IJHS

Original Article

A retrospective cross-sectional study of antibiotics prescribing patterns in admitted patients at a tertiary care setting in the KSA

Ahmad Alharafsheh[1], Mohamed Alsheikh[1], Sheraz Ali[2],Amani A. Baraiki[1], Ghadah Alharbi[1], Tahani Alhabshi[1], Amina Aboutaleb[1]

[1]Department of Pharmaceutical Care Services, King Saud Medical City, Ministry of Health, Riyadh, Saudi Arabia, [2]Institute of Biomedicine (PANIC Group), University of Eastern Finland, Kuopio, Finland

Address for correspondence:
Sheraz Ali, King Saud Medical City, Ministry of Health, Riyadh, Saudi Arabia.
Tel.: +966595118227.
E-mail: sherazaa@moh.gov.sa

WEBSITE: ijhs.org.sa
ISSN: 1658-3639
PUBLISHER: Qassim University

ABSTRACT

Objective: Little is known about the pattern of antibiotics' prescribing for hospitalized adult patients in the Kingdom of Saudi Arabia. This study explored the prescribing practices of antibiotics in a large tertiary care setting serving diverse population.

Methods: This retrospective cross-sectional study included 1.666 antibiotic prescriptions prescribed over a period of 3 months (January 2016–March 2016) in an adult inpatient department of King Saud Medical City (KSMC). Data were collected from pharmacy electronic database. The World Health Organization (WHO) prescribing indicators were also used.

Results: Of the 13.414 prescriptions in pharmacy database, percentage share of antibiotic prescriptions was 12.41. The average number of drugs per encounter was 1.2. 61% of the prescriptions contained parenteral antibiotics. The percentage of drugs prescribed from essential drug list and by generic name was 100% in each indicator. The most frequently prescribed antibiotics were cefuroxime (19.44%), piperacillin/tazobactam (16.30%), and cefazolin (13.85%). Ciprofloxacin and ceftriaxone were prescribed without stated indications in 62 prescriptions. Restricted antibiotic such as meropenem was prescribed without a diagnosis in 52 prescriptions.

Conclusion: This study gathered baseline data pertinent to the prudent use of antibiotics in KSMC. The diagnosis was not documented in more than one-third of the admission episodes. Majority of the antibiotics were broad spectrum. Three prescribing indicators shows deviation from the WHO's standard values while prescribing from essential drug list and by generic name was not a problem in this setting. There is a need to explore the impact of prescriptions lacked indication on patient's safety.

Keywords: Antibiotics, patients, prescribing pattern, Saudi Arabia

Introduction

Prescribing drugs are recognized as a challenging task and an essential practice which needs to be continuously monitored, assessed and refined accordingly. Moreover, it is based on the understanding of clinical pharmacology principles, knowledge about medicines and particularly experience of the prescriber.[1,2] Antibiotics are the substances that kill or inhibit the growth of microorganisms and are used for the treatment of different types of local and systemic infections.[3] Antibiotics have played a key role in decreasing the morbidity and mortality rates due to infectious diseases while an irrational use of antibiotics increases bacterial drug resistance and adverse drug events, as well.[4,5]

Antibiotics are also prescribed inappropriately for the respiratory infections that are caused by virus such as common cold.[6] According to the World Health Organization (WHO), 20–50% of the antibiotics are used inappropriately in the community.[7] Polypharmacy, inappropriate use of antibiotics, overuse of injectables, self-medication, prescribing of medicines without following clinical guidelines are recognized as the common causes of irrational use of medicines.[8] In 1993, the WHO in collaboration with the International Network of Rational Use of Drugs (INRUD) developed a set of core drug use indicators to assess the use of antimicrobials (antibiotics and similar drugs) at a health-care setting.[9] Inappropriate antibiotic prescribing is a serious threat worldwide owing to the fact that many organisms have become resistant to commonly used antibiotics which eventually affect human health.[10] Methicillin-resistant *Staphylococcus aureus* is alone responsible for the large number of deaths in the United States of America than other diseases such as HIV/AIDS, emphysema, homicide, and Parkinson's disease.[11] Antibiotic

resistance adversely affects those patients having less access to the health care. Consistent with this notion, it also prolongs hospital stays and causes several infections.[10,12] Irrational use of antibiotics increases patient's visit to the hospital and the risks of adverse effects.[12] The Center for Disease Control and WHO consider antibiotic-resistant bacterial infections as one of the biggest public health threats, whereas antibiotics will no longer be useful in future for the treatment of commonly cured and serious bacterial infections.[13]

Antibiotics are often prescribed as an empirical therapy for inpatient and outpatient by the physicians based on their experience and comfort that can also lead to the overuse of antibiotics.[14] Factors such as lack of education, socioeconomic status, age and storing antibiotics at home also promote the abuse, and misuse of antibiotics in the community.[15-17] There is a scarcity of literature regarding the prescribing pattern of antibiotics for hospitalized adult patients in the Kingdom of Saudi Arabia (KSA). Most of the studies in the KSA were conducted in an outpatient setting, and the targeted population was pediatrics. Therefore, the aim of this study was to determine the prescribing patterns of antibiotics in an adult inpatient department of a large tertiary care hospital in the Kingdom. The findings of this study will help alleviate this scarcity, facilitate tertiary care setting to optimize antibiotic prescribing, and aid in implementing an antibiotic stewardship program, thus reducing the bacterial resistance and promoting patient safety.

Methods

A retrospective cross-sectional study conducted from January 2016 to March 2016 at Pharmaceutical Care Services of King Saud Medical City (KSMC), a largest tertiary care Ministry of Health hospital with a 1400-bed capacity in Riyadh, KSA. This hospital serves a wide range of patients drawn from a large population, many of whom present with complex medical comorbidities and are referred from different regions of the KSA. Pharmaceutical Care Services is composed of medication safety, drug information, inventory, clinical, and inpatient and outpatient pharmacy units.

The hospital's medical system (Medisys®) is an electronic health record system that has been upgraded regularly since 2006. The electronic prescribing system is connected to the Medisys®. Data were collected from this system, and the variables examined in this study were age, gender, diagnosis, and antibiotics (oral or parenteral) per prescription. Adult's (≥18 years of age) antibiotic prescriptions that contained at least one antibiotic (oral and parenteral) were selected. This study included unique medical record numbers and avoided duplications. There were duplications of prescriptions in pharmacy electronic database owing to patient's visit to the hospital after discharge for refilling prescriptions; we only included unique medical record numbers to get an exact number of encounters and avoided repetitions. Topical antimicrobials, antituberculous, antifungals, and antiprotozoal drugs were excluded from this study. A total of 1.666 antibiotic prescriptions were reviewed. Antibiotics were classified into the following groups: Cephalosporin, penicillin, carbapenem, tetracycline, sulfonamide, fluoroquinolone, aminoglycoside, oxazolidinone, macrolide, lincosamide, glycylcycline, glycopeptide, and others. We included the most commonly prescribed antibiotic classes in this study.

WHO/INRUD core prescribing indicators that were selected for this study are as follows: Average number of drugs prescribed per encounter (standard value 1.6–1.8), percentage of encounters with an antibiotic prescribed (standard value 20.0–26.8%), percentage of drugs prescribed by generic name (standard value 100.0%), and percentage of encounters resulting in prescription of an injection (standard value 13.4–24.1%), and percentage of drugs prescribed from the essential drug list (standard value 100.0%).[9,15] The data were analyzed by Statistical Package of the Social Sciences version 21 software (IBM Corporation, Armonk, NY, USA). Descriptive statistics were used to calculate frequencies and percentages. This study was initiated after approval (Reference Number: H1RI-10-Aug16-01) was obtained from the Institutional Review Board of KSMC. For this type of study formal consent is not required and waiver was granted by the Institutional Review Board of KSMC.

Ethical approval

This study was initiated after approval (Reference Number: H1RI-10-Aug16-01) was obtained from the Institutional Review Board of KSMC.

Operational definitions

Restricted Antimicrobials are those prescribed by infectious disease consultant or approved the order when he/she is available.

Controlled Antimicrobials are those prescribed by the consultant where the drug order should be countersigned by the treating consultant.

Results

A total of 9.940 antimicrobial prescriptions were identified from the pharmacy database of 13.414 prescriptions; 8.274 prescriptions were excluded as per exclusion criteria. A sample of 1.666 antibiotic prescriptions was assessed retrospectively in the adult's inpatient department of the KSMC from January 2016 to March 2016.

Of these 1666 patient's prescriptions, 66.5% were male, and 33.5% were female while the most common age group was 18–30 years that accounted for 23% of antibiotic prescriptions. Injectable and oral antibiotics were prescribed with a share of 61% and 39%, respectively. More than 80% of the prescriptions contained single

antibiotic. Of a total of 1.666 prescriptions, the indication was not documented in 653 patient's prescriptions [Table 1].

Piperacillin/tazobactam was prescribed with lack of indication in 81 patient's prescriptions. Restricted antibiotics such as meropenem, colistin, linezolid, and imipenem were prescribed without indication in 52, 26, 23, and 17 prescriptions, respectively. Controlled antibiotics such as ciprofloxacin and ceftriaxone were prescribed without documenting diagnosis in 62 prescriptions.

Figure 1 illustrates that β-lactam or broad-spectrum antibiotics were predominant. Consistent with this notion, the most frequently prescribed antibiotic classes were cephalosporin (43.7%), carbapenem (20.5%), and penicillin (18.1%).

The most common prescribed drugs were cefuroxime (19.44%), piperacillin/tazobactam (16.30%), cefazolin (13.85%), meropenem (13.66%), ceftriaxone (10.29%), and metronidazole (9.91%) [Table 2].

Antibiotics were mostly prescribed for the infections of urinary tract followed by respiratory tract and central nervous systems. The average number of medicines per encounter was 1.2. The percentage of drugs prescribed by generic name was 100%. Of the 13.414 prescriptions in pharmacy database, percentage share of antibiotic prescriptions was 12.41. The percentage of drugs prescribed from the WHO model list of essential medicines was found to be 100% [Table 3].

Discussion

As per our knowledge, this is the first such study of its type conducted in adult's inpatient department in the KSA to determine the prescribing pattern of antibiotics as per WHO/INRUD standards. Therefore, study findings provide baseline information that is pertinent to the prescribing practices of antibiotics in an adult hospitalized population and help to assess whether a tertiary care setting following clinical practice standards or deviating from the international standards. This study shows that the percentage of antibiotic prescription (12.4%) is not in line with the standard (20.0–26.8) recommended by the WHO.[18] This would suggest that either there is a low prevalence of infection-related cases in adult's inpatient, or physicians prescribing antibiotics in an appropriate manner. These values are comparatively higher in the previous study conducted on hospitalized patients (52.4%).[19] The impact of irrational prescribing of antibiotics on patients health status remain at the forefront globally that eventually leads to the adverse drug reactions and high rate of hospital admissions.[20]

The average number of drugs per prescription, 1.2, at a large tertiary care setting is markedly lower than the WHO's derived

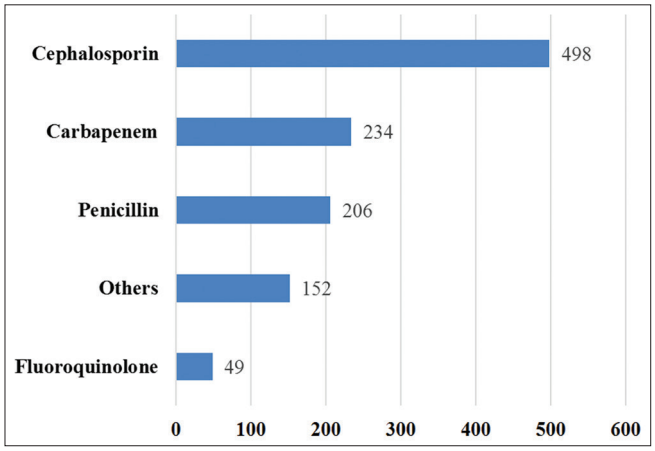

Figure 1: Most commonly prescribed antibiotic classes

Table 1: Demographic characteristics and antibiotics prescribing patterns (n=1.666)

Characteristic	*n* (%)
Age group	
18–30	383 (23.0)
31–40	251 (15.1)
41–50	252 (15.1)
51–60	304 (18.2)
61–70	197 (11.8)
>70	279 (16.7)
Gender	
Male	1.108 (66.5)
Female	558 (33.5)
Diagnosis	
Mentioned	1.013 (61)
Not mentioned	653 (39.2)
Route of administration	
Oral	653 (39.2)
Parenteral	1.013 (61)
Number of drugs per prescription	
One	1.363 (81.8)
Two	269 (16.1)
Three	32 (1.9)
Four	2 (0.1)

Table 2: Most commonly prescribed antibiotics

Antibiotic	*n* (%)
Cefuroxime	202 (19.44)
Piperacillin/tazobactam	169 (16.30)
Cefazolin	144 (13.85)
Meropenem	142 (13.66)
Ceftriaxone	107 (10.29)
Metronidazole	103 (9.91)
Colistin	68 (6.54)
Ciprofloxacin	55 (5.30)
Linezolid	49 (4.71)
Total	1.039 (100)

Table 3: WHO/INRUD prescribing indicators in the adult inpatient department

Prescribing indicators	Value	Standard value
Average number of drugs per encounter	1.2	1.6–1.8
Percentage of encounters with an antibiotic prescribed (1.666/13.414)	12.41%	20.0–26.8%
Percentage of encounters with an injection prescribed (1.013/1.666)	61%	13.4–24.1%
Percentage of drugs prescribed by generic name (1.666/1.666)	100%	100.0%
Percentage of drugs prescribed from the essential list (1.666/1.666)	100%	100.0%

INRUD: International Network of Rational Use of Drugs, WHO: World Health Organization

standard value (1.6–1.8) for this indicator and those found in a tertiary care setting.[18,19] Consistent with this notion, majority of the prescriptions contained a single antibiotic which is consistent to earlier findings,[19] thus negating irrational practice such as polypharmacy in hospitalized patients which correlates with the number of items per encounter. A prescription having multiple drugs eventually promotes non-compliance of the patients and causes adverse events.[18] In contrast to our study findings, previous studies also reported high values of average number of items per prescription.[21-23] The only explanation of evidently low value was the shortage of drugs in our government hospital owing to the financial crisis in the KSA. The study findings reveal that over half of the prescriptions (61%) contained injectable antibiotics which is comparatively higher than the WHO's standard range.[21] An observational study conducted in Oman also found that more than 50% of the adult's inpatient prescriptions contained parenteral antibiotics.[22] This study analyzed the prescriptions of adult's inpatient department where the excessive use of parenteral may be attributed to the patient's health status as their condition is usually not stable which does not allow physicians to prescribe oral antibiotics. Nonetheless, unsterile use of injections may increase the incidence of blood-borne infectious diseases.[8]

WHO advocates the culture of prescribing drugs with generic names, thus reducing the cost of drugs. In our study, all the drugs were prescribed by generic name, similar to the standard of 100%.[18] In contrast, studies conducted in Europe and South America reported low rates of generic prescribing.[23,24] This study was conducted in a large government hospital which follows standard government policies, and hospital prescribing system does not allow prescribes to select brand names. According to the WHO, prescribing of drugs by brand names exert financial burden on patients and national health-care budget.[8]

This study demonstrated that the predominant classes of antibiotics were cephalosporin, carbapenem, and penicillin which replicate the findings of an observational study conducted on a similar population in a tertiary teaching hospital in Oman.[25] These findings are also in line with the results of earlier studies conducted on hospitalized patients.[25,26]

This study reveals another major finding regarding the prescriptions lacked indication. 39% of the prescriptions did not contain diagnosis. Consistent with this notion, 180 prescriptions were written for controlled and restricted antibiotics without documenting a diagnosis. According to the KSMC policy, approval is required from an infectious disease consultant before prescribing restricted medications while drug orders for controlled antibiotics are approved by the treating consultant. In addition, pharmacist ensures the control of any antimicrobial medication dispensed by reviewing the appropriateness of the drug order or prescription. Point prevalence study in the United Kingdom also reported low documentation of indication.[27] In contrast, Al-Maliky *et al*. found that more than 80% of the prescriptions contained indication.[22] It is imperative to educate doctors regarding the importance of documenting all core components of a prescription. As per the WHO's practical manual for good prescribing, diagnosis is crucial in the process of rational treatment and initiating an antibiotic treatment, and it should be documented in patient's prescriptions.[28] With regard to the prescribing of drugs using the WHO's model list of essential medicines, study findings are consistent to the standard derived value as all the antibiotics were prescribed from this list.[18] The selection of drugs from the WHO model list promotes rational prescribing of the drugs.[29]

There are certain limitations of this study as it was conducted in a single tertiary care setting and results cannot be generalized to the whole population in the KSA. WHO prescribing indicator merely quantify the prescribing tendencies irrespective of the quality aspects. Future research should be directed toward determining the impact of incomplete prescriptions on patient's health status and drug resistance.

Conclusion

This study demonstrated that two-third of the prescribed antibiotics were broad spectrum, mainly cephalosporins, penicillins, and carbapenems. More than one-third of the prescriptions lacked diagnosis; 11% of these prescriptions contained controlled and restricted antibiotics which advocate a need to educate doctors regarding the importance of documenting all important components of a prescription and prescribing norms of controlled and restricted medications. Out of five, two prescribing indicators; percentage of antibiotics prescribed from essential drug list and by generic drugs, were in line with the standard recommended by the WHO. Future studies should focus on exploring the consequences of antibiotic prescriptions lacking information about the diagnosis.

References

1. Benet LZ. Principles of prescription order writing and patients compliance instructions. In: Goodman AG, Rall TW, Nies AS, Taylor P, editors. Goodman and Gilman's the Pharmacological Basis

of Therapeutics. 8th ed. New York: Pergamon Press Inc.; 1991. p. 1640.

2. Likic R, Maxwell SR. Prevention of medication errors: Teaching and training. Br J Clin Pharmacol 2009;67:656-61.
3. Leekha S, Terrell CL, Edson RS. General principles of antimicrobial therapy. Mayo Clin Proc 2011;86:156-67.
4. Strengthening Pharmaceutical Systems. How to Investigate Antimicrobial Use in Hospitals: Selected Indicators. Published for the U.S. Agency for International Development by the Strengthening Pharmaceutical Systems Program. Arlington, VA: Management Sciences for Health; 2012 Available From: http://www.apps.who.int/medicinedocs/documents/s21031en/s21031en.pdf. [Last accessed on 2017 May 15].
5. Muna K, Elmorsy S, Alfhm A, Alhadhrami R, Ekram R, Althobaiti I, *et al.* Patterns of antibiotic prescriptions in the outpatient department and emergency room at a Tertiary care center in Saudi Arabia. Saudi J Med Med Sci 2015;3:124-9.
6. Palikhe N. Prescribing pattern of antibiotics in paediatric hospital of Kathmandu valley. Kathmandu Univ Med J (KUMJ) 2004;2:6-12.
7. World Health Organization. The World Health Report 2007 - A Safer Future: Global Public Health Security in the 21st Century; 2007. Available From: http://www.who.int/whr/2007/en. [Last accessed on 2016 Jul 27].
8. World Health Organization. Promoting Rational Use of Medicines: Core Components-WHO Policy Perspectives on Medicines; 2002. Available From: http://www.qapps.who. Int/medicinedocs/en/d/Jh3011e. [Last accessed on 2017 May 22].
9. World Health Organization. How to Investigate Drug use in Health Facilities: Selected Drug Use Indicators. Geneva: WHO Publications; 1993.
10. Hashemi S, Nasrollah A, Rajabi M. Irrational antibiotic prescribing: A local issue or global concern? EXCLI J 2013;12:384-95.
11. Infectious Diseases Society of America (IDSA), Spellberg B, Blaser M, Guidos RJ, Boucher HW, Bradley JS, *et al.* Combating antimicrobial resistance: Policy recommendations to save lives. Clin Infect Dis 2011;52 Suppl 5:S397-428.
12. Llor C, Bjerrum L. Antimicrobial resistance: Risk associated with antibiotic overuse and initiatives to reduce the problem. Ther Adv Drug Saf 2014;5:229-41.
13. Centers for Disease Control and Prevention. Antibiotics Aren't Always the Answer; 2015. Available From: http://www.cdc.gov/features/getsmart. [Last accessed on 2016 Jul 29].
14. Williams A, Mathai AS, Phillips AS. Antibiotic prescription patterns at admission into a tertiary level intensive care unit in northern India. J Pharm Bioallied Sci 2011;3:531-6.
15. Gebeyehu E, Bantie L, Azage M. Inappropriate use of antibiotics and its associated factors among urban and rural communities of Bahir Dar city administration, Northwest Ethiopia. PLoS One 2015;10:e0138179.
16. Yu M, Zhao G, Stålsby Lundborg C, Zhu Y, Zhao Q, Xu B, *et al.* Knowledge, attitudes, and practices of parents in rural china on the use of antibiotics in children: A cross-sectional study. BMC Infect Dis 2014;14:112.
17. Awad A, Eltayeb I, Matowe L, Thalib L. Self-medication with antibiotics and antimalarials in the community of Khartoum state, Sudan. J Pharm Pharm Sci 2005;8:326-31.
18. Isah AO, Ross-Degnan D, Quick J, Laing R, Mabadeje AF. The Development of Standard Values for the WHO Drug Use Prescribing Indicators. ICUM/EDM/WHO. Available from: http://www.archives.who.int/prduc2004/rducd/ICIUM_Posters/1a2_txt.htm. [Last accessed on 2017 Jul 16].
19. Atif M, Azeem M, Sarwar MR, Shahid S, Javaid S, Ikram H, *et al.* WHO/INRUD prescribing indicators and prescribing trends of antibiotics in the accident and emergency department of Bahawal victoria hospital, Pakistan. Springerplus 2016;5:1928.
20. Beringer PM, Wong-Beringer A, Rho JP. Economic aspects of antibacterial adverse effects. Pharmacoeconomics 1998;13:35-49.
21. Atif M, Sarwar MR, Azeem M, Umer D, Rauf A, Rasool A, *et al.* Assessment of WHO/INRUD core drug use indicators in two tertiary care hospitals of Bahawalpur, Punjab, Pakistan. J Pharm Policy Pract 2016;9:27.
22. Al-Maliky GR, Al-Ward MM, Taqi A, Balkhair A, Al-Zakwani I. Evaluation of antibiotic prescribing for adult inpatients at Sultan Qaboos University hospital, Sultanate of Oman. Eur J Hosp Pharm 2017. Doi: 10.1136/ejhpharm-2016-001146.
23. Wang H, Li N, Zhu H, Xu S, Lu H, Feng Z, *et al.* Prescription pattern and its influencing factors in Chinese county hospitals: A retrospective cross-sectional study. PLoS One 2013;8:e63225.
24. Vallano A, Montané E, Arnau JM, Vidal X, Pallarés C, Coll M, *et al.* Medical specialty and pattern of medicines prescription. Eur J Clin Pharmacol 2004;60:725-30.
25. Hogerzeil HV, Bimo, Ross-Degnan D, Laing RO, Ofori-Adjei D, Santoso B, *et al.* Field tests for rational drug use in twelve developing countries. Lancet 1993;342:1408-10.
26. Díaz-Martín A, Martínez-González ML, Ferrer R, Ortiz-Leyba C, Piacentini E, Lopez-Pueyo MJ, *et al.* Antibiotic prescription patterns in the empiric therapy of severe sepsis: Combination of antimicrobials with different mechanisms of action reduces mortality. Crit Care 2012;16:R223.
27. Barking, Havering and Redbridge Hospitals NHS Trust. Trust Board Papers. 7th September; 2011. Available from: https://www.Hsj.Co.Uk/Journals/2011/11/03/d/b/r/BHR.Pdf. [Last accessed on 2017 May 23].
28. De Vries TP, Henning RH, Hogerzeil HV, Fresle DA. World Health Organization. Guide to Good Prescribing - A Practical Manual. WHO/DAP/94.11. 1994. Available From: http://www.who.int/medicinedocs/en/d/Jwhozip23e. [Last accessed on 2017 May 27].
29. World Health Organization 19th WHO Model List of Essential Medicines. Available from: http://www.who.int/medicines/publications/essentialmedicines/EML2015_8-May-15.pdf. [Last accessed on 2017 Apr 21].