Zia et al. Saudi J Er Med. 2022;3(1):017-024
https://doi.org/10.24911/SJEMed/72-1634136332

ORIGINAL ARTICLE

Trends in outpatient antibiotic prescriptions by emergency physicians of a tertiary hospital in UAE: a retrospective cross-sectional study

Sania Zia[1]*, Rasha Al-khateeb[1], Muna Aljallaf[1], Manal Yaslam[1], Syed Ibrahim Muneeb[1], Firas AlNajjar[1], Laila AlDabal[2]

ABSTRACT

Background: Community-acquired bacterial pneumonia (CAP), skin and soft-tissue infection (SSTI), and urinary tract infection (UTI) are frequently encountered in the emergency department (ED) but treated with varied antibiotic regime. We aimed to assess the antibiotic prescribing practice in ED for CAP, SSTI, and UTI based on hospital guideline adherence (choice, dose, and duration of antibiotic). To the authors' knowledge, this is the first study to address this issue by a dual model of physician survey and prescription review from the ED perspective.

Methods: One hundred ED physicians were surveyed followed by a cross-sectional study of 300 uncomplicated adult ED outpatient infections (100 CAP, 100 SSTI, and 100 UTI) from August 2017 to August 2018 retrospectively at Rashid Hospital in Dubai.

Results: Most of the participants (91%) had never been in an antibiotic stewardship. 30%, 52%, and 48% were not aware of CAP, SSTI, and UTI hospital guidelines, respectively. Majority (58%) of physicians preferred a parenteral first dose of empirical therapy.

Mean age of patients was 45.14 ± 17.8 years and the majority were males (55.7%). The most frequently prescribed antibiotics were β-lactams (n = 157, 52.3%, 95% CI 46.5-58.1). Non-adherence to guidelines was noted in 59% (95% CI 53.2-64.6) of cases; the frequency was highest for UTI (75%), followed by CAP (71%) and SSTI (31%). The most common cause of non-adherence was incorrect drug choice (n = 126, 42%,95% CI 36.3-47.8).

Conclusion: High rates of physician non-compliance to guidelines for outpatient empirical antibiotic prescriptions exists in the ED with incorrect drug choice being the most common cause.

Keywords: Antibiotic, resistance, prescription, emergency, guideline, stewardship.

Introduction

The discovery of antibiotics is one of the greatest achievements in the history of medicine. However, its indiscriminate use leading to dissemination of antimicrobial resistance is an urgent and persistent global public health crisis, increasing the possibility of returning to the pre-antibiotic era [1]. Irrational antibiotic prescribing can be attributed to knowledge gaps, assumption by the provider or patient that antibiotic therapy is the safest strategy, consenting to patients' demands for antibiotics or time constraints of providers [2]. The busy, dynamic, complex, and myriad activities of an emergency department (ED) make it vulnerable to occurrence of a multitude of errors. Community-acquired bacterial pneumonia (CAP), skin and soft-tissue infection (SSTI), and urinary tract infection (UTI) are the most frequently encountered

Correspondence to: Sania Zia
*Emergency Department, Rashid Hospital, Dubai Health Authority, Dubai, United Arab Emirates.
Email: sania1029@gmail.com
Full list of author information is available at the end of the article.
Received: 13 October 2021 | **Accepted:** 6 December 2021

Table 1. *Hospital guidelines for empirical antibiotic used in our ED.*

Diagnosis	Recommended antibiotic	
	First line	Alternative
CAP	Azithromycin 500 mg per oral (PO) once a day (OD) for 5 days (if comorbidities present add amoxicillin/ clavulanate 1 g PO 2 times daily (BD) for 5-7 days)	Moxifloxacin 400 mg PO OD for 5-7 days OR Levofloxacin 750 mg PO OD for 5-7 days
SSTI	Amoxicillin/Clavulanate 1 g BD for 3-10 days	Clindamycin 450-600 mg 3 times daily for 3-10 days OR TMP/SMX (160/800 mg) tab. BD for 3-10 days
UTI	Fosfomycin 3 g PO once OR Trimethoprim sulfamethoxazole (TMP/SMX) (160/800 mg) tab. BD for 3-7 days	Amoxicillin/Clavulanate 1 g PO BD for 3-7 days

Table 2. *Physician survey questionnaire and responses.*

No.	Question	Responses	Percentage
1	Country of specialty training acquisition	UAE	63%
		India	12%
		Syria	7%
		Pakistan	6%
		Jordan, Iraq, Sudan	2% each
		UK, Australia, Canada, France Poland, Egypt	1% each
2	Total years of work experience	10	73%
		11-20	12%
		21-30	10%
		31-38	5%
3	Have you been in a didactic clinical program on antibiotics stewardship?	No	91%
4	Are you aware of any national or hospital-based guideline/ policy about management of CAP, SSTI and UTI in UAE?	CAP No SSTI No	30% 52%
		UTI No	48%
5	What is your out-patient 1st choice of antibiotic in an adult patient diagnosed with CAP?	Previously healthy Amoxicillin-clavulanate 39% Azithromycin 35% Levofloxacin 23% Cefuroxime 3%	Comorbidities/prior antibiotic use within 90 days 20% 10% 63% 7%
6	What is your out-patient first choice of antibiotic in an adult patient diagnosed with SSTI?	Amoxicillin-clavulanate 67% Oxacillin/Flucloxacillin 11% Clindamycin 10% Cefuroxime 10% Cephalexin 2%	21% 29% 25% 21% 4%
7	What is your out-patient first choice of antibiotic in an adult patient diagnosed with UTI?	Ciprofloxacin 58% Amoxicillin-clavulanate 17% Nitrofurantoin 13% Cefuroxime 10% Cephalexin 2% Cefpodoxime 0%	53% 15% 13% 14% 1% 4%
8	If you decide to start empirical therapy for CAP, SSTI or UTI; which route of administration do you prefer to start the first dose of antibiotics	Intravenous	58%
		Oral	42%
9	Does patient's request for antibiotics influence your decision when prescribing treatment?	Yes No	17% 83%
10	Rank the following factors which influence your decision when choosing the type of antibiotics for your patients from the most influential (1) to the least influential (8)	1. Adherence to guidelines 2. Prior personal experience with that Antibiotic 3. Patient's clinical data 4. Observation of senior colleagues 5. Cost 6. Patient compliance 7. Patient request 8. Pharmaceutical advertising	

infections in the ED [3]. Inappropriate prescribing can cause treatment failure, increased patient morbidity and mortality, thus financially burdening the health care system. Nevertheless, to the authors' knowledge, there is no published data addressing this issue in the United Arab Emirates (UAE). Due to cultural and demographic similarities between Dubai, other emirates and surrounding countries, the outcomes obtained herein can be generalized to the Middle East region. An appropriate antibiotic protocol is crucial in aiding patient recovery, mitigating antimicrobial resistance, and reducing healthcare costs.

We aimed to assess the current outpatient empirical antibiotic prescribing practice in the ED for CAP, SSTI and UTI based on hospital guideline adherence (choice, dose, and duration of antibiotic treatment).

Methods

Study design and setting

We conducted a monocentric observational study at Rashid Hospital and Trauma Center (RHTC), Dubai, UAE. It is a 786-bed tertiary academic hospital with a 68 bed ED that receives approximately 480-550 patients per day serving the population of Dubai and Northern Emirates. The study was done in the following two steps. First, we conducted a voluntary cross-sectional survey on a convenience sample of 100 emergency physicians (EPs) to assess the knowledge, attitude, and practice of prescribing outpatient empirical antibiotics. Simultaneously, we conducted a cross-sectional study on a convenience sample of 300 common uncomplicated adult ED outpatient infections (100 CAP, 100 SSTI, and 100 UTI) from August 2017 to August 2018 retrospectively from the electronic medical records (EMR) system.

Selection of participants

Survey

All EPs (n = 120; consultants, specialist registrars, and residents) currently working at RHTC, Dubai were invited to voluntarily participate in the survey. The purpose of the study was explained and confidentiality was assured by anonymous responses. The completion of the survey was taken as an indication of informed consent.

Review

All adult patients with a documented uncomplicated CAP, SSTI, or UTI treated with antibiotics in the ED during the study period were included in the study. The medical records unit selected 300 patients' files using a specific query to identify outpatient computerized prescriptions on the hospital's EMR (Epic-Salama®).

Patients requiring admission, children less than 13 years (considered pediatric age as per hospital protocol), pregnant females and those with multiple infections were excluded.

Methods and measurements

Pilot study

A pilot survey was conducted on five EPs. This enabled us to test the wording of the questionnaire to avoid inter-observer variation or bias. A slight modification was done after the pilot study.

Survey

An online survey link (SurveyMonkey®) was distributed to all ED physicians via official institutional email, which consisted of 10 questions in the English language curated by six EPs and one Infectious disease physician.

Review

Data collection was entirely performed by the investigators. Adherence to guidelines was defined as correct usage of antibiotic drug, dose and duration of treatment (Table 1). Investigators reviewed the patient's files without bias to assess adherence to hospital guidelines that had been drafted based on international guidelines [4-7]. Patient demographic and clinical data were recorded including age, gender, diagnosis, co-morbidities, drug allergies, antibiotic drug, dose, and duration of treatment. Intravenous antibiotics if given in the ED before discharge were also recorded. The data was tabulated in a password protected excel spreadsheet with limited access to the researchers only and analyzed.

Outcomes

The primary outcome was the extent of adherence of EPs to the hospital guidelines for CAP, SSTI and UTI, including the choice of antibiotic, dose and duration of the treatment.

Data analysis

Descriptive statistics were used to analyze the data using Microsoft Excel software. Mean and standard deviation (SD) were used for numerical variables while frequencies and percentages for categorical variables. 95% confidence interval was calculated to estimate the proportions of outcome variables and univariate associations were assessed by the Chi-square test using online software [8,9].

Results

Physician survey results (Table 2)

Of the 120 EPs, 100 (83.3%) completed the survey. The majority (92%) of physicians were trained in Asia. The years of work experience ranged from 1 to 38 years with a median of 6 years. 91% of them had never been in a didactic clinical program on antibiotics stewardship. 30%, 52% and 48% were not aware of any hospital-based guidelines about the management of CAP, SSTI, and UTI respectively. 58% of physicians preferred a parenteral first dose of empirical therapy

Table 3. *Patient demographics and prescribed antibiotics.*

Characteristics		
Age in years (mean ± SD)	45.14 ± 17.8	
Gender, *n* (%)		
Male Female	167 (55.7) 133 (44.3)	
Pre-existing medical conditions[a], *n* (%) Diabetes mellitus Hypertension Ischemic heart disease Dyslipidemia Stroke Others	 59 (19.7) 40 (13.3) 17 (5.7) 11 (3.7) 4 (1.3) 11 (3.7)	
Infectious disease diagnosis, *n* (%)		
CAP UTI SSTI	100 (33.33) 100 (33.33) 100 (33.33)	
Overall antibiotics prescribed	*n* (%)	95% CI
1. β-lactams Penicillins Amoxicillin-clavulanate Flucloxacillin Cephalosporins Cefuroxime Cefprozil Carbapenems Ertapanem 2. Fluoroquinolones Ciprofloxacin Levofloxacin 3.Macrolides Azithromycin 4.Lincosamide Clindamycin 5.Nitroimidazole Metronidazole 6.Combinations Amoxicillin-clavulanate + Clindamycin	 157 (52.3) 115 (38.3) 114 (38) 1 (0.3) 41 (13.7) 40 (13.3) 1(0.3) 1 (0.3) 114 (38) 53 (17.7) 61 (20.3) 25 (8.3) 2 (0.7) 1(0.3) 1(0.3)	 46.5-58.1 32.8-44.1 32.5-43.8 0.01-1.8 9.9-18.1 9.7-17.7 0.01-1.8 0.01-1.8 32.5-43.8 13.5-22.5 15.9-25.3 4.5-12.1 0.08-2.4 0.01-1.8 0.01-1.8

SD, Standard deviation; CAP, Community acquired pneumonia; SSTI, Skin and soft-tissue infection; UTI, Urinary tract infection.

[a] One patient could have several conditions.

Others- asthma, chronic kidney disease, epilepsy, cerebral palsy, gout, psoriasis, ulcerative colitis, progressive supranuclear palsy, prostatic hyperplasia, hepatitis B, bladder cancer, osteoporosis, anemia.

Table 4. Factors likely to influence the appropriateness of antibiotic prescriptions.

Characteristics	Appropriate prescription (*n* = 123, 41%)	Inappropriate prescription (*n* = 177, 59%)	*p*-value
Age (in years) 14-59 > 60	 96, 78.1 27, 21.9	 132, 74.6 45, 25.4	0.48
Gender Male Female	 74, 60.2 49, 39.8	 93, 52.5 84, 47.5	 0.19
Pre-existing medical conditions	35, 28.5	58, 32.8	0.42
Infectious disease diagnosis CAP SSTI UTI	 29, 23.6 69, 56.1 25, 20.3	 71, 40.1 31, 17.5 75, 42.4	 <0.00001

in the ED. The most preferred antibiotic for CAP was amoxicillin-clavulanate (39%) in previously healthy and levofloxacin (63%) in comorbidities/prior antibiotics use within 90 days. For SSTI, 67% chose amoxicillin-clavulanate in previously healthy and 29% chose oxacillin/flucloxacillin in comorbidities/prior antibiotics use within 90 days. For UTI, ciprofloxacin was the top choice in both groups (58% *vs.* 53%). Adherence to guidelines, prior personal experience and patient's clinical data ranked as the top three decision influencers. However, 17% were influenced by the patient's request.

Prescription review results

Three hundred adult uncomplicated outpatient prescriptions (100 CAP, 100 SSTI, and 100 UTI) were studied. Mean age of patients was 45.14 ± 17.8 years and the majority were males (55.7%). None of the patients

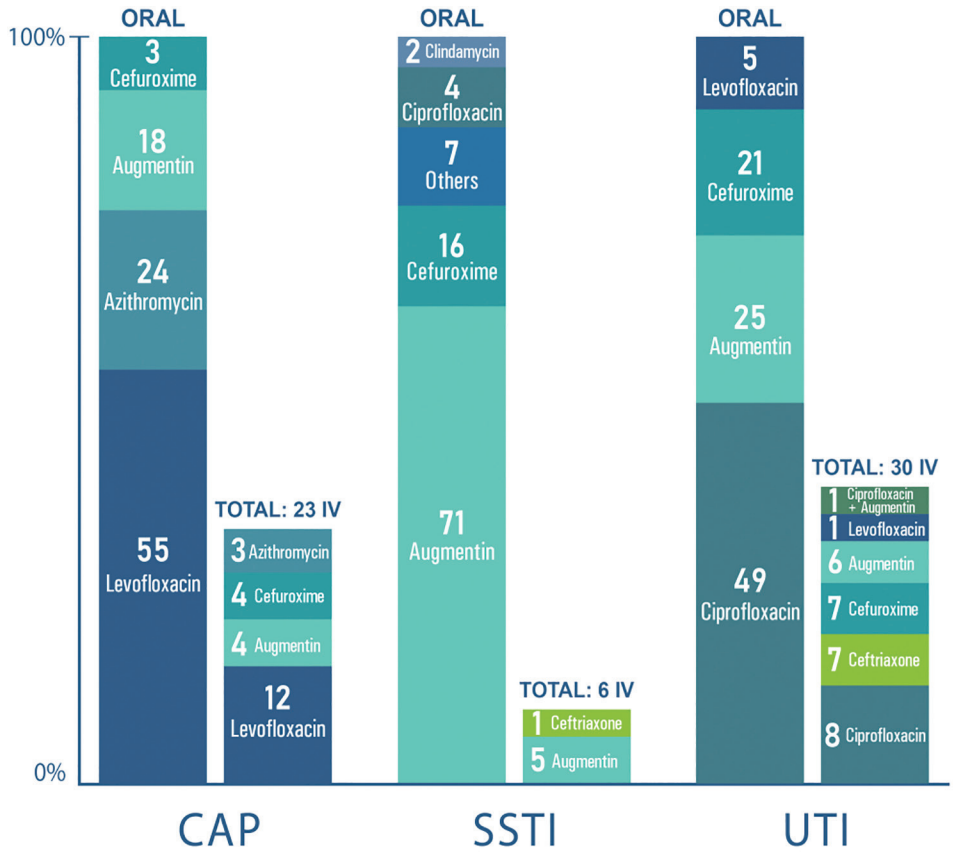

Figure 1. *Most frequent choice of antibiotic. CAP, Community acquired pneumonia; SSTI, Skin and soft-tissue infection; UTI, Urinary tract infection; IV, Intravenous.*

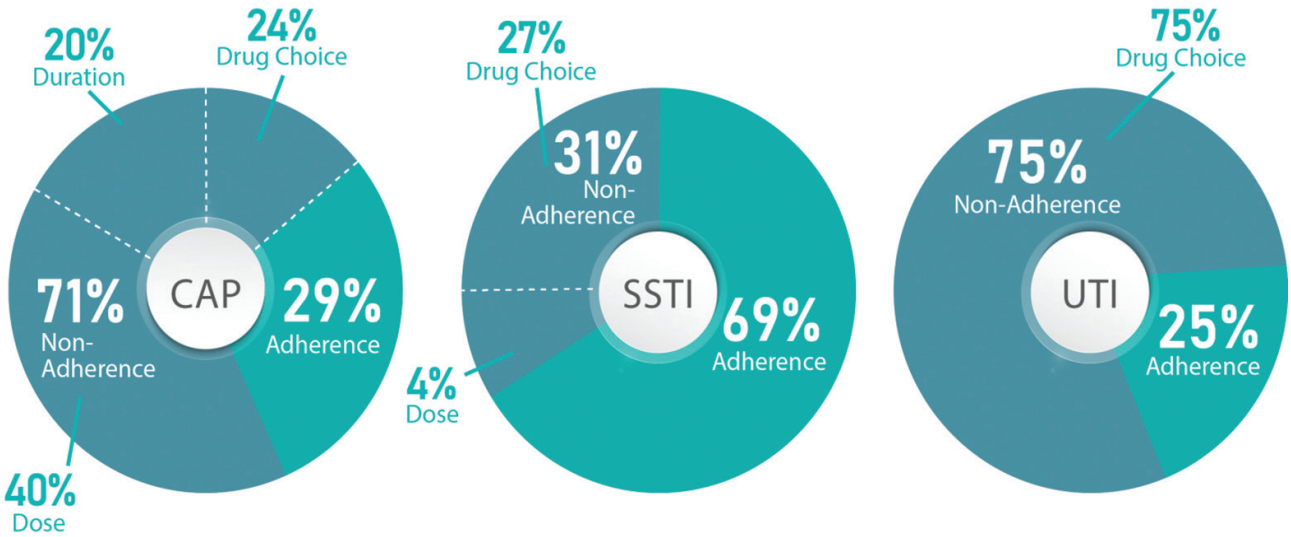

Figure 2. *Non-adherence to guidelines on the basis of drug choice, dose and duration. CAP, Community acquired pneumonia; SSTI, Skin and soft-tissue infection; UTI, Urinary tract infection; IV, Intravenous.*

had a history of drug allergies. Table 3 shows overall the most frequently prescribed antibiotics in our study were β-lactams (n = 157, 52.3%, 95% CI 46.5-58.1). Only one prescription had combination of antibiotic (amoxicillin-clavulanate and clindamycin). Figure 1 shows the most prescribed antibiotic in CAP, SSTI, and UTI was levofloxacin (55%), amoxicillin-clavulanate (71%), and ciprofloxacin (49%), respectively. Also, 19.7% (23% CAP, 6% SSTI, and 30% UTI) cases were given an additional intravenous first dose antibiotic in the ED along with the oral antibiotic on discharge. Non-adherence to guidelines was noted in 59% (95% CI 53.2-64.6) of cases; the frequency was highest for UTI (75%), followed by CAP (71%) and SSTI (31%). Overall, the most common cause of non-adherence was incorrect drug choice (n = 126, 42%, 95% CI 36.3-47.8). Figure 2 describes the

breakdown of three reasons due to which prescriptions were deemed non-adherent. Table 4 shows a difference in appropriateness percentage between different age groups, gender, comorbidities, and infections. Inappropriateness was more common in patients younger than the age of 60 years ($p = 0.48$), without comorbidities ($p = 0.42$) or those with UTI ($p < 0.00001$). Also, males (52.5%) were more likely than females (47.5%) to be inappropriately prescribed antibiotics ($p = 0.19$).

Discussion

Antibiotics - once deemed as the "miracle drugs" - are gradually losing their efficacy due to rampant misuse [10]. A survey essentially records an opinion as it only reveals what was said but there may be considerable gaps between what is said and what is done. Hence, to prevent this, we incorporated both physician survey and prescription review to describe the pattern and appropriateness of antibiotics prescribed in the ED, and up to our current knowledge, this study is the first of its kind.

In our study, non-adherence to guidelines was noted in 59.7% of cases. A physician's choice to deviate from the guidelines might be due to patient-related factors (e.g., the patient was already on a certain antibiotic for *X* number of days, unable to afford the recommended antibiotic) which were not documented in the EMR. Interestingly, in the literature, the data reports non-adherence rates for studies done in Bahrain (80.9%) [11], US (73%) [12], Lebanon (67.4%) [13], France (60%) [14], Australia (48.6%) [15], Denmark (47%) [16], Saudi Arabia (46.2%) [17], Qatar (45%) [18], and Spain (43%) [19]. However, none of these studies used the dual model of survey and review like ours. Also, unlike our study, some were conducted on only specific patient populations like inpatients [12,15,16] or patients diagnosed with upper respiratory tract infections [18]. Incorrect drug choice (42.7%) was the most common cause of non-adherence in our study. However, improper duration of treatment was the most common cause of non-adherence in a study done in Spain (39.9%) [20] as well as in Saudi Arabia (29%) [17].

In our study, there was no statistically significant difference in adherence to guideline in terms of age, gender or co-morbidities of patients. However, a recent meta-analysis of 11 studies from 10 countries (Israel, Spain, Denmark, Sweden, Belgium, Italy, Germany, New Zealand, England, and Wales) showed that women between the age group of 16-54 years received a significantly higher number of prescriptions of cephalosporins and macrolides in primary care settings than male patients [21].

The most frequently prescribed antibiotics in our study were β-lactams, similar to studies in Lebanon (87.2%) [13], Spain (54%) [19], and Saudi Arabia (30%) [22]. In contrast, cephalosporins were the most prescribed antibiotic in Bahrain (37.5%) [11] and Bangladesh (31.8%) [23], while fluoroquinolones were the most common in France (40.8%) [14].

Between the years 2004 and 2006, penicillin susceptibility was 57% [24] which dropped to 33.3% in 2011-2013 [25]. Azithromycin susceptibility in *Streptococcus pneumoniae* from the UAE was 67% [24] in 2004-2006 but dipped to 47.9% in 2011-2013 [25]. Hence, the overall trend for penicillin and macrolide resistance seems to be increasing in the UAE. Similarly, susceptibility to amoxicillin (with or without clavulanate) was high (98%) [24] in 2004-2006 but significantly lower in 2011-2013 (89.6%) [25]. Nevertheless, amoxicillin/clavulanic acid remains one of the more potent agents against *Streptococcus pneumoniae* from the UAE. Fluoroquinolones were the only agents that did not show a decreased susceptibility in 2011-2013 in the UAE. Fluoroquinolone susceptibility (using ofloxacin as a marker) was 64% in 2004-2006 [24] but levofloxacin susceptibility was 97.9% in 2011-2013 [25]. However, no data is available after 2013. Hence, it is possible that physicians might have deviated from the hospital guidelines (derived from international guidelines) based on their expectations or apprehensions surrounding the above local sensitivity patterns.

This study also revealed that without documentation of a clear indication, intravenous form of antibiotics was administered as first dose in the ED. Misuse of intravenous therapy increases the cost of care, risk of cannula related infection and requires an increase in the number of available medical staff such as nurses [26-28].

These results could play an influential role in designing an antibiotic stewardship program throughout the various health care delivery systems. By observing drug utilization patterns, current trends and common errors in prescriptions may be highlighted and rational use of antimicrobials can ensure optimum quality of care with cost containment.

Recommendations

Efforts to improve prescribing practices include a multidisciplinary approach involving the ED pharmacist, attendance of outreach programs, workshops, post prescription review by an infectious disease physician, and academic training and awareness. Setting up a default option in the discharge instructions in the EMR can help standardize the choice of antibiotic and duration of treatment relating to common infections, therefore, minimizing the aspect of physician non-adherence. Unavailability of ED guidelines can lead to physicians following their own practice. We suggest a centralized system for antibiotic prescription across the country according to local antibiogram. Future research using a larger sample size measuring the cost impact of antibiotic misuse and repercussions on patient outcome should be considered.

Limitations

First, the potential for selection bias exists owing to nonrandomized convenience sampling. Second, a retrospective cross-sectional design does not prove causality, nor does it allow for real-time knowledge of reasoning for the deviation from the guidelines. Nonetheless, the authors have considered that well designed observational studies are suited to check for guideline adherence as it would be unethical to conduct a randomized control trial with a non-

adherent arm. Third, potential consequences, if any, of inappropriate prescriptions could not be accounted for since the studied sample were outpatients only. Lastly, a monocentric study might raise questions regarding its generalizability. However, we believe that the results obtained in the country's largest and busiest ED catering to a cosmopolitan population of nearly 200 nationalities [29] can be generalized.

Conclusion

The study results revealed a significantly high level of physician non-compliance to guidelines for outpatient empirical antibiotic prescriptions in the ED with incorrect drug choice being the most common cause. The authors emphasize that physicians must therefore be vigilant about antibiotic choice, dose, and treatment duration.

Acknowledgment
Not applicable.

List of Abbreviations

CAP	Community-acquired bacterial pneumonia
SSTI	Skin and soft-tissue infection
UTI	Urinary tract infection

Conflict of interest
The authors declare that they have no conflict of interest.

Funding
None.

Consent to participate
Informed consent was obtained from individual survey participants.

Ethics approval
The study received institutional review board approval by the Clinical Governance Office, Health Regulation Department, Dubai Health Authority, Dubai (HRD/CGO/005- December 2018).

Author details
Sania Zia[1], Rasha AL-khateeb[1], Muna Aljallaf[1], Manal Yaslam[1], Syed Ibrahim Muneeb[1], Firas AlNajjar[1], Laila AlDabal[2]

1. Emergency Department, Rashid Hospital, Dubai Health Authority, Dubai, United Arab Emirates
2. Department of Internal Medicine, Infectious Disease Unit, Rashid Hospital, Dubai Health Authority, Dubai, United Arab Emirates

References

1. Velez R, Sloand E. Combating antibiotic resistance, mitigating future threats and ongoing initiatives. J Clin Nurs. 2016;25(13-14):1886–9. https://doi.org/10.1111/jocn.13246
2. Battles JB, Cleeman JI, Kahn KL, Weinberg DA. Advances in the prevention and control of HAIs. In: Agency for healthcare research and quality; 2014. Available from: https://www.ahrq.gov/hai/patient-safety-resources/advances-in-hai/index.html
3. Nassisi D, Oishi ML. Evidence-based guidelines for evaluation and antimicrobial therapy for common emergency department infections. Emerg Med Pract. 2012;14(1):1–28.
4. Joint Formulary Committee. British National Formulary (BNF) 66. London, UK; Chicago, IL: Pharmaceutical Press; 2013. Available from: https://www.worldcat.org/title/british-national-formulary-bnf-66/oclc/857365219
5. Moran GJ, Rothman RE, Volturo GA. Emergency management of community-acquired bacterial pneumonia: what is new since the 2007 Infectious Diseases Society of America/American Thoracic Society guidelines. Am J Emerg Med. 2013;31(3):602–12. https://doi.org/10.1016/j.ajem.2012.12.002
6. Tan CW, Chlebicki MP. Urinary tract infections in adults. Singapore Med J. 2016;57(9):485–90. https://doi.org/10.11622/smedj.2016153
7. Napolitano LM. Sepsis 2018: definitions and guideline changes. Surg Infect (Larchmt). 2018;19(2):117–25. https://doi.org/10.1089/sur.2017.278
8. Kohn MA, Senyak J. Sample size calculators [website]. UCSF CTSI; 2020. Available from: https://www.sample-size.net/
9. Chi Square Calculator - up to 5 × 5, with steps. Socscistatistics.com. 2020. Available from: https://www.socscistatistics.com/tests/chisquare2/default2.aspx.
10. World Health Organization. Antimicrobial use [Internet]. Geneva, Switzerland: World Health Organization; 2019. Available from: https://www.who.int/antimicrobial-resistance/global-action-plan/optimise-use/antimicrobials/en/
11. Al Salman JM, Alawi S, Alyusuf E, Albasri E, Almarzooq S, Alnashaba F, et al. Patterns of antibiotic prescriptions and appropriateness in the emergency room in a major secondary care hospital in Bahrain. Int Arab J Antimicrob Agents. 2015;5(3):1–8. https://doi.org/10.3823/776
12. Filice GA, Drekonja DM, Thurn JR, Hamann GM, Masoud BT, Johnson JR. Diagnostic errors that lead to inappropriate antimicrobial use. Infect Control Hosp Epidemiol. 2015;36(8):949–56. https://doi.org/10.1017/ice.2015.113
13. Fahs I, Shrayteh Z, Abdulkhalek R, Salameh P, Hallit S, Malaeb D. Professional practice evaluation of emergency department prescriptions for community-acquired infections in Lebanon. Int J Infect Dis. 2017;64:74–9. https://doi.org/10.1016/j.ijid.2017.09.010
14. Grenet J, Davido B, Bouchand F, Sivadon-Tardy V, Beauchet A, Tritz T, et al. Evaluating antibiotic therapies prescribed to adult patients in the emergency department. Med Mal Infect. 2016;46(4):207–14. https://doi.org/10.1016/j.medmal.2016.04.006
15. Cotta MO, Robertson MS, Upjohn LM, Marshall C, Liew D, Buising KL. Using periodic point-prevalence surveys to assess appropriateness of antimicrobial prescribing in Australian private hospitals. Intern Med J. 2014;44(3):240–6. https://doi.org/10.1111/imj.12353
16. Hagen TL, Hertz MA, Uhrin GB, Dalager-Pedersen M, Schønheyder HC, Nielsen H. Adherence to local antimicrobial guidelines for initial treatment of community-acquired infections. Dan Med J. 2017;64(6):A5381.
17. Alanazi MQ, Al-Jeraisy MI, Salam M. Prevalence and predictors of antibiotic prescription errors in an emergency department, Central Saudi Arabia. Drug Healthc Patient Saf. 2015;7:103–11. https://doi.org/10.2147/DHPS.S83770

18. Butt AA, Navasero CS, Thomas B, Marri SA, Katheeri HA, Thani AA, et al. Antibiotic prescription patterns for upper respiratory tract infections in the outpatient Qatari population in the private sector. Int J Infect Dis. 2017;55:20–3. https://doi.org/10.1016/j.ijid.2016.12.004

19. Martínez RA, Santos CI, García MR, Corbella CE. Antibiotic prescription quality at an hospital emergency service. Med Interna. 2005;22(6):266–70.

20. Laguna P, Moya MS, García F, Salgado R, Calabrese S. Utilization of antibiotics in a hospital emergency department. Quality of prescription. Rev clínica española. 1996;196(7):431–6.

21. Schröder W, Sommer H, Gladstone BP, Foschi F, Hellman J, Evengard B, et al. Gender differences in antibiotic prescribing in the community: a systematic review and meta-analysis. J Antimicrob Chemother. 2016;71(7):1800–6. https://doi.org/10.1093/jac/dkw054

22. Oqal MA, Elmorsy S, Alfhmy A, Alhadhrami RM, Ekram RA, Althobaiti IA, 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(2):124. https://doi.org/10.4103/1658-631X.156419

23. Biswas M, Roy DN, Tajmim A, Rajib SS, Hossain M, Farzana F, et al. Prescription antibiotics for outpatients in Bangladesh: a cross-sectional health survey conducted in three cities. Ann Clin Microbiol Antimicrob. 2014;13(1):15. https://doi.org/10.1186/1476-0711-13-15

24. Sievers J, SOAR Study Group. Antibacterial resistance among *Streptococcus pneumoniae* from 8 countries in Africa and the Middle East: results from the Survey of Antibiotic Resistance (SOAR) 2004-2006. Abstract C2-0425. In: Abstracts of the forty-sixth interscience conference on antimicrobial agents and chemotherapy, San Francisco, CA; Washington, DC: American Society for Microbiology; 2006.

25. Jamsheer A, Rafay AM, Daoud Z, Morrissey I, Torumkuney D. Results from the survey of antibiotic resistance (SOAR) 2011-13 in the Gulf States. J Antimicrob Chemother. 2016;71(Suppl 1):i45–61. https://doi.org/10.1093/jac/dkw064

26. Hecker MT, Aron DC, Patel NP, Lehmann MK, Donskey CJ. Unnecessary use of antimicrobials in hospitalized patients: current patterns of misuse with an emphasis on the antianaerobic spectrum of activity. Arch Intern Med. 2003;163(8):972–8. https://doi.org/10.1001/archinte.163.8.972

27. Cunha BA. Intravenous-to-oral antibiotic switch therapy. A cost-effective approach. Postgrad Med. 1997;101(4):111–2. https://doi.org/10.3810/pgm.1997.04.199

28. Ramirez JA. Antibiotic streamlining: development and justification of an antibiotic streamlining program. Pharm Pract Manag Q. 1996;16(3):19–34.

29. Fact sheet. The official portal of the UAE Government; 2020. Available from: https://u.ae/en/about-the-uae/fact-sheet