was available in the medical notes. A change in the antimicrobial treatment during admission was registered for 24.7% of the antimicrobials (N=1012): escalation in 425 cases (10.4%), switch from intravenous to oral in 256 cases (6.2%), de-escalation in 237 cases (5.8%), change due to an adverse effect in 21 cases (0.5%), and change for another of unknown reason in 73 cases (1.8%).

HEALTHCARE-ASSOCIATED INFECTIONS

In the ECDC PPS 2017, 911 HAIs were registered. The crude prevalence of having at least one HAI was 7.3% (95% CI 6.8-7.7%). This prevalence ranged from 0.0% to 18.1% in the participating hospitals. In total, 856 patients (mean age 66.4 years ±20.7, 51.5% male) had at least one HAI (patients ≥65 years: 8.6% (95% CI 7.9-9.3%), <65 years: 5.7% (95% CI 5.1-6.3%)). In 53 (6.2%) patients, two HAIs were detected, and 1 patient (0.1%) had three HAIs. The crude prevalence per hospital type and per patient specialty can be consulted in Table 4.

Table 4: Crude prevalence of patients with at least one healthcare-associated infection (HAI), ECDC point prevalence survey (PPS) 2017, Belgium

	Total number of patients	Patients with at least one HAI		
		N	Crude prevalence (%)	95% CI
Total prevalence	**11800**	**856**	**7.3**	**6.8-7.7**
Prevalence by hospital type				
Primary	7214	489	6.8	6.2-7.4
Secondary	3337	253	7.6	6.7-8.5
Tertiary	1249	114	9.1	7.5-10.7
Prevalence by patient specialty				
Medicine	3600	265	7.4	6.5-8.2
Surgery	2531	204	8.1	7.0-9.1
Intensive care	583	122	20.9	17.6-24.2
Geriatrics	1813	158	8.7	7.4-10.0
Obstetrics/ Maternity	583	9	1.5	0.5-2.5
Healthy neonates	156	0	0.0	
Neonatology	121	4	3.3	0.1-6.6
Pediatrics	464	12	2.6	1.1-4.0
Psychiatry	823	9	1.1	0.4-1.8
Rehabilitation	903	67	7.4	5.7-9.1
Long-term care	33	4	12.1	1.0-23.3
Mix	28	0	0.0	
Other	50	2	4.0	0.0-9.4

ECDC = European Centre for Disease Prevention and Control, CI = confidence interval; N = number of patients with at least one HAI

The most frequently registered HAIs were pneumonia (N=197, 21.6%), UTIs (N=194, 21.3%), SSIs (N=154, 16.9%), BSIs (N=105, 11.5%) and gastro-intestinal infections (N=87, 9.6%; including 30 (3.3%) CDIs). The distribution of the main groups of HAIs are presented in Table 5, with more detailed data for the most frequent patient specialties, i.e. medicine, surgery, ICU and geriatrics. One-fifth of the HAIs (N=190, 20.9%) was linked to an invasive device. Most of the HAIs were linked to the current hospital (N=810, 88.9%) and the current ward (N=617, 67.7%). The median time between hospital admission and the onset of the HAI was 11 days (IQR 5;22). In 27.6% of all HAIs (N=251), the HAI was registered on the first two days after admission, including 163 HAIs (17.9%) already present on hospital admission. These patients were readmitted less than 48 hours after a previous admission to an acute care hospital with exceptions for SSIs, infections with an invasive device and *Clostridium difficile* infections. The most common HAIs present less than 48h after (re-)admission to the hospital were SSIs (N=83, 33.1%), pneumonia (N=40, 15.9%) and UTIs (N=32, 12.7%).

Table 5: Distribution of main groups of healthcare-associated infections (HAI), ECDC point prevalence survey (PPS) 2017, Belgium

	Patient Specialty				
	Total	**Medicine**	**Surgery**	**Intensive care**	**Geriatrics**
Pneumonia	197 (21.6%)	69 (24.6%)	20 (9.1%)	49 (36.3%)	43 (25.9%)
Other lower respiratory tract infection	45 (4.9%)	10 (3.6%)	2 (0.9%)	14 (10.4%)	10 (6.0%)
Urinary tract infection	194 (21.3%)	57 (20.3%)	39 (17.8%)	12 (8.9%)	54 (32.5%)
Surgical site infection	154 (16.9%)	16 (5.7%)	95 (43.4%)	15 (11.1%)	5 (3.0%)
Bloodstream infection	105 (11.5%)	40 (14.2%)	21 (9.6%)	24 (17.8%)	15 (0.9%)
Gastro-intestinal infection	87 (9.6%)	32 (11.4%)	15 (6.8%)	9 (6.7%)	22 (13.3%)
Systemic infection	40 (4.4%)	20 (7.1%)	6 (2.7%)	5 (3.7%)	5 (3.0%)
Skin and soft tissue infection	35 (3.8%)	14 (5.0%)	8 (3.7%)	1 (0.7%)	7 (4.2%)
Eye, ear, nose or mouth infection	19 (2.1%)	10 (3.6%)	1 (0.5%)	0	3 (1.8%)
Catheter-related infection	14 (1.5%)	7 (2.5%)	3 (1.4%)	2 (1.5%)	2 (1.2%)
Cardiovascular infection	9 (1.0%)	3 (1.1%)	2 (0.9%)	3 (2.2%)	0
Bone and joint infection	6 (0.7%)	2 (0.7%)	3 (1.4%)	0	0
Central nervous system infection	4 (0.4%)	0	3 (1.4%)	1 (0.7%)	0
Reproductive tract infection	2 (0.2%)	1 (0.4%)	1 (0.5%)	0	0
Specific neonatal cases	0	0	0	0	0
Total	911	281 (30.8%)	219 (24.0%)	135 (14.8%)	166 (18.2%)

ECDC = European Centre for Disease Prevention and Control

No microbiological samples were taken in 77 HAIs (8.5%). Test results were positive, negative or unknown/missing on the day of the PPS for 62.0% (N=565), 2.2% (N=20) and 27.3% (N=249) of the HAIs, respectively.

Overall 721 microorganisms were reported. The top 10 most commonly isolated microorganisms were *Escherichia coli* (N=162, 17.8%), *Staphylococcus aureus* (N=81, 8.9%), *Pseudomonas aeruginosa* (N=47, 5.2%), *Enterococcus faecalis* (N=44, 4.8%), *Klebsiella pneumonia* (N=38, 4.2%), *Enterobacter cloacae* (N=38, 4.2%), *Staphylococcus epidermidis* (N=37, 4.1%), *Clostridium difficile* (N=30, 3.3%), *Proteus mirabilis* (N=20, 2.2%), and *Candida albicans* (N=19, 2.1%).

Antimicrobial susceptibility results were collected for selected bug-drug combinations and are presented in Table 6. Overall, a composite index of AMR of 18.6% (92/495) was calculated. The % carbapenem resistance in *Enterobacteriaceae* was 1.3% (4/318).

Table 6: Overview of the number of isolates (selected bug-drug combinations) with known antimicrobial susceptibility testing results (AST; first-level antimicrobial resistance (AMR) markers combined) for healthcare-associated infections (HAIs) and resistant results to the antimicrobials included in the protocol, ECDC point prevalence survey (PPS) 2017, Belgium

Selected microorganisms (MO)	Number of MO with a known AST result * / all isolated MO	Number of resistant results to the included antimicrobials
Staphylococcus aureus	80/81	OXA (N=7), GLY (N=0)
Enterococcus faecium	11/11	GLY (N=1)
Enterococcus faecalis	42/44	GLY (N=1)
Escherichia coli	160/162	C3G (N=29), CAR (N=0)
Klebsiella pneumonia	37/38	C3G (N=18), CAR (N=0)
Klebsiella oxytoca	13/13	C3G (N=3), CAR (N=1)
Klebsiella spp., not specified	2/2	C3G (N=0), CAR (N=0)
Enterobacter cloacae	36/38	C3G (N=14), CAR (N=2)
Enterobacter aerogenes	9/10	C3G (N=2), CAR (N=0)
Enterobacter agglomerans	1/1	C3G (N=0), CAR (N=0)
Proteus mirabilis	18/20	C3G (N=1), CAR (N=0)
Proteus vulgaris	3/3	C3G (N=2), CAR (N=0)
Proteus spp., other	1/1	C3G (N=0), CAR (N=0)
Morganella spp.	10/13	C3G (N=4), CAR (N=0)
Serratia marcescens	11/13	C3G (N=1), CAR (N=0)
Citrobacter koseri	7/7	C3G (N=1), CAR (N=0)
Citrobacter freundii	5/5	C3G (N=3), CAR (N=1)
Citrobacter spp., other	1/1	C3G (N=1), CAR (N=0)
Acinetobacter baumannii	4/4	CAR (N=0)
Pseudomonas aeruginosa	44/47	CAR (N=4)

ECDC = European Centre for Disease Prevention and Control; MO = microorganism; AST = antimicrobial susceptibility testing; OXA = oxacilline; GLY = glycopeptides; C3G = third-generation cephalosporins; CAR = carbapenems; spp. = species

* First-level antimicrobial resistance markers combined

HOSPITAL INDICATORS

In Table 7, the results of several hospital structure and process indicators that were collected during the ECDC PPS are presented.

Table 7: Hospital indicators, ECDC point prevalence survey (PPS) 2017, Belgium

Indicators	Number of responding hospital sites	Median (IQR)
FTE antimicrobial stewardship / 250 beds	29	0.29 (0.20;0.55)
FTE infection control nurses / 250 beds	42	0.79 (0.58;1.11)
FTE infection control physicians / 250 beds	42	0.33 (0.26;0.55)
Number of blood culture sets / 1000 patient days	40	61.49 (39.24; 97.81)
Liters alcohol hand rub consumption / 1000 patient days	40	20.30 (15.91; 24.75)
FTE nurses / 100 beds	36	94.79 (73.79;112.76)

ECDC = European Centre for Disease Prevention and Control, FTE = fulltime equivalent, IQR = interquartile range

DISCUSSION

This report presented the results of the ECDC PPS 2017 in Belgian acute care hospitals. In total, 47 Belgian hospital sites (33 mergers) participated in this PPS. Patient characteristics were collected for 11800 eligble patients. HAI and antimicrobial use data are presented for patients having at least one active HAI and/or using at least one antimicrobial on the day of the survey. In addition, data on hospital indicators are presented.

MAIN RESULTS ON ANTIMICROBIAL CONSUMPTION

- The crude prevalence of patients with at least one antimicrobial treatment was 28.1%, with the highest prevalence in tertiary hospitals (30.8%) and on ICU wards (52.7%). This prevalence is similar than reported for the Belgian hospitals participating in the ECDC PPS 2011 (28.9%, 95% CI 26.8-31.1) and lower than reported in the European hospitals in the ECDC PPS 2011 (35.0%, country range: 21.4-54.7%, tertiary hospitals: 37.4%, ICU: 56.5%) (5).

- The top 3 of most frequently prescribed antimicrobials consisted of 'amoxicillin and a beta-lactamase inhibitor' (19.7%), cefazolin (9.7%) and 'piperacillin and a beta-lactamase inhibitor' (7.7%). Two-third of the antimicrobials (65.6%) were administered parenterally. These results correspond with the results of the national surveillance of antimicrobial consumption in Belgian hospitals (BeH-SAC) (10). The use of 'Penicillins in combination with a beta-lactamase inhibitor' (J01CR) was substantially higher in the current study (27.6% of all antimicrobials) than in other European countries (18.1%, based on the results of the ECDC PPS 2011) (5).

- Medical and surgical prophylaxis and treatment of HAIs were reported as indication in 6.2%, 13.5% and 24.2% of the prescribed antimicrobial agents, respectively. This is similar to the Belgian results of the ECDC PPS 2011 (9.0%, 11.8 and 26.4%, respectively) (5).

- The reason for antimicrobial use was available in the medical notes in 80.8% of the cases, an improvement in comparison with the Belgian results of the ECDC PPS 2011 (73.7%) (5). According to the action plan of BAPCOC 2014-2019, the target of 90.0% for this process indicator should be reached by 2019 (11).

MAIN RESULTS ON HAI

- A crude prevalence of patients with at least one HAI of 7.3% was detected. This is a status quo in comparison with the Belgian results of the ECDC PPS 2011 (7.1%, 95% CI 6.1-8.3) (5). The highest prevalences were found in tertiary hospitals (9.1%) and on ICU (20.9%). The HAI prevalence in Belgian acute care hospitals remains clearly higher than in other

European countries (ECDC PPS 2011: 6.0%, country range: 2.3-10.8%, tertiary hospitals: 7.2%, ICU: 19.5%) (5).

- The most frequently reported HAIs were pneumonia (21.6%), UTIs (21.3%), SSIs (16.9%) and BSIs (11.5%), and the most isolated microorganism was *Escherichia coli* (17.8%), which is in line with the results of the previous ECDC PPS in 2011 (5).

- Based on these results and using the Rhame and Sudderth formula, ECDC performed a conversion from prevalences to incidences. In Belgian acute care hospitals, the number of patients that develop a HAI every year was estimated at 101110 (95% CI 68186-141713). More information on these calculations can be found in the paper of Suetens et al. (12).

MAIN RESULTS ON HOSPITAL INDICATORS

- In comparison with the results of the ECDC PPS 2011, the median liters of alcohol hand rub consumption (20.3 liters) per 1000 patient days slightly increased in Belgian acute care hospitals. The median FTE infection control nurses per 250 beds remained stable (0.79 FTE) while the median FTE infection control physicians per 250 beds decreased from approximately 0.7 in 2011 to 0.33 FTE in 2017 (5).

- As far as we know, this is the first time that results on the indicator FTE antimicrobial stewardship (median: 0.29) per 250 beds in Belgian acute care hospitals are published. In a French study (2016), Le Coz et al. estimated that 3.6 FTE/1000 beds for antibiotic/infectious disease lead supervisors, 2.5 FTE/1000 beds for pharmacists, and 0.6 FTE/1000 beds for microbiologists are needed to perform all antimicrobial stewardship activities in French acute care hospitals (13).

STRENGTHS AND LIMITATIONS

- A standardised internationally recognized protocol of ECDC was used to perform this PPS in Belgian acute care hospitals, which makes it possible to compare the Belgian results with other European countries. The EU results of the ECDC PPS 2017 were not yet published at the moment that this report was written.

- Detailed data on antimicrobial consumption and HAIs were collected in a considerable number of hospitals sites (N=47). All participating hospitals already received a report of their individual results, benchmarked with the national results.

- Limitations associated with the study design should be acknowledged. This cross-sectional study is only taking a snapshot of a specific moment in time and may not represent the prevalence at all times. Consequently, HAIs and antimicrobial use of longer duration are more likely to be captured by PPSs.

- We had to rely on the hospitals to provide valid data. The PPS results were not adjusted according to the results of the validation study performed simultaneously in five Belgian hospitals and 250 patients. This was because the results were not representative at the

national level and therefore they will only be used for validation at the European level. Moreover, the results were not corrected for case-mix. Therefore, comparisons with the results of the previous PPS in 2011, with another subset of hospitals, should be interpreted carefully. Between 2011 and 2017, there has been a decrease in the length of stay in Belgian acute care hospitals (mean length of stay approximately 7.2 and 6.8 days in 2011 and 2016 respectively (10)), which could have had an influence on the results.

FUTURE PERSPECTIVES

- PPS should be performed repeatedly to follow-up the evolution of antimicrobial use and HAIs and to be able to evaluate the impact of antimicrobial stewardship and/or infection control programs. The next ECDC PPS will probably be planned in 2021. In the meantime, hospitals can participate in the Global PPS focusing on antimicrobial consumption and resistance (7). It is recommended to work with a fixed time-interval to organize a PPS in Belgian acute care hospitals (e.g. every two years) to provide reliable data for benchmarking.

- The high use of 'Penicillins in combination with a beta-lactamase inhibitor' and 'Fluoroquinolones' in Belgian acute care hospitals is an action point for the future. One of the current strategic goals of BAPCOC is to reduce antibiotic prescribing for UTIs in hospitals and long-term care facilities. In 2017-2018, actions were therefore launched and targeted in the first instance the reduction of unnecessary urinary catheter use and increase of knowledge among healthcare workers in order to prevent UTIs.

- The reasons for the high prevalence of HAIs in Belgian acute care hospitals, which remained stable over time, should be investigated further. Targets for improvement should be set.

- The low number of FTE for infection control and antimicrobial stewardship in Belgian acute care hospitals should be a subject in further discussions on the implementation of infection control and antimicrobial stewardship programs.

ACKNOWLEDGEMENTS

We would like to thank all the participating hospitals for their cooperation in this study:

- St. Joseph Klinik Sint Vith
- Algemeen ziekenhuis Turnhout
- Universitair ziekenhuis Brussel
- GZA ziekenhuizen
- Algemeen ziekenhuis Vilvoorde
- Sint-Trudo ziekenhuis
- Centre Hospitalier de Mouscron
- Clinique Saint Pierre
- CHU UCL Namur
- Centre Hospitalier Regional de la Citadelle
- Algemeen ziekenhuis St. Lucas
- Algemeen ziekenhuis St. Blasius
- Institut Jules Bordet
- Kliniek Sint-Jan
- Algemeen Ziekenhuis Vesalius
- Algemeen Ziekenhuis Sint-Dimpna
- Centre Hospitalier de Huy
- Algemeen ziekenhuis Sint-Elisabeth
- CHU et Psychiatrie de Mons-Borinage
- Algemeen Ziekenhuis Groeninge
- Centre Hospitaliers Jolimont
- Onze Lieve Vrouwziekenhuis Aalst
- Centre hospitaluer de Wallonie Picarde – Chwapi
- Centre Hospitalier Universitaire Saint-Pierre
- Algemeen Ziekenhuis Jan Palfijn
- Centre Hospitalier de la Haute Senne
- Centre Hospitalier Universitaire de Charleroi
- Clinique Notre-Dame de Grace
- Cliniques Universitaires Saint-Luc
- Vivalia – Centre Hospitalier de l'Ardenne
- Vivalie – Institut Famenne-Ardenne-Condroz
- CHC Liège (sites St. Joseph, Espérance, Waremme, Hermalle)
- CHC Liège (sites St. Elisabeth, St. Vincent)

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