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Original Research

Antimicrobial stewardship leads from inpatient point prevalence surveillance of a tertiary-level care hospital

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Abstract

Background: To explore the scope of antimicrobial stewardship activities based on the point prevalence study of antimicrobials among hospitalized patients in a tertiary-level care hospital in the UAE. Methods: A single-center cross-sectional prevalence study was conducted among inpatients admitted to a tertiary care hospital using the European Surveillance of Antimicrobial Consumption tool in February 2023. Antimicrobials used against bacteria only were surveyed. All patients admitted to the selected departments at 8 AM on the day of the survey were included. Data were described in numbers and percentages. Results: Among 136 patients admitted at the time of the study, 87 received antimicrobials, representing a prevalence of 64%. A total of 144 antimicrobial prescriptions were prescribed in 87 patients. The majority of the antimicrobials were administered parenterally (n=122, 84.7%), and over 60% (n=53) of the patients on antimicrobials received two antimicrobials. The majority of antimicrobials used for therapy were empiric in nature (n=68, 89.5%). Over half of the patients receiving antimicrobials for surgical prophylaxis were prescribed antimicrobials for two or more days. More than 60% of the antimicrobial orders were adherent to the hospital guidelines. Conclusion: The point prevalence of the use of antimicrobials is high, which highlights the need for more efficient and targeted stewardship efforts in improving adherence with the hospital guidelines. Wide usage of broad-spectrum antimicrobials is observed.

Keywords: Antimicrobial Stewardship, United Arab Emirates, Tertiary-level Care, Pilot study

INTRODUCTION

Antimicrobial resistance (AMR) has been posing a serious threat to the existence of many valuable antimicrobials. Increasing AMR by specific pathogens is a concern globally, including in the United Arab Emirates (UAE).[1,2] AMR can increase costs, length of hospital stay, treatment failures, and mortality.[3] AMR is attributed to 1.27 million deaths globally in 2019, and by the year 2050, this number is estimated to increase to 10 million per year if no action is taken in combating resistance.[4] In 2015, based on the recommendations of the 68th World Health Assembly, WHO adopted a global action plan (GAP) on AMR to ensure the treatment and prevention of infectious diseases.[5] The UAE has a national action plan on AMR that is aligned with the WHO GAP-AMR.[6] Actions on containing AMR need to happen at institutional and patient levels with a national and global vision.

Antimicrobials overuse is associated with AMR.[7] To formulate effective policies and interventions to optimize their use, it is essential to collect information on the current situation of antimicrobial use. Collecting hospital-level data on the use of antimicrobials can identify targets for quality improvement. It also helps in monitoring the quality of prescribing and tracking the usage of antimicrobials using a standardized tool over time. Subsequently, implementing informed interventions to optimize antimicrobial use in hospitals has the potential to lower AMR at local and higher levels.[8]

Point prevalence surveys are efficient and well-established tools for identifying the usage of antimicrobials in hospitals. There are many reports on the prevalence of antimicrobials from European countries and the United States of America.[9,10] The literature on the prescription pattern and prevalence of antimicrobial use in the UAE is limited, with only one research report on the prevalence of use in a secondary level care hospital.[11] In addition, antimicrobial utilization data could help in designing antimicrobial stewardship (AMS) projects. Hence, our research aimed to explore the scope of AMS based on the point prevalence study of antimicrobials among hospitalized patients in a tertiary-level care hospital in the UAE.

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METHODS

Study design

A point prevalence surveillance aimed to develop AMS leads

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at the study site was conducted with a cross-sectional survey of data from the medical records. The study focused more on antimicrobial use in bacterial infections for inpatient care. A census sampling technique was used to collect antimicrobial data from all inpatients administered with antimicrobials on the day of data collection.

Study setting

The study was conducted at a 350-bed tertiary-level care hospital in the UAE. The hospital started operation in 2020, providing care services to patients, including medicine (internal medicine, cardiology, pulmonology, gastroenterology, neurology, and nephrology), surgery (general surgery, plastic surgery, and neurosurgery), obstetrics and gynaecology, pediatrics, neonatology, urology, intensive care, and ear, nose and throat care.

Data collection

A single-center cross-sectional prevalence study was conducted among inpatients admitted to the hospital in February 2023. The study was conducted with the approval of the institutional review board (IRB/COP/FAC/50/DEC-2022). The European Surveillance of Antimicrobial Consumption tool collected detailed information on antimicrobial use for patients receiving antimicrobials. The team of clinical pharmacists was trained to collect the data using the data collection tool for patients admitted to the hospital in medical, surgical, pediatric, maternal wards, and two intensive care units. All hospitalized patients in the ward at 8:00 A.M. on the day of the survey were included. The patients admitted for less than 24 hours, those admitted for day-care procedures, and those who were discharged from the wards before the time of the survey were excluded from the analysis. Only data on the admitting department and payment mode were collected for patients not on antimicrobials. The patients receiving antimicrobials for therapeutic use were classified as antimicrobials used on an empiric or directed basis. For patients receiving surgical antimicrobial prophylaxis, their medical records were reviewed to ascertain whether it was prescribed as a single dose, for less than 24 hours, or more than 24 hours from the medication administration records. Adherence with guidelines was assessed by comparing the antimicrobials prescribed with the hospital-based local antimicrobial policy. Antimicrobial prescriptions were classified as adherent if the selection of the drug was based on the hospital guidelines, partially adherent if the alternate choice was prescribed that was not the most preferred antimicrobial, and nonadherent if the prescribed antimicrobial was not mentioned in the guidelines. Not applicable if the indication was unclear. Antimicrobials were classified according to the WHO Anatomical Therapeutic Chemical (ATC) Classification.

Data Analysis

Descriptive statistics like mean, median, interquartile range, and frequency were used to present the data. Microsoft Excel and SPSS version 26 were used for the data analysis.

RESULTS

Among 136 eligible patients, 87 (64%) received antimicrobials. The patients on antimicrobials had a median age of 28 years (IQR 5-30), and the majority (n=54, 62.1%) were females. Almost all of them had normal kidney function (96.6%). Over a quarter of patients on antimicrobials (n=24, 27.6%) had a history of antimicrobial use on admission, which is one of the risk factors for multidrug resistant (MDR) pathogens, and 12 patients (13.8%) had a history of admission to healthcare facilities in the past 90 days. There were 31 patients (35.7%) who underwent surgery since admission. Only 2 (2.3%) patients had an active hospital-acquired infection. Further details on patient characteristics are presented in Table 1.

Among 87 patients who received antimicrobials, there were a total of 144 antimicrobial prescriptions. Among 144 antimicrobial prescriptions, 76 (52.8%) were therapeutic, and the remaining 68 (47.2%) were prophylactic in nature. The majority of the 144 prescriptions were parenterally (n=122, 84.7%) administered. Over 60 percent (n=53) of the patients on antimicrobials received 2 antimicrobials, and 32 (36.8%) of them received a single antimicrobial. The majority of

Table 1. Characteristics of patients

Patient Characteristics	**Number (%)***
Total number of eligible patients for PPS	136
Number of patients on antimicrobials	87 (64%)
Median age of patients receiving antimicrobials, years (IQR)	28 (5-30)
Gender	
Female	54 (62.1%)
Male	33 (37.9)
Number of patients with impaired renal function	3 (3.4)
History of antimicrobial use on admission	24 (27.6)
History of admission in HCF in the past 90 days	12 (13.8)
Number of patients on urinary catheter	9 (10.3%)
Number of patients on mechanical ventilation	3 (3.4%)
Active hospital-acquired infections	2 (2.3%)
Number of patients underwent surgery since admission	31 (35.6)
McCabe Score	
Non fatal disease	82 (94.3)
Ultimately fatal	0 (0)
Rapidly Fatal	5 (5.7)
Inpatient Ward Category	
Maternity	34 (39.1)
Pediatric	21 (24.1)
Surgical	14 (16.1)
Medical	11 (12.6)
NICU	4 (4.6)
ICU	3 (3.4)

*Data on the patient characteristics is among 87 patients who were on antimicrobials; PPS: point prevalence survey, IQR: interquartile range, HCF: healthcare facility, NICU: neonatal intensive care unit, ICU: intensive care unit; impaired renal function: estimated glomerular filtration rate <60 ml/min/1.73 m^2

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antimicrobials used for therapy were empiric in nature (n=68, 89.5%). Over half of the patients receiving antimicrobials for surgical prophylaxis were prescribed antimicrobials for 2 or more days. More than 60% of the antimicrobial orders were adherent to the hospital guidelines (Table 2).

Table 2. Details of the antimicrobial prescriptions*

Antimicrobial details	**Number of prescriptions (%)***
Number of antimicrobial prescriptions	144
Number of antimicrobials prescribed per patient	
1	32 (36.8)
2	53 (60.9)
3	2 (2.3)
Routes of administration	
IV	122 (84.7)
PO	22 (15.3)
Antimicrobial indication	
Therapeutic	76 (52.8)
Directed	8
Empiric	68
Prophylactic	68 (47.2)
Medical prophylaxis	18
One day	3
Single dose	8
Two or more days	39
Adherence to hospital clinical guidelines	
Fully adherent	87 (60.4)
Partially adherent	21 (14.6)
Nonadherent	28 (19.4)
Not applicable	8 (5.6)

*refers to the number and percentage from a total of 144 prescriptions

The antimicrobials used in the hospital during the point prevalence survey included doxycycline, penicillins, second-, third-, and fourth-generation cephalosporins, carbapenems, macrolides, aminoglycosides, fluoroquinolones, metronidazole, vancomycin, and trimethoprim/sulfamethoxazole. The most common antimicrobial used was ceftriaxone (n=32, 22.2%), followed by metronidazole (n=27, 18.8%), cefuroxime (n=25, 17.4%) and ampicillin (n=9, 6.3%). Three antimicrobials, namely cefepime, gentamicin, and azithromycin, had an equal number of orders (n=8, 5.6%). The most common antimicrobial used in medical and surgical patients was ceftriaxone and cefuroxime, respectively (Table 3).

There were prescriptions of antimicrobials classified as restricted antimicrobials as per the hospital antimicrobials policy. The majority of the prescriptions for these antimicrobials were for cefepime, followed by meropenem (Table 4). Cefepime was used majorly in surgical patients in intraabdominal surgeries as a first-line agent, whereas meropenem, amikacin,

Table 3. Antimicrobial agents prescribed

Antimicrobial	**Number of prescriptions (%)***
Tetracycline (J01AA)	
· Doxycycline (J01AA02)	2 (1.4)
Penicillins with extended-spectrum (J01CA)	
· Ampicillin (J01CA01)	9 (6.3)
Combinations of penicillins (J01CR)	
· Amoxicillin-clavulanic acid (J01CR02)	3 (2.1)
Second-generation cephalosporins (J01DC)	
· Cefuroxime (J01DC02)	25 (17.4)
Third generation cephalosporins (J01DD)	
· Ceftazidime (J01DD02)	1 (0.7)
· Ceftriaxone (J01DD04)	32 (22.2)
· Cefixime (J01DD08)	3 (2.1)
Fourth generation cephalosporins (J01DE)	
· Cefepime (J01DE01)	8 (5.6)
Carbapenems (J01DH)	
· Meropenem (J01DH02)	6 (4.2)
Combinations of sulfonamides and trimethoprim, incl. derivatives (J01EE)	
· Trimethoprim/Sulfamethoxazole (J01EE01)	4 (2.8)
Macrolides (J01FA)	
· Clarithromycin (J01FA09)	1 (0.7)
· Azithromycin (J01FA10)	8 (5.6)
Other aminoglycosides (J01GB)	
· Gentamicin (J01GB03)	8 (5.6)
· Amikacin (J01GB06)	2 (1.4)
Fluoroquinolones (J01MA)	
· Ciprofloxacin (J01MA02)	1 (0.7)
· Levofloxacin (J01MA12)	5 (3.5)
Imidazole derivatives (J01XD)	
· Metronidazole (J01XD01)	27 (18.8)
Glycopeptide antibacterials (J01XA)	
· Vancomycin (J01XA01)	2 (1.4)
Total	144

*refers to the number and percentage from a total of 144 prescriptions

Table 4. Restricted antimicrobials usage

Antimicrobial	**History of previous antimicrobial use/restricted antimicrobial***
Cefepime (J01DE01)	0/8 (0%)
Amikacin (J01GB06)	2/2 (100%)
Meropenem (J01DH02)	5/6 (83.3%)
Vancomycin (J01XA01)	2/2 (100%)

*The numerator is the number of patients with a history of previous antimicrobial use in the last 90 days, and the denominator is the total number of patients with restricted antimicrobial prescriptions.

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and vancomycin were used in medical patients with MDR risk factors who have a history of previous antimicrobial use.

The major indication for using antimicrobials for therapeutic purposes was LRTI (n=26, 47.4%). The prescription of antimicrobials based on the site of infection is presented in Table 5.

Table 5. Antimicrobial prescription pattern by indication

Site	Total number (%)	Treatment (n=76)	Prophylaxis (n=68)
Bone and ioint	3 (2.1)	3	0
Central nervous system	2 (1.4)	2	0
Genital	56 (38.9)	1	55
Intraabdominal	18 (12.5)	9	9
Respiratory	46 (31.9)	46	0
Skin soft tissue	6 (4.2)	2	4
Unidentified	13 (9)	13	0

DISCUSSION

The hospital audit of antimicrobial prescription practices using point prevalence surveillance is an established strategy to assess the antimicrobial prescription practices, identify the areas of concern to devise interventions, and track the future use of antimicrobials at the same study site.[12] This study described antimicrobial use in the UAE tertiary-level care hospital and identified the areas of improvement to design/modify, implement, and monitor feasible AMS projects. The prevalence of the use of antimicrobials in our study was high. A report from a secondary care hospital found their antimicrobial use prevalence to be almost half of our study.[11] This difference can be explained by the difference in the scope of services provided by the two hospitals. The hospital with half the prevalence of antimicrobials has mostly departments related to surgery (80.5%), whereas our study included patients treated in intensive care units, including neonatal ICU, medicine, pediatrics, surgery, and obstetrics departments. In the absence of reports from the tertiary-level care settings in the Emirates, we compared the antimicrobial prevalence in our study to the prevalence in the Middle East region. A study from a Jordanian hospital had a similar prevalence of antimicrobials 78.2%, which was more than the prevalence identified in our study.[13] The overall prevalence of antimicrobial use among 26 hospitals in Saudi Arabia was found to be 46.9%, ranging from 16.7 to 76%.[14]

Antimicrobials were administered by parenteral route in 85% of our patients, which was almost the same when compared to the above-mentioned UAE, Saudi Arabia, and Jordan hospital studies.[11,13,14] Third-party private insurance networks insured the majority of the patients at the study site, and high percentages of parenteral antimicrobials are attributed to the short length of hospital stay. The majority of our patients were prescribed 2 antimicrobials, which was high. One possible reason for this can be the addition of metronidazole to surgical prophylaxis.

The most common antimicrobial used was ceftriaxone, and the pattern is almost the same as reports from the Jordan study.[13] The major reason for the prescription of ceftriaxone in our patients was that the majority of the prescriptions used for therapy were on an empiric basis, and ceftriaxone was the empiric choice of antimicrobials for many adult and pediatric indications. Metronidazole was next to ceftriaxone in the hospital's most commonly used antimicrobials. Metronidazole is used in surgical patients, similar to the region's reports.[15,16] The majority of use of metronidazole was in combination with other antimicrobials, which is an area of improvement for the stewardship team.

Cefuroxime remains the most widely used antimicrobial in surgical patients, which is in accordance with the hospital guidelines. Our usage of cefuroxime is similar to other hospitals in the region.[17,18] The use of cefuroxime is common in the region, as seen in reports from Qatar and Saudi Arabia.[15,19] However, there are also practices in regions where first-generation cefazolin is being used as surgical prophylaxis.[20,21] The use of ceftriaxone for surgical prophylaxis was very less in our study; however, there are reports on the use of third-generation antimicrobial ceftriaxone in the region.[15,19]

Inappropriate use of cefepime was seen in surgical patients undergoing intraabdominal surgeries. This could contribute to growing resistance, as was reported by a high prevalence of MDR *Pseudomonas aeruginosa*, particularly in patients having a history of antimicrobial use by Ahmed et al. from Qatar.[22] The use of restricted antimicrobials in our setting was less, and in the majority of cases, they were used in patients having a history of antimicrobial use in the past. One of the reasons for less use of restricted antimicrobials could be the need for verification and approval by clinical pharmacists to continue use after the first dose. Prolonged duration of surgical antimicrobials was used in the majority (78%) of our patients. The same problem was reported in many settings.[19,22] About 60% of the antimicrobial prescriptions in our setting were found to be adherent to the local guideline, which was low compared to some settings in the Middle East and Europe.[9,11]

This study has the natural limitations and advantages of point prevalence antimicrobial use studies. Again, the results could be different if the study was performed on a different date and month of the year. Though the study findings are not

generalizable even to other healthcare facilities in the country or region, this report is a case of institutional antimicrobial use, which is an experience worth referring to. The information might have global relevance to reflect on this case and what actions are the ways forward in such situations. As our focus was on exploring the needs of AMS, this study serves its purpose of more targeted follow-up studies of the effectiveness of AMS that shall be conducted in the study site.

CONCLUSION

The point prevalence of the use of antimicrobials is high, which highlights the need for more effective stewardship efforts in improving adherence to hospital guidelines. Moreover, the use of broad-spectrum antimicrobials in surgical patients is also an area of concern needing stewardship interventions. The prioritized leads for a targeted AMS from this study were reduced use of metronidazole in combination, reduced duration of surgical prophylaxis, and improvements in the prescription pattern of cefepime in surgical patients.

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