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Antimicrobial use in hospitalized patients: a point prevalence survey across four tertiary hospitals in Niger

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Background: Antimicrobial resistance (AMR) is a global threat to public health. Misuse or overuse of antimicrobials contributes to the emergence of AMR. Data on antimicrobial prescribing represent the cornerstone for guiding antimicrobial stewardship strategies. This study aimed to assess the use, indications, classification, and quality indicators of antimicrobials prescribed to patients in four tertiary hospitals in Niger.

Methods: This cross-sectional study used the methodology for Global Point Prevalence Surveys in tertiary hospitals between January and April 2024. Hospital records of all inpatients on admission at 08:00 hours on a specific day were reviewed for antimicrobial use during the survey.

Results: The overall prevalence of antibiotic use across hospitals was 54.5% (n=470/862), ranging between 66.2% (n=149/234) and 44.3% (n=183/258). Most antibiotics used were antibacterials (89.0%, n=637). Third-generation cephalosporins (48.2%, 307/637), imidazole derivatives (14.7%, 105/716), penicillins with extended spectrum (9.6%, 69/716), and fluoroquinolones (6.1%, 44/716) were the most commonly prescribed classes of antibiotics. Most antibiotics (84.9%, n=608) were prescribed to treat community-acquired infections, while surgical prophylaxis accounted for 6.4% (n=47/716). Most antibiotics (96.1%; n=688/716) were used empirically, and less than a quarter (20.7%) of antibiotics prescribed had a documented stop/review date recorded. Only, 4.2% (n=31/716) of prescribed antibiotics had cultures and susceptibility testing requested.

Conclusion: This study shows that antibiotic prescription rates are high in tertiary hospitals, with relatively high use of third-generation cephalosporins. Most antibiotics were empirically used and not guided by culture and susceptibility testing. These results could be the subject of key interventions for hospital antibiotic stewardship strategies in Niger.

Introduction

Antimicrobial resistance (AMR) is acknowledged by the WHO as one of the greatest threats to public health, with an estimated 1.3 million deaths directly attributable to AMR in 2019 and nearly 5 million deaths associated with AMR.[1]

In sub-Saharan Africa (SSA), the relative burden of infectious diseases is high, and factors including health status, population education levels, infrastructure, prescriber training levels, and quality of antibiotics dispensed lead to the emergence and spread of antibiotic resistance.[2,3] West Africa is the region of the world most affected by antibiotic resistance, with high rates of death attributable to AMR of 27.3–114.8 deaths per 100 000 population.[1] Although antibiotic resistance results from a natural adaptation by bacteria, the emergence and spread of new resistant strains have been accelerated by misuse and overuse of antibiotics.[4–7] Studies have shown that up to 50% of hospitalized patients receive antibiotics unnecessarily.[8,9] Several studies conducted in Europe and Africa have shown a high prevalence of antibiotic use in hospitals.[9–14] A national Point Prevalence Survey (PPS) conducted in 26 hospitals in Sierra Leone revealed a 73.7% prevalence of antibiotic use.[15] A recent review found that antibiotic use among hospitalized patients ranged from 51.4%–83.5% in West Africa.[16]

To limit the emergence of AMR, optimize antibiotic use, and ensure appropriate antimicrobial use, it is necessary to implement antimicrobial stewardship programmes (ASPs).[17] Data on the quantity and quality of antimicrobial prescribing represent the cornerstone for guiding interventions under the ASP.[18]

A PPS is an approach used to obtain information on antimicrobial prescribing practices in hospitals worldwide.[18,19] It is a feasible method for obtaining data on antimicrobial use, and results can be used to identify intervention strategies.[7] It allows data to be collected at specific times with standardized procedures that enable data to be compared between hospital sites, regions, and countries.[19,20]

In Niger, to the best of our knowledge, no study has been carried out to evaluate the use of antibiotics in hospitals using the Global PPS methodology. PPS is an ideal tool in low-income countries like Niger, where medical records are primarily paper based, and routine monitoring of antibiotic prescribing is a challenge due to the high workload and resource issues faced by regular health data collection.

Therefore, this study aimed to assess the use, indications, classification, and quality indicators of antimicrobials prescribed to patients admitted to four tertiary hospitals in Niger.

Methods

Study design

This was a hospital-based, cross-sectional survey of antimicrobial use in four tertiary hospitals in Niger between January and April 2024.

General setting

In Niger, the healthcare system is organized according to a pyramidal structure with three levels: central, intermediate, and peripheral. The technical organization also includes an administrative component and a healthcare delivery component.

From bottom to top, the healthcare delivery component comprises the following:

- Primary level, represented by health district with its community relays, its network of health establishments consisting of health huts, infirmaries, private practices, and treatment rooms;
- Intermediate level, represented by regional hospital centres, mother and child health centres, polyclinics, and private clinics.
- The tertiary level comprises general referral hospitals, national hospitals, maternity hospitals, and national referral centres. They provide specialized medical care on the recommendation of health professionals at intermediate or primary levels.

Specific setting and study population

The four purposely selected sites included three national central and tertiary hospitals in Niger, as well as a national reference maternity, conveniently chosen considering their status as academic or tertiary referral hospitals of the country. Those were 'Hôpital Général de Reference (HGR)', 'Hôpital National Amirou Boubacar Diallo (HNABD)', 'Hôpital National de Niamey (HNN)' and 'Maternité Issaka Gazoby (MIG)'. All are located in Niamey, the capital city of Niger, and offer microbiology services, including bacterial cultures and antibiograms. None of these hospitals has an ASP.

Study instruments

The Global PPS method was adopted to provide a standardized method of monitoring antimicrobial use and assessing the quality of antibiotic prescribing in line with Global PPS and WHO definitions.[20,21] The Global PPS platform includes a free web-based application with forum-based user interfaces for data entry. Application checks for erroneous data entry, such as double entry of the same drug. The application also features built-in error and alert checks for data validation, as well as real-time analysis tools for feedback and reporting. Global PPS covers the whole world, and the online application enables direct comparison of antimicrobial use patterns in hospitals in different regions at national or international levels.

Study personnel and training

Before the survey, a team of health workers was assembled, including researchers of this study and other health professionals (final-year medical and pharmacy students). A 1-day information and training session was held for staff involved in PPS. Global PPS helpdesk, which hosts answers to frequently asked questions, was used to support training sessions. The training covered PPS terms and definitions, survey operations, and data collection procedures. This training was necessary to improve the reliability of the study results. The training was designed to introduce survey staff to the objectives of PPS and the purpose of each element of the data collection tool, such as the definition of terms, methods of evaluating individual patient data, and the responsibilities of each survey staff member. Following the training session, a pilot PPS was carried out in HNABD paediatric department before the start of the hospital-wide survey to enable corrective actions to be implemented.

Data collection tool and variables recorded

The study's variables are divided into three levels: hospital, department, and patient. Patient-level information also includes specific variables on indications and antibiotics. For targeted antibiotic prescriptions, various pathogens found and their respective types of resistance were recorded. ECDC defined the list of microorganism codes based on the following criteria: frequency of healthcare-associated infections (HAIs) and/or public health importance.[20] Antibiotic data variables provide information on each antibiotic prescribed and/or dispensed to the patient.

There was no interaction between patients and the researcher team, and the data collection process did not interrupt patient care.

We interviewed all hospital patients on the days of the survey. Inpatients of any age admitted for more than 24 h were eligible for inclusion in the study, while patients attending the on-call ward or admitted for less than 24 h to the ward were excluded. Medical records of patients admitted to the ward by 8:00 a.m. on the survey day at a given hospital were reviewed within 12 h to ascertain the current use of systemic antimicrobials. Data on topically administered antimicrobials were not collected. All departments within a hospital were surveyed in a single survey. Patient and departmental data were recorded on paper forms. Patient data were collected by reviewing clinical notes and patient records. For each patient receiving at least one antimicrobial treatment, patient data included age, gender, patient antimicrobial use and reasons for use, dosage, route of administration, presence of active community or HAIs, results of routine microbiological tests performed, and quality of antimicrobial prescription. Data collected onwards included ward type, the total number of beds, and number of patients admitted to each ward at the time of the survey.

To minimize the impact of patient movements between departments, each department was fully surveyed within a single day. Due to the reduced availability of staff, the survey was not conducted over weekends and public holidays.

As the survey collects information on surgical prophylaxis (SP) for 24 h before or at 8.00 a.m. on the day, the survey was not conducted in surgical departments the day after a weekend or public holiday, as elective procedures may be reduced on these days.

General terminologies

A therapy was defined as one treatment (i.e. administration of at least one antibiotic) per diagnosis. A prescription was defined as the use of a substance by one route of administration.

Anti-infectives have been classified as all drugs administered to treat or prevent infection. The list of antimicrobial agents to be surveyed according to the WHO ATC classification[22] included antibacterials for systemic use (J01), antimycotics and antifungals for systemic use (J02 and D01BA), drugs for treatment of tuberculosis (J04A), antibiotics used as intestinal anti-infectives (A07AA), antiprotozoals used as antibacterial agents, nitroimidazole derivatives (P01AB), antivirals for systemic use (J05), and antimalarials (P01B). A prescription was defined as the use of an antimicrobial by a single route of administration.

Pathogen-targeted antibiotics were defined as antibiotic prescriptions based on laboratory results for bacterial culture and susceptibility testing. For patients receiving SP, the duration of prophylaxis is coded as a single dose, 1 day, or more than 1 day. The protocol and additional definitions used in data collection are available at http://www.global-pps.com/documents/.

Data collection and analysis

Data were collected on paper forms and then entered into a database using the Global PPS web application (https://www.global-pps.com/fr/project/) for data entry, validation, and reporting.[21] They were then exported from the online platform to an Excel database and imported into SPSS (version 27) for analysis. Antibiotic agents were classified using the WHO Anatomical Therapeutic Chemical (ATC) classification system.[22] The prevalence of antimicrobial use is expressed as a percentage of the total number of patients receiving an antimicrobial at the time of the survey, divided by the number of patients admitted. We calculated the proportion of antimicrobials prescribed for each type of service, each therapeutic indication, and each diagnosis. We calculated the proportion of antimicrobials prescribed about quality indicators as a percentage of the total number of antimicrobials prescribed in each hospital. For treatments based on biomarker data or microbiological laboratory test results, the denominator was the number of antimicrobials prescribed for therapeutic use.

Ethical approval

The study was approved by the National Health Research Ethics Committee of Niger (N°03/2024/CNERS). Permission to conduct the study was sought from the chief executive officers of each selected hospital participating. All survey data were completely anonymized. In addition, the survey did not require direct contact with patients. Each patient file was assigned a unique but non-identifiable survey number, which was generated automatically. Data collection forms and electronic data were accessible only to study investigators.

Results

The four included hospitals had a total of 58 wards and 1430 patient beds (range: 182–607 beds per hospital). The median bed size was 24 (IQR: 14–31 beds) per ward. Over the study period, 862 individual folders and charts of patients admitted to all 58 wards were reviewed for the current use of antimicrobials.

Prevalence of antibiotic use

Of the 862 patients on admission, there were 716 antimicrobials prescribed for 470 patients (patient/prescription ratio, 1:1.52). The prevalence of antimicrobial consumption was 54.5% (470/862) among the patients reviewed. The median age of patients on antimicrobials was 35 years (IQR: 8–50 years). It ranged from 1 day to 90 years. The most typical route of antibiotic administration was the parenteral route (80.6%, n=577). Prevalence of antibiotic use varied between hospitals and departments (Table 1).

Most antibiotics used were antibacterials for systemic use (89.0%, n=637), followed by antiprotozoals (8.5%, n=61) and antimycobacterial (2.5%, n=18). Third-generation cephalosporins (48.2%, 307/637), imidazole derivatives (14.7%, 105/716), penicillins with extended spectrum (9.6%, 69/716), and fluoroquinolones (6.1%, 44/716) were the most commonly prescribed classes of antibacterials for systemic use (Table 2).

Drug utilization

Thirty-two different antibiotics were prescribed in all four hospitals. The five most frequently prescribed antibiotics were ceftriaxone (39.5%; 283/716), metronidazole (18.3%; 131/716), amoxicillin (8.5%; 61/716), gentamicin (8.2%; 59/716), and ciprofloxacin (4.9%; 35/716). This pattern of antibiotic use varied among different age groups. In children, ceftriaxone (48.2%, n=54/112), gentamicin (32.1%, n=36/112), ampicillin (6.3%, n=7/112), metronidazole (2.7%, n=3/112), and ciprofloxacin (1.8%, n=2/112) were the most common antibiotics used. Among the adult population, ceftriaxone (37.9%, n=229/604), metronidazole (21.2%, n=128/604), amoxicillin (9.9%, n=60/604), ciprofloxacin (5.5%, n=33/604), and amoxicillin/clavulanic acid (4.8%, n=29/604) were the five most commonly prescribed antibiotics. Figure 1 describes drug utilization at 100% (DU 100%) by ATC level 5 and the indications for use.

Antimicrobials' prescriptions by type of infection

According to the anatomical site of infection, the top three infections for which antibiotics were prescribed were skin and soft tissue infections (12,6%; n=90), pneumonia or lower respiratory infections (9.2%; n=66), and infections of the CNS (8,7%; n=62) (Table 3). The top three antibiotics for the treatment of skin and soft tissue infections were ceftriaxone (38.9%; n=35), metronidazole (26.7%; n=24), and amoxicillin (15.6%; n=14). For pneumonia or lower respiratory infections, the top three antibiotics used were ceftriaxone 28.8%; n=19), amoxicillin and clavulanic acid (22.7%; n=15), and amoxicillin (15.2%; n=10). The top three antibiotics for treating infections of the CNS were ceftriaxone (64.5%; n=40), gentamicin (11.3%; n=7), and metronidazole (8,1%; n=7).

Table 1. Overall antimicrobial use prevalence

Characteristics	HGR N (%)	HNABD N (%)	HNN N (%)	MIG N (%)	Overall N (%)	Range
Hospital						
Total beds	277	364	607	182	1430	182–607
Hospitalized patients	121 (43.7)	225 (61.8)	413 (68.0)	103 (56.7)	862 (60.3)	43.7–68.0
Treated patients	79 (65.3)	149 (66.2)	183 (44.3)	59 (57.3)	470 (54.5)	44.3–66.2
Prescribed antibiotics (per patient)	114 (1.4)	234 (1.6)	258 (1.4)	110 (1.9)	716 (1.5)	1.4–1.9
Department						
Surgical department	51 (44.7)	77 (32.9)	73 (28.3)	68 (61.8)	269 (37.6)	28.3–61.8
Medical department	44 (38.6)	155 (66.2)	179 (69.4)	25 (22.7)	403 (56.3)	69.4–22.7
Intensive care unit	19 (16.7)	2 (0.9)	6 (2.3)	17 (15.5)	44 (6.1)	0.9–16.7
Gender						
Male	74 (64.9)	143 (61.1)	151 (58.5)	2 (1.8)	370 (51.7)	1.8–64.9
Female	40 (35.1)	91 (38.9)	107 (41.5)	108 (98.2)	346 (48.3)	38.9–98.2
Route administration						
Oral	52 (45.6)	25 (10.7)	52 (20.2)	10 (9.1)	139 (19.4)	9.1–45.6
Parenteral	62 (54.4)	209 (89.3)	206 (79.8)	100 (90.9)	577 (80.6)	54.4–90.9
Indication						
Community-acquired infection	99 (86.8)	216 (92.3)	229 (88.8)	64 (58.2)	608 (84.9)	58.2–92.3
Hospital-acquired infection	—	3 (1.3)	23 (8.9)	6 (5.5)	32 (4.5)	0.0–8.9
Medical prophylaxis	—	—	—	1 (0.9)	1 (0.1)	0.0–0.9
Surgical prophylaxis (1 day)	—	2 (0.9)	—	—	2 (0.3)	0.0–0.9
Surgical prophylaxis (>1 day)	5 (4.4)	4 (1.7)	—	35 (31.8)	44 (6.1)	0.0–31.8
Unknown	10 (8.8)	9 (3.4)	6 (2.3)	4 (3.6)	29 (4.1)	2.3–8.8
Treatment						
Empirical therapy	107 (93.9)	225 (96.2)	246 (95.3)	110 (100)	688 (96.1)	93.9–100
Targeted therapy	7 (6.1)	9 (3.8)	12 (4.7)	—	28 (3.9)	0.0–6.1

HGR, Hôpital General de Reference; HNABD, Hôpital National Amirou Boubacar Diallo; HNN, Hôpital National de Niamey; MIG, Maternité Issaka Gazoby.

Table 2. Classification of antimicrobials prescribed by ATC classification system therapeutic subgroup and chemical subgroup (ATC4 level)

Antimicrobial classification	ATC code	Overall N (%)	HGR N (%)	HNABD N (%)	HNN N (%)	MIG N (%)
Total		716	114	234	258	110
Antibacterials for systemic use	J01	637 (89.0)	101 (88.6)	227 (97.0)	205 (79.5)	104 (94.5)
Third-generation cephalosporins	J01DD	307 (48.2)	37 (36.6)	102 (44.9)	117 (57.1)	51 (49.0)
Imidazole derivatives	J01XD	105 (16.5)	10 (9.9)	29 (12.8)	16 (7.8)	50 (48.1)
Penicillins with extended spectrum	J01CA	69 (10.8)	25 (24.8)	23 (10.1)	20 (9.8)	1 (1.0)
Other Aminoglycosides	J01GB	60 (9.4)	2 (2.0)	34 (15.0)	22 (10.7)	2 (1.9)
Fluoroquinolones	J01MA	44 (6.9)	18 (17.8)	14 (6.2)	12 (5.9)	—
Combinations of penicillins, including β-lactamase	J01CR	32 (5.0)	3 (3.0)	14 (6.2)	15 (7.3)	—
Macrolides	J01FA	10 (1.6)	4 (4.0)	4 (1.8)	2 (1.0)	—
β-Lactamase-resistant penicillins	J01CF	4 (0.6)	1 (1.0)	2 (0.9)	1 (0.5)	—
First-generation cephalosporins	J01DB	2 (0.3)	—	2 (0.9)	—	—
Carbapenems	J01DH	2 (0.3)	—	2 (0.9)	—	—
Sulfonamide and trimethoprim combinations	J01EE	2 (0.3)	1 (1.0)	1 (0.4)	—	—
Antimycobacterials	J04	18 (2.5)	1 (0.9)	7 (3.0)	10 (3.9)	—
Combinations of drugs for the treatment of tuberculosis	J04AM	18 (100)	1 (100)	7 (100)	10 (100)	—
Antiprotozoals	P01	61 (8.5)	12 (10.5)	—	43 (16.7)	6 (5.5)
Nitroimidazole derivatives	P01AB	27 (44.3)	10 (83.3)	—	13 (30.2)	4 (66.7)
Artemisinin and derivatives	P01BE	26 (42.6)	—	—	26 (60.5)	—
Combinations of artemisinin and derivatives	P01BF	8 (13.1)	2 (16.7)	—	4 (9.3)	2 (33.3)

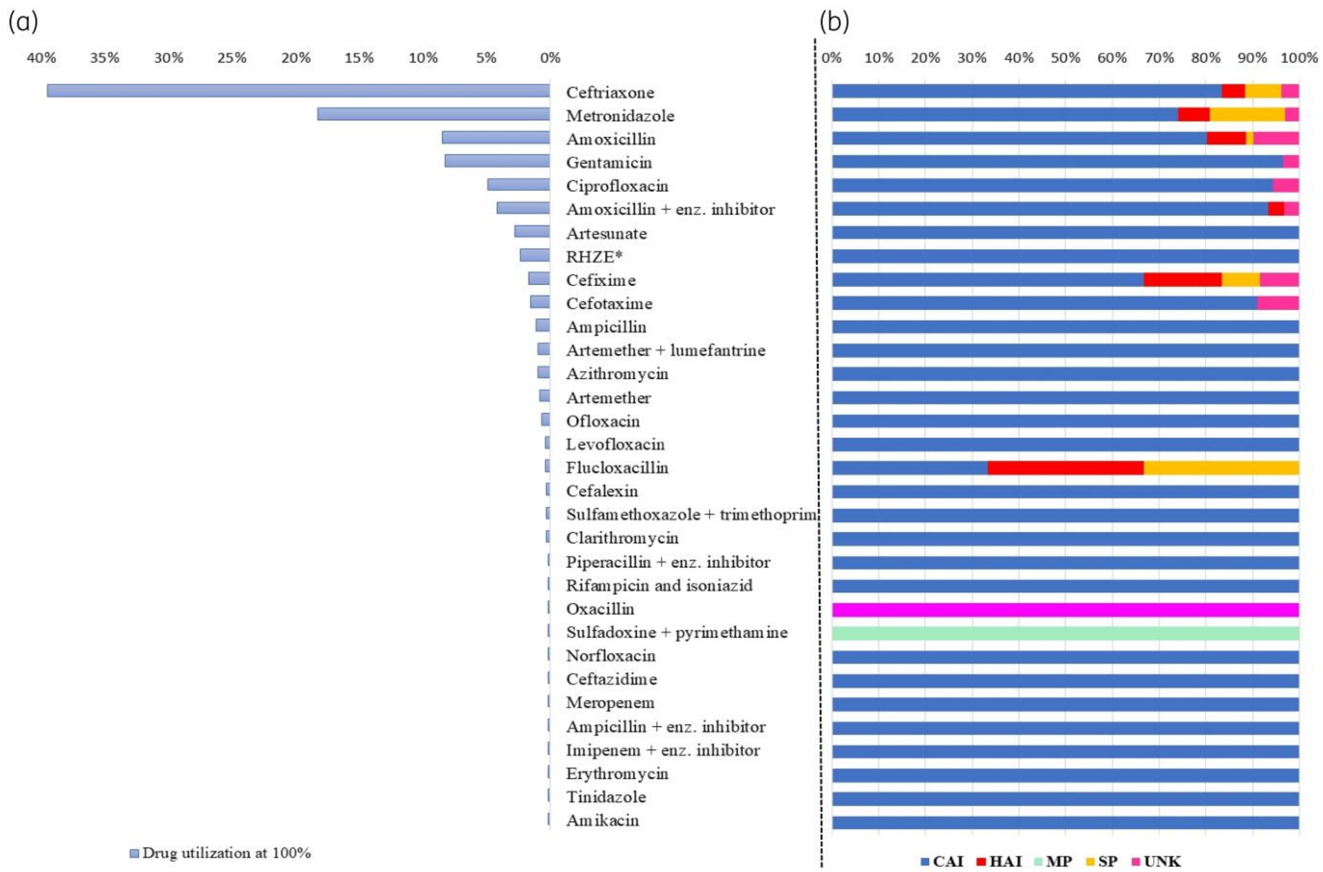


Figure 1. (a) Drug utilization at 100% by ATC level 5 and (b) the indications for use. CAI, community-acquired infections; HAI, healthcare-associated infections; MP, medical prophylaxis; SP, surgical prophylaxis; UNK, unknown. *Rifampicin, pyrazinamide, ethambutol, and isoniazid.

Table 3. Ten most common diagnoses for antimicrobial prescription by hospital

Diagnosis	Overall *N* (%)	HGR *N* (%)	HNABD *N* (%)	HNN *N* (%)	MIG *N* (%)
Total antimicrobials prescribed	716 (100)	114 (100)	234 (100)	258 (100)	110 (100)
Skin and soft tissue, including surgical site infection	90 (12.6)	38 (33.3)	16 (6.8)	32 (12.4)	4 (3.6)
Pneumonia or lower respiratory tract infections	66 (9.2)	4 (3.5)	24 (10.3)	32 (12.4)	6 (5.5)
Infections of the CNS	62 (8.7)	12 (10.5)	5 (2.1)	45 (17.4)	—
Intra-abdominal sepsis	58 (8.1)	6 (5.3)	35 (15.0)	15 (5.8)	2 (1.8)
Malaria	56 (7.8)	2 (1.8)	19 (8.1)	33 (12.8)	2 (1.8)
Obstetric/gynaecological infections	50 (7.0)	—	—	2 (0.8)	48 (43.6)
Sepsis	37 (5.2)	3 (2.6)	19 (8.1)	15 (5.8)	—
Bone/joint infections	37 (5.2)	14 (12.3)	10 (4.3)	13 (5.0)	—
Prophylaxis for obstetric or gynaecological surgery	35 (4.9)	—	—	—	35 (31.8)
Gastro-intestinal infections	32 (4.5)	10 (8.8)	14 (6.0)	8 (3.1)	—

HGR, Hôpital General de Reference; HNABD, Hôpital National Amirou Boubacar Diallo; HNN, Hôpital National de Niamey; MIG, Maternité Issaka Gazoby.

Antibiotics' prescription by type of indication

The indications of antibiotics were therapeutic in 89.4% ($n=640$) and prophylactic in 6.6% ($n=47$). Regarding the therapeutic use of antibiotics, most of the indications were for community-acquired infections (CAIs) (84.9%; $n=608$), followed by HAIs (4.5%, $n=32$) (Table 4). For all indications, third-generation cephalosporins were the most prescribed antibiotics, followed by imidazole derivates (Figure 2).

Overview of quality of antimicrobial agents' prescription

Of the 716 antimicrobial prescriptions registered, around 96.0% (*n* = 688) were prescribed empirically. A diagnosis or indication was documented in the patient record at the initiation of 94.4% (676/716) of antimicrobials whereas 20.7% (148/716) of antibiotics had a stop or review date documented, and 75.3% (539/716) of antimicrobial prescriptions were judged to be compliant with local guidelines (Table 5).

The use of biomarkers to support prescribing decisions has been reported in 67.2% (481/716). Only 4.3% (31/716) of prescribed antibiotics had cultures requested, of which 61.3% (19/31) of culture results were available in the files, with 5 isolates recorded. The identified organisms were *Mycobacterium tuberculosis* complex, *Klebsiella pneumoniae*, *Escherichia coli*, *Enterobacter* spp., and *Salmonella* spp.

Table 4. Indications for antibiotic use by hospital

	CAI		HAI		UNK		MP		SP	
Hospital	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
Overall	608	84.9	32	4.5	29	4.1	1	0.1	46	6.4
HGR	109	95.6	0	0.0	10	8.8	0	0.0	5	4.4
HNABD	225	96.2	3	1.3	9	3.8	0	0.0	6	2.6
HNN	235	91.1	23	8.9	6	2.3	0	0.0	0	0.0
MIG	68	61.8	6	5.5	4	3.6	1	0.9	35	31.8

CAI, community-acquired infections; HAI, healthcare-associated infections; MP, medical prophylaxis; SP, surgical prophylaxis; HGR, Hôpital General de Reference; HNABD, Hôpital National Amirou Boubacar Diallo; HNN, Hôpital National de Niamey; MIG, Maternité Issaka Gazoby.

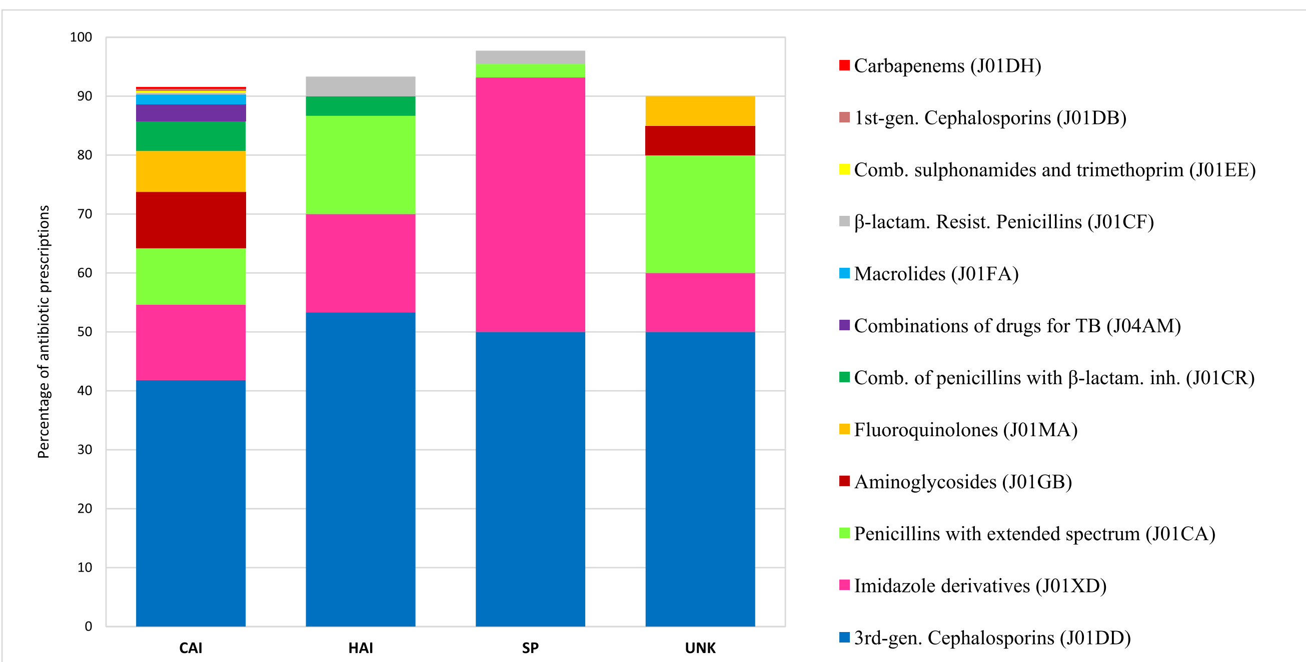
AWaRe classification

According to the WHO AWaRe classification, 42% of antibiotics prescribed belonged to the Access group and 51% to the Watch group (Figure 3). Regarding the Watch group, ceftriaxone (77.7%, *n* = 283) was the most antibiotic prescribed, followed by ciprofloxacin (9.62%, *n* = 35).

Discussion

This study evaluated the prevalence, indication, and types of antibiotics used among hospitalized patients in four referral acute care hospitals in Niger, as well as the quality indicators of antibiotic prescribing. For the first time, the point prevalence survey was conducted on patient-level antimicrobial use in Nigerien hospitals as part of an international study—the Global PPS. PPSs have proven to be a simple and effective method of providing valuable data on antimicrobial prescribing to set targets for improving antibiotic use and guiding ASPs.[23,24]

Antibiotic use was usual in tertiary care hospitals in Niger. In this study, 54.5% of patients received antibiotics at the time of the survey; of those, approximately 50% received two or more antimicrobial drugs for the same indication. This prevalence of antibiotic use was in line with what was found in previous studies in other low -and middle-income countries.[7,9,12,25–27] However, it was significantly lower than in other studies in



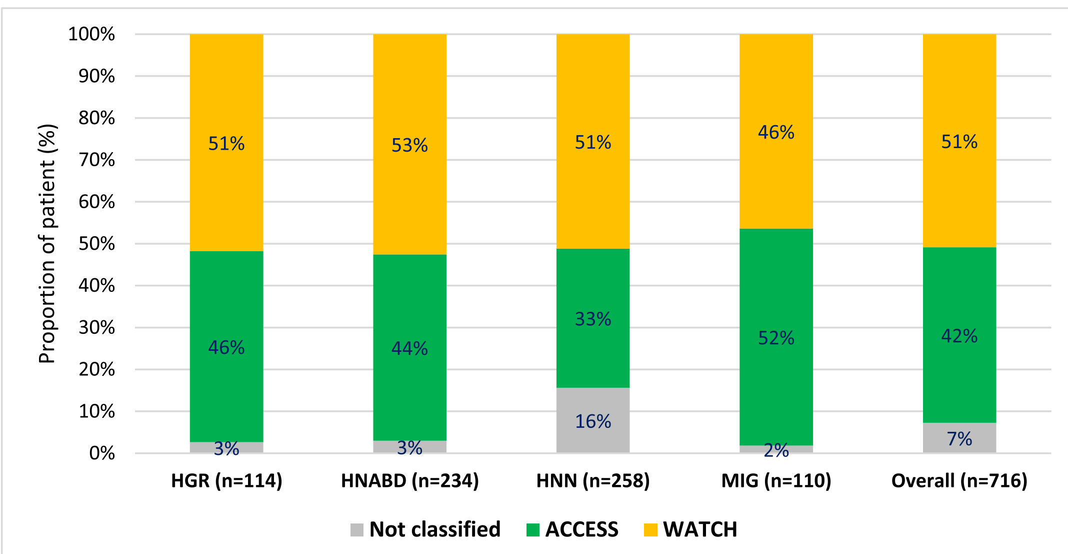
CAI = community-acquired infection, HAI = healthcare-associated infections, SP = surgical prophylaxis, UNK=unknown. *sum of the % prescriptions CAI – HAI – SP – UNK = 100%

Figure 2. Percentage of antibiotic prescriptions per antibiotic (ATC4 level) and indication. CAI, community-acquired infection; HAI, healthcare-associated infection; SP, surgical prophylaxis; UNK, unknown. Sum of the % prescriptions CAI–HAI–SP–UNK = 100%.

Table 5. Quality indicators of antimicrobial prescriptions at hospital level for all patients

	Hospital *N* (%) of antibiotic prescriptions				
Indicator	Overall	HGR	HNABD	HNN	MIG
Total antimicrobials prescribed	716	114	234	258	110
Number of antimicrobials for therapeutic use	669	109	228	248	69
Reasons for antimicrobials prescription recorded	676 (94.4)	105 (92.1)	219 (93.6)	247 (95.7)	105 (95.5)
Stop or review date documented	148 (20.7)	13 (11.4)	63 (26.9)	67 (26.0)	5 (4.5)
Compliant with guidelines	539 (75.3)	76 (66.7)	170 (72.6)	227 (88.0)	66 (60.0)
Not compliant with guidelines	118 (16.4)	25 (21.9)	31 (13.3)	22 (8.5)	40 (36.4)
Not assessable (no guideline for this indication)	30 (4.2)	3 (2.6)	26 (11.1)	1 (0.4)	—
No information (diagnosis/indication is unknown)	29 (4.1)	10 (8.8)	7 (3.0)	8 (3.1)	4 (3.6)
Targeted treatment[a]	28 (4.2)	7 (6.4)	9 (4.0)	12 (4.8)	—
Use of biomarkers[a]	448 (67.0)	62 (56.9)	190 (83.3)	138 (53.5)	58 (78.4)
Culture requests	31 (4.3)	8 (7.0)	8 (3.4)	15 (5.8)	—
Laboratory test results	19 (61.3%)	6 (75.0)	1 (12.5)	12 (80.0)	—
Antimicrobials for surgical prophylaxis	46 (6.0)	5 (4.4)	6 (2.6)	—	35 (31.8)
≤1 day[b]	2 (4.3)	—	2 (4.3)	—	—
>1 day[b]	44 (95.7)	5 (100.0)	4 (66.7)	—	35 (100.0)

[a]Denominator is number of antimicrobials prescribed for therapeutic use.
[b]Denominator is number of antimicrobials prescribed for surgical prophylaxis.



HGR: "Hôpital General de Reference", HNABD: "Hôpital National Amirou Boubacar Diallo", HNN: "Hôpital National de Niamey", MIG: "Maternité Issaka Gazoby"

Figure 3. Antibiotic prescribing patterns according to the WHO AWaRe classification. HGR, Hôpital General de Reference; HNABD, Hôpital National Amirou Boubacar Diallo; HNN, Hôpital National de Niamey; MIG, Maternité Issaka Gazoby.

Africa,[11,13–15] but higher than in similar studies in high-income countries.[18,23,28–31] Moreover, this finding was higher than the reference value of less than 30% recommended by the WHO.[32]

Overall, as reported in most countries,[6,7,12–14,16,23,26] β-lactams were the most frequently prescribed antibiotic class in our survey. Third-generation cephalosporins, mainly ceftriaxone, were the most commonly prescribed antibiotic class, with a high prescribing rate for community-acquired and HAIs. The overuse of ceftriaxone in this study highlights the need for antibiotic prescription guidelines to reduce its irrational use. In a systematic review of the use of ceftriaxone in SSA, the authors revealed that 60% of patients with ceftriaxone got inappropriate prescriptions.[33]

The most common indications for antibiotic use in this study were CAIs, followed by SP and HAIs. These findings corroborate reports from a PPS performed in Nigeria[11] and Tanzania.[34] More in-depth analyses are needed to determine the proportion of HAIs, mainly surgical site infections, caused by extended-spectrum β-lactamase-producing organisms. We noted many HAIs among SST infections in some hospitals. Further research is warranted to explain the reasons for this pattern.

Five quality indicators have been studied to identify inappropriate antibiotic prescribing.[18] These indicators could easily be used to set criteria for improving the quality of antibiotic use in hospitals.[18,35] The documentation of the reason for antibiotic prescribing in patient notes ensures communication of diagnosis and treatment between clinicians and other healthcare providers. It records when the prescription was stopped or revised and other interventions, such as antibiotic de-escalation. In line with previous studies,[13,18] the reasons for antimicrobial prescription were recorded in over 90% of this study. The documentation of the dates for stop/review was recorded for less than a quarter of the antibiotics prescribed in this study. This process review should be targeted as a critical intervention, and repeated PPSs should measure the effects of this intervention.[18,35] The third quality indicator, parenteral administration, was the most common in our study, accounting on average for over 80.6% of patients on antibiotics. The administration of broad-spectrum antibiotics such as third-generation cephalosporins is common practice in many hospitals.[6,7,13,23] The switch from parenteral to oral antibiotics has many advantages, including reduced catheter-related complications, lower healthcare costs, and shorter hospital stays. It represents a key measure for hospital management processes.[18,23,36,37] The fourth quality indicator concerned compliance with antibiotic therapy guidelines. Compliance with guidelines concerned only the choice of drug for therapeutic or prophylactic use.[18,21] In this study, around 4% of patients were treated with antibiotics for an unknown diagnosis, contrary to the guidelines. Overall, the average compliance with local treatment guidelines was 75%. This result suggested inappropriate antibiotic prescribing and that participating hospitals could use it as a target for improving antibiotic prescription. Prolonged SP was the fifth quality indicator. It was frequent in our survey, with 96% of patients having 24-h antibiotic prophylaxis. This result is similar to that reported in previous studies carried out in Europe and Africa.[9,11,13,16,18] For most surgical indications, antibiotic prophylaxis of more than 24 h does not prevent postoperative infections compared with SP of 24 h or less, and it also increases side effects and the risk of antibiotic resistance.[38,39] Most antimicrobials are prescribed empirically without supporting microbiological data, even in facilities where microbiological services are available. This situation reflects the low utilization of diagnostic microbiology services in Niger and other low-resource settings.[9,12,26]

The WHO has provided a list of antibiotics grouped into three major classes to support antibiotic stewardship. These are Access, Watch, and Reserve groups. In this study, only 42% of the antibiotics prescribed were in the Access group, while 51% were in the Watch group. The use of the Watch group in this study is higher than reported by previous studies in Ghana,[12] Kenya,[14] and Uganda.[13] None of the facilities at the time of the survey had patients on antibiotics classified in the Reserve group of the WHO AWaRe system, similar to previous studies.[12–14] Globally, this study's findings did not meet the target of at least 60% of the Access group's consumption, as defined by the WHO Thirteenth General Programme of Work.[40]

This study aligns with the national strategy and highlights the need to establish antimicrobial stewardship within the high prevalence of antibiotic use. It is important to note that most hospitals in Niger do not have specific guidelines for antimicrobial use. Local antibiotic guidelines improve the optimal use of antibiotics, promote behaviour change in antibiotic prescribing and dispensing practices, improve quality of care and patient outcomes, and build the best-practice capacity of healthcare professionals regarding the rational use of antibiotics.[41]

Our study has some limitations. Firstly, although we found similarities in the prevalence of antibiotic prescribing within hospitals, the findings cannot be generalized to the country. For example, private healthcare facilities were not surveyed, secondary and primary level hospitals were not represented, and the overall rates provided are averages. Secondly, the analysis was limited to descriptive statistics. However, to our knowledge, this is the first study in Niger to use Global PPS methodology data to characterize antibiotic prescribing. The results of this study may serve as a reference for other studies.

Conclusion

This study provided valid and reliable information on antimicrobial prescribing practices in tertiary hospitals in Niger. On average, every second patient received an antibiotic, with relatively high use of third-generation cephalosporins and metronidazole, particularly for CAIs. The documentation of dates for stop/review was recorded for less than a quarter of the antimicrobials prescribed. Almost all antibiotics were prescribed empirically, without microbiological testing. An urgent need is to improve access to bacterial culture and antibiotic susceptibility testing to guide antibiotic prescribing. The results of this study could be the subject of key interventions, and repeated PPSs should evaluate the effects of these interventions.

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Transparency declarations

None to declare.

Author contributions

O.T. conceptualized and designed the study, gathered the data for the Global PPS, carried out the statistical analyses, drafted the manuscript, and reviewed and revised the manuscript. C.C.D. assisted in conceptualizing the study, designing the study, and reviewing and revising the manuscript. A.Y. assisted in the conceptualization of the study, methodology, validation, formal analysis, investigation, and data curation, supervised the data management, and reviewed and revised the manuscript. E.M.T. assisted in the data collection for the Global PPS. N'K.T.N. assisted with the statistical analyses and reviewed and revised the manuscript. I.A.S. reviewed and revised the manuscript. S.B. assisted in the study's conceptualization, supervised the data management, and reviewed and revised the manuscript. S.M.S., M.D., E.O.A., and A.V.H. reviewed and revised the manuscript. S.M. coordinated and directed the study and reviewed and revised the manuscript. All authors read and approved the final manuscript.

References

1 Murray CJ, Ikuta KS, Sharara F *et al.* Global burden of bacterial antimicrobial resistance in 2019: a systematic analysis. *The Lancet* 2022; **399**: 629–55. https://doi.org/10.1016/S0140-6736(21)02724-0

2 Leopold SJ, van Leth F, Tarekegn H *et al.* Antimicrobial drug resistance among clinically relevant bacterial isolates in sub-Saharan Africa: a systematic review. *J Antimicrob Chemother* 2014; **69**: 2337–53. https://doi.org/10.1093/jac/dku176

3 Ouedraogo AS, Pierre HJ, Banuls A-L *et al.* Émergence et diffusion de la résistance aux antibiotiques en Afrique de l'Ouest: facteurs favorisants et évaluation de la menace. *Med Sante Trop* 2017; **27**: 147–54. https://doi.org/10.1684/mst.2017.0678

4 CDC. *Antibiotic Use in the United States, 2017: Progress and Opportunities*. Centers for Diseases and Prevention Control; 2020. https://archive.cdc.gov/www_cdc_gov/antibiotic-use/stewardship-report/2017.html.

5 Aboulmagd E, Kassem MA, Abouelfetouh A. Global landscape of microbial resistance. In: *21st Century Challenges in Antimicrobial Therapy and Stewardship*. Bentham Science Publishers, 2020; 1–31.

6 Haseeb A, Faidah HS, Algethamy M *et al.* Antimicrobial usage and resistance in Makkah region hospitals: a regional point prevalence survey of public hospitals. *Int J Environ Res Public Health* 2021; **19**: 254. https://doi.org/10.3390/ijerph19010254

7 Porto APM, Goossens H, Versporten A *et al.* Global point prevalence survey of antimicrobial consumption in Brazilian hospitals. *J Hosp Infect* 2020; **104**: 165–71. https://doi.org/10.1016/j.jhin.2019.10.016

8 Jacobs TG, Robertson J, van den Ham HA *et al.* Assessing the impact of law enforcement to reduce over-the-counter (OTC) sales of antibiotics in low- and middle-income countries; a systematic literature review. *BMC Health Serv Res* 2019; **19**: 536. https://doi.org/10.1186/s12913-019-4359-8

9 Labi A-K, Obeng-Nkrumah N, Dayie NTKD *et al.* Antimicrobial use in hospitalized patients: a multicentre point prevalence survey across seven hospitals in Ghana. *JAC Antimicrob Resist* 2021; **3**: dlab087. https://doi.org/10.1093/jacamr/dlab087

10 Vicentini C, Quattrocolo F, D'Ambrosio A *et al.* Point prevalence data on antimicrobial usage in Italian acute-care hospitals: evaluation and comparison of results from two national surveys (2011–2016). *Infect Control Hosp Epidemiol* 2020; **41**: 579–84. https://doi.org/10.1017/ice.2020.18

11 Abubakar U. Antibiotic use among hospitalized patients in northern Nigeria: a multicenter point-prevalence survey. *BMC Infect Dis* 2020; **20**: 86. https://doi.org/10.1186/s12879-020-4815-4

12 Amponsah OKO, Buabeng KO, Owusu-Ofori A *et al.* Point prevalence survey of antibiotic consumption across three hospitals in Ghana. *JAC Antimicrob Resist* 2021; **3**: dlab008. https://doi.org/10.1093/jacamr/dlab008

13 Kiggundu R, Wittenauer R, Waswa J *et al.* Point prevalence survey of antibiotic use across 13 hospitals in Uganda. *Antibiotics* 2022; **11**: 199. https://doi.org/10.3390/antibiotics11020199

14 Kamita M, Maina M, Kimani R *et al.* Point prevalence survey to assess antibiotic prescribing pattern among hospitalized patients in a county referral hospital in Kenya. *Front Antibiot* 2022; **1**: 993271. https://doi.org/10.3389/frabi.2022.993271

15 Kamara IF, Kanu J, Maruta A *et al.* Antibiotic use among hospitalised patients in Sierra Leone: a national point prevalence survey using the WHO survey methodology. *BMJ Open* 2023; **13**: e078367. https://doi.org/10.1136/bmjopen-2023-078367

16 Abubakar U, Salman M. Antibiotic use among hospitalized patients in Africa: a systematic review of point prevalence studies. *J Racial and Ethnic Health Disparities* 2024; **11**: 1308–29. https://doi.org/10.1007/s40615-023-01610-9

17 Paterson DL. The role of antimicrobial management programs in optimizing antibiotic prescribing within hospitals. *Clin Infect Dis* 2006; **42**: S90–5. https://doi.org/10.1086/499407

18 Versporten A, Zarb P, Caniaux I *et al.* Antimicrobial consumption and resistance in adult hospital inpatients in 53 countries: results of an internet-based global point prevalence survey. *Lancet Glob Health* 2018; **6**: e619–29. https://doi.org/10.1016/S2214-109X(18)30186-4

19 ECDC. *Point prevalence survey of healthcare-associated infections and antimicrobial use in European acute care hospitals—Protocol version 6.1, ECDC PPS 2022*–2023. 2019. https://data.europa.eu/doi/10.2900/017250.

20 WHO. WHO methodology for point prevalence survey on antibiotic use in hospitals. 2018. Available at: https://iris.who.int/handle/10665/280063.

21 Global-PPS. Global point prevalence survey of antimicrobial consumption and resistance. 2023. https://www.global-pps.com/.

22 WHOCC. WHO Collaborating Centre for Drug Statistics Methodology, Guidelines for ATC classification and DDD assignment 2023. 2022. https://www.whocc.no/filearchive/publications/2023_guidelines_web.pdf.

23 Versporten A, Bielicki J, Drapier N *et al.* The Worldwide Antibiotic Resistance and Prescribing in European Children (ARPEC) point prevalence survey: developing hospital-quality indicators of antibiotic prescribing for children. *J Antimicrob Chemother* 2016; **71**: 1106–17. https://doi.org/10.1093/jac/dkv418

24 Pauwels I, Versporten A, Vermeulen H *et al.* Assessing the impact of the Global Point Prevalence Survey of Antimicrobial Consumption and Resistance (Global-PPS) on hospital antimicrobial stewardship programmes: results of a worldwide survey. *Antimicrob Resist Infect Control* 2021; **10**: 138. https://doi.org/10.1186/s13756-021-01010-w

25 Momanyi L, Opanga S, Nyamu D *et al.* Antibiotic prescribing patterns at a leading referral hospital in Kenya: a point prevalence survey. *J Res Pharm Pract* 2019; **8**: 149. https://doi.org/10.4103/jrpp.JRPP_18_68

26 Oo WT, Carr SD, Marchello CS *et al.* Point-prevalence surveys of antimicrobial consumption and resistance at a paediatric and an adult tertiary referral hospital in Yangon, Myanmar. *Infect Prev Pract* 2022; **4**: 100197. https://doi.org/10.1016/j.infpip.2021.100197

27 Labi A-K, Obeng-Nkrumah N, Nartey ET *et al.* Antibiotic use in a tertiary healthcare facility in Ghana: a point prevalence survey. *Antimicrob Resist Infect Control* 2018; **7**: 15. https://doi.org/10.1186/s13756-018-0299-z

28 Magill SS, Edwards JR, Beldavs ZG *et al.* Prevalence of antimicrobial use in US acute care hospitals, May-September 2011. *JAMA* 2014; **312**: 1438–46. https://doi.org/10.1001/jama.2014.12923

29 Plachouras D, Kärki T, Hansen S *et al.* Antimicrobial use in European acute care hospitals: results from the second point prevalence survey (PPS) of healthcare-associated infections and antimicrobial use, 2016 to 2017. *Euro Surveill* 2018; **23**: 1800393. https://doi.org/10.2807/1560-7917.ES.23.46.1800393

30 Vandael E, Latour K, Goossens H *et al.* Point prevalence survey of antimicrobial use and healthcare-associated infections in Belgian acute care hospitals: results of the Global-PPS and ECDC-PPS 2017. *Antimicrob Resist Infect Control* 2020; **9**: 13. https://doi.org/10.1186/s13756-019-0663-7

31 German GJ, Frenette C, Caissy J-A *et al.* The 2018 Global Point Prevalence Survey of antimicrobial consumption and resistance in 47 Canadian hospitals: a cross-sectional survey. *Canadian Medical Association Open Access Journal* 2021; **9**: E1242–51. https://doi.org/10.9778/cmajo.20200274

32 Ofori-Asenso R. A closer look at the World Health Organization's prescribing indicators. *J Pharmacol Pharmacother* 2016; **7**: 51–4. https://doi.org/10.4103/0976-500X.179352

33 Meresa Bishaw B, Tegegne GT, Berha AB. Appropriate use of ceftriaxone in sub-Saharan Africa: a systematic review. *IDR* 2021; **14**: 3477–84. https://doi.org/10.2147/IDR.S329996

34 Seni J, Mapunjo SG, Wittenauer R *et al.* Antimicrobial use across six referral hospitals in Tanzania: a point prevalence survey. *BMJ Open* 2020; **10**: e042819. https://doi.org/10.1136/bmjopen-2020-042819

35 Malcolm W, Nathwani D, Davey P *et al.* From intermittent antibiotic point prevalence surveys to quality improvement: experience in Scottish hospitals. *Antimicrob Resist Infect Control* 2013; **2**: 3. https://doi.org/10.1186/2047-2994-2-3

36 Pollack LA, Plachouras D, Sinkowitz-Cochran R *et al.* A concise set of structure and process indicators to assess and compare antimicrobial stewardship programs among EU and US hospitals: results from a multinational expert panel. *Infect Control Hosp Epidemiol* 2016; **37**: 1201–11. https://doi.org/10.1017/ice.2016.115

37 Shrayteh ZM, Rahal MK, Malaeb DN. Practice of switch from intravenous to oral antibiotics. *SpringerPlus* 2014; **3**: 717. https://doi.org/10.1186/2193-1801-3-717

38 Hagel S, Scheuerlein H. Perioperative antibiotic prophylaxis and antimicrobial therapy of intra-abdominal infections. *Viszeralmedizin* 2014; **30**: 310–6. https://doi.org/10.1159/000368582

39 Branch-Elliman W, O'Brien W, Strymish J *et al.* Association of duration and type of surgical prophylaxis with antimicrobial-associated adverse events. *JAMA Surg* 2019; **154**: 590. https://doi.org/10.1001/jamasurg.2019.0569

40 WHO. *The WHO AWaRe (Access, Watch, Reserve) Antibiotic Book*. World Health Organization. ;2022. https://www.who.int/publications/i/item/9789240062382.

41 WHO. *Antimicrobial Stewardship Programmes in Health-Care Facilities in Low- and Middle-Income Countries: A WHO Practical Toolkit*. World Health Organization; 2019. https://iris.who.int/handle/10665/329404.