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RESEARCH ARTICLE

Prescription Patterns and Compliance with Antimicrobial Stewardship Team Recommendations Among Physicians in a Private Hospital in United Arab Emirates

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Abstract:
Aim: To describe the prescription patterns and the compliance to antimicrobial stewardship team recommendations among physicians practicing at Al Zahra Private Hospital, Dubai.

Methods: A point prevalence study of antimicrobial prescription between January 2020 to April 2020 in “Al-Zahra” private hospital, Dubai, United Arab Emirates. All patients aged > 14 years who were prescribed at least one dose of antimicrobial agents were included with a total of 666 patients.

Exclusion Criteria: Patients are seen in A/E and ambulatory care who did not stay overnight and those who received antimicrobials for perioperative or medical prophylaxis were excluded.

Statistical Analysis: Statistical Analysis was done using excel program descriptive statistics were used to describe the baseline demographic data and clinical characteristics. Categorical variables are presented as counts and percentages, whereas continuous variables are presented as mean.

Results: A total of 666 patients’ medical records were reviewed during January 2020 to April 2020. Respiratory tract infections were the most common diagnosis encountered (456/666), representing 68.5% in total. A total of 994 courses of antimicrobials were prescribed during the study period. Antimicrobial was considered ‘appropriate’ in 70.3% (979/1393), and ‘not indicated’ in 19.7% (273/1393) of cases. In the remaining 10% of cases (141/1393), antimicrobial was indicated but required antimicrobial stewardship team (A.M.S) intervention. The compliance to accept antimicrobial stewardship team recommendations and change therapy accordingly in our study was only 32.6% (133/412)

Conclusion: In this study, the prevalence of inappropriate antimicrobial prescribing is comparable to that found in other studies worldwide. However, the compliance with AMS recommendations is much lower than described in the literature.

Keywords: Antimicrobial, Stewardship, Compliance, United Arab Emirates, Infectious Disease Society of America, Electronic Medical Record.

1. INTRODUCTION

Antimicrobial Resistance (AMR) is a global problem. According to a U.S the Centre for Disease Control (CDC) report in 2019, more than 2.8 million infections were recorded each year due to antibiotic-resistant organisms in the United States. These infections caused more than 35,000 deaths. In addition, nearly 223,900 people in the US required hospitalization for Clostridioides Difficile Infection (CDI) [1]. Antimicrobial Stewardship Program (AMSP) is an effective strategy to combat the emergence of AMR. It has been shown...
that AMSP can reduce unnecessary antibiotic prescribing in hospitalized patients, which in turn can lead to a reduction in hospital-acquired infections and AMR [2]. The Joint Commission (JC) and Joint Commission International (JCI) require organizations to develop AMSP to meet standards for accreditation [3].

In the United Arab Emirates (UAE), the National Antimicrobial Stewardship Sub-Committee was established in August 2018. The committee includes members from governmental, academic, and private organizations, and it oversees all antibiotic stewardship activities across the UAE.

Al Zahra Private Hospital (Dubai) established an AMSP in 2017. The aims of this program are:

1. Development of perioperative antimicrobial prophylactic guidelines and monitoring compliance with those guidelines.
2. Prospective audit with intervention and feedback of all antimicrobial prescriptions across the hospital.
3. Implementation of various strategies to optimize antimicrobial prescribing, such as extended antimicrobial infusion, dose optimization according to kidney and liver function, therapeutic antimicrobial level monitoring, and de-escalation.
4. Development of hospital guidelines for the treatment of commonly encountered infections.
5. Reduction in inappropriate antimicrobial prescribing.
6. Education of prescribers regarding AMR and optimization of antimicrobial prescribing.
7. Implementation of clinical decision support tools to support antimicrobial prescribing in the Electronic Medical Record (EMR).

The AMS team at Al Zahra Hospital consists of a team leader, an intensive care consultant, a clinical pharmacist, a clinical microbiologist, and an infection control nurse. The core strategy adopted by the team is daily prospective audit and feedback of all antimicrobial prescriptions, including surgical prophylaxis. The AMS team reviews the patient's EMR, makes their recommendation regarding the antimicrobial prescribed, documents it in the EMR, and then communicates it to the Most Responsible Physician (MRP) via phone. A 72-hour antibiotic time-out alert within the EMR system encouraged the physicians to review their initial antimicrobial prescription and de-escalate therapy if microbiology results revealed a susceptible organism. The AMS team reports to Antimicrobial Stewardship Committee on monthly basis. The committee comprises the following members: Chief Medical Officer (CMO), Nursing Director, Director of pharmacy, physicians representing different departments, infection preventionist, and the AMS team members.

This study aims to describe the prescription pattern and compliance with AMS team recommendations among physicians at Al Zahra Private Hospital (Dubai).

2. METHODS

This was a point-prevalence study conducted during the time period between January to April 2020. The hospital is a 121-bed hospital located in the center of Dubai. The hospital has several specialties such as internal medicine, gastroenterology, neurology, cardiology, oncology, nephrology, general surgery, surgical oncology, urology, orthopedics, obstetrics, and gynecology. The intensive care unit is a 10-bed closed unit admitting medical and surgical patients. Our administration approved the ethical committee exemption for this study because it does not involve any patient’s intervention. Consent forms were waived because the patients’ data were deidentified.

All patients aged more than 14 years admitted for at least one day and received at least one dose of an antimicrobial were included in the study. Exclusion criteria were:

1. Patients visiting the accident and emergency department who were not admitted to the hospital.
2. Patients seen at the outpatient clinic.
3. Ambulatory care patients who did not stay overnight.
4. Patients who were prescribed antimicrobials for perioperative prophylaxis.
5. Patients on antimicrobials for medical prophylaxis.

2.1. Data Collection

The point-prevalence study was performed for the time period of 1st of January to 30th of April 2020. This data was collected by the clinical pharmacist in a secure database (Excel). Training was provided for the clinical pharmacist on data entry using a structured data collection tool. The point-prevalence survey was performed by members of the AMS team on all admitted patients prescribed at least one antimicrobial agent for suspected or confirmed infection.

2.2. Study Variables

The following data were extracted from the EMR:

1. General Information: patient demographic information such as age and gender, hospital length of stay, intensive care admission, comorbidities such as diabetes mellitus, renal impairment, the requirement of hemodialysis, penicillin allergy, and if any surgery performed during current admission.
2. Antimicrobial related information: prescriber specialty, indication for antimicrobial prescription, antimicrobial international non-proprietary name, start date, dose, frequency, route of administration.
3. A.M.S. team intervention related Information: whether intervention is needed or not and type of intervention, and prescriber agreement with A.M.S. recommendations and 72 hours review of antimicrobial prescription.
4. Ordered tests related information: collected microbiological cultures, isolated organisms, multiplex polymerase chain reaction, and radiological examinations.

2.3. Statistical Analysis

Statistical Analysis was done using Excel program. Descriptive statistics were used to describe the baseline demographic data and clinical characteristics. Categorical
variables are presented as counts and percentages, whereas continuous variables are presented as mean.

2.4. Definitions

Community-acquired infections: if patients presented with infection less than 48 hours from hospital admission [4].

Hospital-acquired infections: if patients presented with infection more than 48 hours from hospital admission [4].

Appropriate antimicrobial prescription: antimicrobial prescription is considered appropriate if it is complying with the recommendations of the Infectious Disease Society of America (IDSA) practice guidelines in terms of indication, antimicrobial used, dose, frequency, route, and duration [5 - 11].

Prospective audit and feedback: defined as a review of the antimicrobial therapy by the AMS team after the agent has been prescribed accompanied by suggestions to optimize use [12].

Antibiotic course: defined as any a single or combination of antimicrobials prescribed for a suspected or confirmed infection.

Polymerase Chain Reaction (PCR) Multiplex Test: a technology that is used for rapid and simultaneous detection of multiple organisms and resistance markers using a fluorescently labeled probe and more than one primer [13].

3. RESULTS

3.1. Demographic Data

A total of 666 patients were reviewed during the study period. The mean age is 42.2 ± 15.58 years (14-92 years). Fifty-four percent (54%) were males. The mean hospital length of stay is 6.7 ± 11.55 days (1 – 130 days). Fifteen patients (2.25%) died during this period. Table 1 lists patients' characteristics and comorbidities.

Table 1. Patients characteristics.

| Characteristic                   | Number |
|----------------------------------|--------|
| Male                             | 360 (54%) |
| ICU admission                    | 96 (14.4%) |
| Diabetes mellitus                | 94 (14.1%) |
| Creatinine level > 120 mmol/L   | 38 (5.7%) |
| Hemodialysis                     | 12 (1.8%) |
| Cancer                           | 43 (6.4%) |
| Surgery during current admission | 79 (11.8%) |
| Penicillin allergy               | 28 (4.2%) |

Abbreviation: ICU: Intensive Care Unit.

3.2. Types of Diagnosed Infections

A total of 771 infectious diagnoses were recorded (Table 2). Some patients were having more than one episode of infection during their hospital stay (105/666). Out of all diagnoses, 3.2% (25/771) were hospital-acquired, and 96.8% (746/771) were community-acquired. There were 11 cases of hospital-acquired pneumonia, 5 cases of ventilator-associated pneumonia, 4 cases of Clostridioides difficile, 3 cases of catheter-related bloodstream infection, one case of catheter-associated urinary tract infection, and one case of surgical site infection.

Table 2. Top 15 infectious diagnoses.

| Diagnoses                         | Number |
|-----------------------------------|--------|
| Community-acquired pneumonia      | 135 (17.5%) |
| COVID-19                          | 124 (16.1%) |
| Intra-abdominal infection         | 75 (9.7%) |
| Bronchitis                        | 57 (7.4%) |
| Influenza                         | 67 (8.7%) |
| Urinary tract infection           | 45 (5.8%) |
| Gastroenteritis                   | 29 (3.7%) |
| Skin and soft tissue infection    | 22 (2.8%) |
| Pharyngitis                       | 22 (2.8%) |
| Obstetrics/gynaecological Infection | 21 (2.7%) |
| Sepsis of un-identified source    | 15 (1.5%) |
| Hospital-acquired pneumonia       | 11 (1.4%) |
| Aspiration pneumonia              | 10 (1.3%) |
| Meningitis                        | 6 (0.8%) |

Respiratory tract infection was the most common diagnosis encountered, followed by intra-abdominal and urinary tract infections. Table 2 lists the top 15 infectious diagnoses.

In 37 cases (4.8%), antimicrobials were prescribed for non-infectious diagnoses, such as renal colic (9 cases), biliary colic (6 cases), non-infectious diarrhea (6 cases), intestinal obstruction (3 cases), non-specific abdominal pain (2 cases), cough (3 cases), hemorrhoids (2 cases), non-infective exacerbation of certain chronic diseases such as sickle cell vaso-occlusive crises (3 cases), inflammatory bowel disease (2 cases) and chronic obstructive pulmonary disease (1 case).

Antibiotics were also prescribed for patients with a confirmed viral infection (7.1%/55/771). Out of 124 patients with confirmed COVID 19, 72 patients received antibiotics (58%). Seventy percent (70%) of antibiotics prescribed for those patients were not indicated. Other confirmed viral infections that were prescribed antibiotics inappropriately are infectious mononucleosis (2 cases), dengue fever (one case), and cytomegalovirus infection (one case).

More than 77% of patients (44 out of 57 cases) diagnosed with bronchitis received antibiotics unnecessarily. Similarly, 72% of patients with acute pharyngitis (16 out of 22 cases) and 27% (8 out of 29 cases) of patients with gastroenteritis were on antibiotics without clinical or laboratory indication.

3.3. Antibiotic Use During Admission

A total of 994 courses of antimicrobials were prescribed during the study period. The internal medicine department accounted for 310 courses/31.1%, followed by pulmonology (203 courses/20.4%) and intensive care unit (152 courses/15.2%). One thousand three hundred ninety-one (1391) antimicrobials were prescribed, of which 1074 (77.2%) were started empirically, and 317 (22.8%) were started based on culture or PCR multiplex report. Table 3 lists the antimicrobial prescribed.
Table 3. Prescribed antimicrobials (Total 1391).

| Antimicrobial                  | Number   |
|-------------------------------|----------|
| Ceftriaxone                   | 263 (18.91%) |
| Lopinavir / Ritonavir         | 121 (8.70%)   |
| Metronidazole                 | 110 (7.91%)   |
| Hydroxychloroquine            | 92 (6.61%)   |
| Levofloxacin                  | 91 (6.54%)   |
| Oseltamivir                   | 87 (6.25%)   |
| Meropenem                     | 67 (4.82%)   |
| Cefuroxime                    | 58 (4.17%)   |
| Clarithromycin                | 56 (4.03%)   |
| Piperacillin/Tazobactam       | 51 (3.67%)   |
| Moxifloxacin                  | 50 (3.59%)   |
| Amoxicillin clavulanate       | 46 (3.31%)   |
| Chloroquine                   | 42 (3.02%)   |
| Ciprofloxacin                 | 35 (2.52%)   |
| Azithromycin                  | 32 (2.30%)   |
| Cefepime                      | 30 (2.16%)   |
| Ertilpenem                    | 25 (1.80%)   |
| Linezolid                     | 20 (1.44%)   |
| Amikacin                      | 13 (0.93%)   |
| Caspofungin                   | 13 (0.93%)   |
| Favipiravir                   | 11 (0.79%)   |
| Vancomycin                    | 11 (0.79%)   |
| Others*                       | 67 (4.82%)   |

*Other antimicrobials: Acyclovir, fluconazole, cefazolin, cefixime, ceftazidime-avibactam, clindamycin, rifaxim, colistin, valaciclovir, liposomal amphotericin B, ampicillin, ethambutol, fosfomycin, isoniazid, pyrazinamide, rifampicin, trimethoprim-sulfamethoxazole, atovaquone-proguanil, darunavir/cobicistat, ganciclovir, imipenem, tigecycline, tinidazole and vibramycin.

Table 4. Antimicrobial stewardship team interventions (Total 141).

| Intervention                  | Number   |
|-------------------------------|----------|
| Change antimicrobial          | 48 (34.0%) |
| Add antimicrobial             | 20 (14.18%)  |
| Increase frequency of antimicrobial | 19 (13.48%)  |
| Increase dose of antimicrobial| 19 (13.48%)  |
| Add loading dose              | 14 (9.93%) |
| Decrease dose of antimicrobial| 6 (4.26%)  |
| Decrease frequency of antimicrobial | 5 (3.55%)  |
| Therapeutic drug monitoring   | 5(3.55%)  |
| Add blood/microbiological test| 4 (2.84%)  |
| De-escalate                   | 1 (0.71%)  |

More than 50% of antimicrobials prescribed were reviewed at 72 hours (53.4%/743/1391). Out of 743 antimicrobials that were reviewed at 72 hours, 30% (221/743) required (A.M.S.) team interventions. Stopping the antimicrobial agent was the most common recommendation (70%/155/221), followed by increasing the dose (9%/20/221) and changing antimicrobial agent (6.3%/14/221). The M.R.P. agreed with 32.1%/71/221 of the AMS team review recommendations.

4. DISCUSSION

4.1. Microbiological Tests Polymerase Chain Reaction Multiplex Radiological Tests not Included

In this study, we found a total of 29.7% of antimicrobial prescriptions were either not indicated (19.7%) or required AMS interventions (10%). In the US, several studies have found a comparable prevalence of unnecessary antimicrobial prescriptions. Hecker et al. (2003) found that 30% of antimicrobial days were unnecessary [14]. A prospective, observational study conducted in Cleveland, Ohio, found that 39% of fluoroquinolone days were deemed unnecessary [15]. Similar results have been found in other countries. A study conducted in 18 tertiary care hospitals in Turkey, 25.7% and 15.9% of prescriptions were considered clinically and microbiologically inappropriate, respectively [16]. In the United Kingdom, there is a high rate of inappropriate antimicrobial prescriptions in general practice, especially for otitis externa (67.3%) and upper respiratory tract infections (38.7%) [17]. In the Netherlands, only 46% of antibiotics prescribed to treat respiratory tract infections by general practitioners adhered to guideline recommendations [18]. Some countries have an even higher prevalence of inappropriate antimicrobial prescriptions. In longitudinal surveillance conducted in Pakistan, 70.3% had at least one inappropriate antimicrobial, and 62.8% of patients with respiratory tract infections were considered to have inappropriate therapy [19].

In our study, we found the following three clinical scenarios where antimicrobials were often prescribed inappropriately:

[1] Non-infectious aetiology, such as biliary colic, renal colic, and non-infective exacerbation of certain conditions such as chronic obstructive pulmonary disease, representing 4.8% of all cases.

[2] Treating confirmed viral infection with antibiotics such as COVID-19, cytomegalovirus infection, and dengue fever, representing 7.1% of all cases.

[3] Treating some self-limiting conditions, which are most commonly caused by viral infections such as bronchitis, gastroenteritis, and pharyngitis.

The compliance to AMS team recommendations in our study was only 32.6%, which is considered low compared with other studies. Singh et al. (2018) reported 54% compliance with AMS recommendations in their research [20]. Thakkar et al. (2011) implemented a plan-do-study-act (PDSDA) approach to improve compliance with AMS recommendations. Over 11 months period, the compliance has increased from 30% to 71% [21]. In a retrospective quasi-experimental study conducted in
a university hospital in London over 12-months, more than 98% of AMS team interventions were accepted by medical/surgical teams [22]. A study to evaluate the compliance with AMS recommendations found that it was 90.5% for medical services and 82.1% for surgical services [23]. A study of 160 patients used a care bundle for AMS consisting of documentation of indication for antibiotic prescription, collection of cultures before antibiotic use, appropriate empiric antibiotic, de-escalation to a narrower spectrum agent based on culture results. The rate of acceptance of AMS recommendations was 91% [24].

Several factors are leading to the low compliance with AMS recommendations at our hospital, including physicians’ resistance to change, lack of hospital-based guidelines for the treatment of common infections, and pressures from patients and families.

In a study of the barriers facing AMS at small hospitals in the US, it was found that the lack of dedicated ID-trained staff, time constraints, insufficient IT support, and limited financial resources were among the main barriers to AMS in hospitals having less than 200 beds [25]. Baubie et al. (2019) studied the barriers to AMS implementation at a 1,300-bed tertiary-care private hospital in Kerala, India [26]. They identified high antibiotic use in the community, high physician workload, physician resistance to change, and limited availability of a clinical pharmacist as barriers to AMS implementation. An interesting finding in the study conducted in a tertiary-care hospital in Ethiopia is that fear of treatment failure and retribution from senior physicians were significant reasons for broad-spectrum antibiotic prescription, especially among junior physicians [27]. Enani (2016) evaluated antimicrobial stewardship programs in Gulf Cooperation Council (G.C.C.) countries using a cross-sectional questionnaire survey. The majority of responders (75%) reported a lack of funding and personnel as significant barriers to program implementation. Ten percent of responders reported resistance from prescribers as a considerable barrier to A.S.P [28].

CONCLUSION

An effective AMS is a key factor in reducing antimicrobial resistance. In our study, the prevalence of inappropriate antimicrobial prescription is similar to that found in other studies worldwide. However, the compliance with AMS recommendations is much lower than described in several other studies. Finding the reasons behind this low rate will be of great importance to find solutions to overcome the barriers for implementing AMS at our hospital.

LIST OF ABBREVIATIONS

| A/E | Accident and Emergency |
| AMR | Antimicrobial Resistance |
| AMS | Antimicrobial Stewardship |
| CT | Computed Tomography |
| EMR | Electronic Medical Record |
| ID | Infectious Disease |
| IDSA | Infectious Disease Society of America |
| IT | Information Technology |
| JCI | Joint Commission International |
| UAE | United Arab Emirates |

ETHICAL STATEMENT

The approval of ethical committee was not required due to retrospective nature of the data collection and anonymous data.

CONSENT FOR PUBLICATION

Not applicable.

AVAILABILITY OF DATA AND MATERIALS

Not applicable.

FUNDING

None.

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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