



Point prevalence survey of antibiotic use in 26 Saudi hospitals in 2016

Maher Al Matar^{a,*}, Mushira Enani^b, Ghada Binsaleh^a, Hala Roushdy^a, Deema Alokaili^a, Amira Al Bannai^a, Yasser Khidir^a, Hail Al-Abdely^a

^a General Directorate of Infection Prevention and Control, Ministry of Health, Saudi Arabia

^b King Fahd Medical City, Saudi Arabia

ARTICLE INFO

Article history:

Received 5 May 2018

Received in revised form 12 August 2018

Accepted 12 September 2018

Keywords:

Antimicrobial stewardship

Antimicrobial consumption

Hospital

Point prevalence survey

Quality indicators

ABSTRACT

Objective: To evaluate the antibiotic prescribing trends, qualitatively and quantitatively, among Saudi Ministry of Health (MOH) hospitals.

Method and materials: In May 2016, information about the hospitals and patients was collected for all inpatients from 26 MOH hospitals in Saudi Arabia. Additional information about antibiotic treatment and infections was gathered. Data collection was done using Global Point Prevalence Survey (PPS) tool designed by University of Antwerp, Belgium.

Results: A total of 3240 antibiotic doses were administered to 2182 patients who represented 46.9% of the total eligible admitted patients. Of those patients on antibiotics, 510 (24%) patients were in the Intensive Care Unit (ICU), 646 (30.4%) patients were medically treated, and 972 (45.7%) patients were in surgical departments. The most commonly prescribed antibiotic group was third-generation cephalosporin (17.2%) and the most frequent indication was respiratory tract infection (n = 597; 18.2%). Antibiotics for surgical prophylaxis represented 23.4% of the total antibiotic doses. Of those, 78% were administered for more than 24 hs. The rate of adherence to antibiotic guidelines was 48.1%. The indications for antibiotics were not documented in the patients' notes for 51.1% of the prescriptions.

Conclusion: This national PPS provided a useful tool to identify targets for quality improvement in order to enhance the prudent use of antibiotics in hospital settings. This survey can provide a background to assess the quality of antibiotic utilisation after any intervention by administering it regularly.

© 2018 The Authors. Published by Elsevier Limited on behalf of King Saud Bin Abdulaziz University for Health Sciences. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Introduction

Inappropriate use of antibiotics, particularly those with broad-spectrum antibacterial coverage, is frequent among common infections [1]. It was estimated that almost 4 out of 10 patients received antibiotic regimens that deviated from recommended antibiotic guidelines among hospitals [2].

Data from several studies has identified a trend of increasing overall antibiotic use during the last two decades, with a significant shift toward prescribing broader-spectrum agents. Inappropriate use of antibiotics has escalated the crisis of antimicrobial resistance, a significant public health concern [3,4]. Furthermore, inappropriate or unnecessary use of antibiotics has been shown to be associated with worse clinical outcomes [5].

Prescribing patterns of antibiotics vary among regions and countries. In Saudi Arabia, the vast majority of patients are treated in MOH hospitals. It is estimated that almost 60% of hospital beds in Saudi Arabia are based on MOH hospitals [6]; yet, there is limited data regarding antibiotic prescribing behaviour at a national level.

This study aims to determine the variation of the quality and quantity of antibiotic prescribing to adults and children in Saudi MOH hospitals. This is to identify targets for quality improvement, and to help hospitals design interventions for prudent antibiotic usage. Also, the study offers an opportunity to assess the effectiveness of such interventions through regularly administering the same PPS.

Material and methods

Study design and setting

This survey was a cross-sectional one-day point prevalence study, which surveyed inpatients who were on systemic anti-

* Corresponding author at: General Directorate of Infection Prevention and Control, Riyadh, Saudi Arabia.

E-mail address: dr.maheralmatar@gmail.com (M. Al Matar).

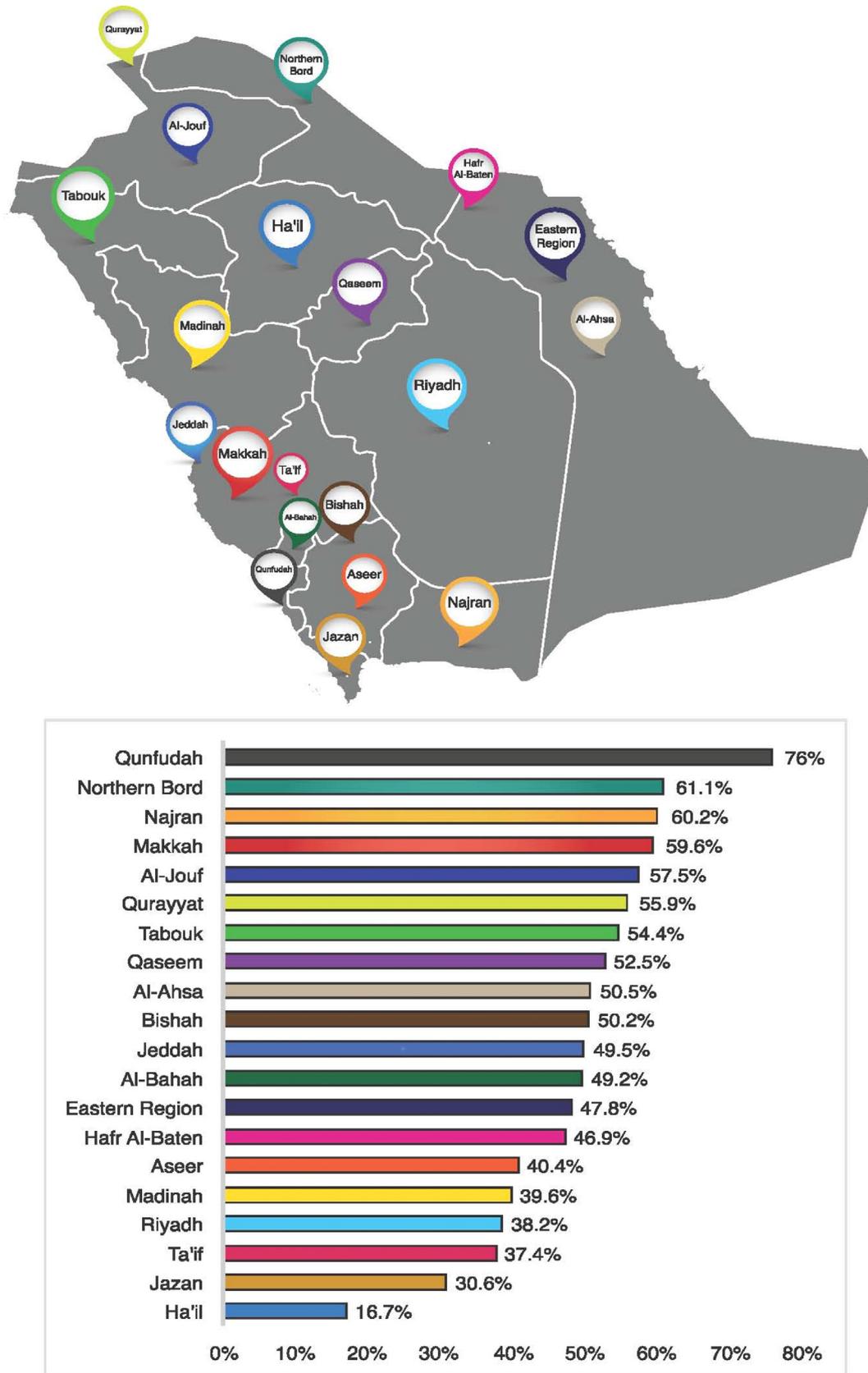


Fig. 1. The distribution of the participating hospitals and the proportion of patients treated with at least one antibiotic in Saudi MOH hospitals, by health care regions.

otics in Saudi MOH hospitals. From the 20 healthcare regions, 28 hospitals were nominated to represent the whole country. From each hospital, one Infection Control Practitioner (ICP) was

assigned the responsibilities of collecting the data and training the other staff from the assigned institution on the study protocol. In April 2016, a one-day workshop was conducted that

Table 1
Antibiotic usage and consumption.

Class	Antibiotic name	Number	Total number (%)
Antivirals	Acyclovir	6	31 (1%)
	Oseltamivir	25	
Aminoglycoside	Amikacin	65	174 (5.4%)
	Gentamicin	107	
	Streptomycin	2	
	Amoxicillin	109	
	Ampicillin	166	
Beta-lactam, penicillin	Cloxacillin	16	306 (9.4%)
	Flucloxacillin	2	
	Benzylpenicillin	4	
	Piperacillin	9	
Penicillin and enzyme inhibitor	Amoxicillin + clavulanic acid	74	284 (8.8%)
	Piperacillin/tazobactam	210	
	Amphotericin B	5	
Antimycotics	Caspofungin	9	37 (1.1%)
	Fluconazole	20	
	Itraconazole	2	
	Voriconazole	1	
Macrolides	Azithromycin	52	93 (2.9%)
	Clarithromycin	35	
	Erythromycin	6	
Beta-lactam, 1st generation cephalosporin	Cefazolin	83	251 (7.7%)
	Cefalexin	26	
Beta-lactam, 4th generation cephalosporin	Cefradine	142	61 (1.9%)
	Cefepime	61	
Beta-lactam, 3rd generation cephalosporin	Cefotaxime	89	557 (17.2%)
	Cefovecin	1	
	Ceftazidime	88	
Beta-lactam, 2nd generation cephalosporin	Ceftriaxone	379	225 (6.9%)
	Cefuroxime	225	
	Ciprofloxacin	91	
	Gatifloxacin	1	
Quinolones	Levofloxacin	64	187 (5.5%)
	Moxifloxacin	28	
	Ofloxacin	3	
Lincosamides	Clindamycin	28	28 (0.9%)
Polymyxins	Colistin	67	67 (2.1%)
	Doxycycline	2	
Tetracyclines	Tetracycline	1	22 (0.7%)
	Tigecycline	19	
	Ethambutol	33	
	Isoniazid	32	
Drugs for TB	Pyrazinamide	28	126 (3.9%)
	Rifampicin	33	
Steroid	Fusidic acid	1	1 (0.03%)
	Imipenem	82	
Beta-lactam, carbapenems	Imipenem/cilastatin	6	266 (8.2%)
	Meropenem	178	
	Linezolid	20	
Others	Metronidazole	324	324 (10%)
	Sulfamethoxazole	3	
Sulfonamides and trimethoprim	Sulfamethoxazole and trimethoprim	11	16 (0.5%)
	Trimethoprim	2	
Glycopeptide	Vancomycin	163	163 (5%)

targeted all assigned ICPs, who started collecting data in May 2016.

Data collection

All admitted inpatients who were receiving a systemic antimicrobial treatment or prophylaxis were included in the data collection. Antimicrobial agents include: antibiotics, antimycotics, antibiotics for the treatment of tuberculosis, and antimalarials. All data was collected using the standard forms from the Global-PPS electronic tool.

Two forms were used to collect the data: one to collect the data about the ward/department; and the other to gather information related to patients who were on a systemic antimicrobial agent during the PPS. The data obtained from the ward/department form included: the type of ward/department (medical, surgical or ICU), the total number of beds, all admitted patients, and the number of

patients on antibiotics. The patient's form was designed to obtain information about patients and the antibiotics they were taking. The data obtained included: the patient's characteristics; details of their prescribed antibiotics, such as, drug name, unit dose, frequency, and reasons for prescribing; and available microbiological and biomarker data. The form also contained information about the quality of prescribing with regards to the presence or absence of guidelines, guideline concordance, and documentation of a review or stop date.

Timeframe

Any participating hospital had to complete the PPS within a maximum of 4 consecutive weeks from the time when the hospital started data collection. All participating hospitals began collecting data in May 2016.

Inclusion and exclusion criteria

Regardless of age, all inpatients who were receiving any systemic antibiotic at eight a.m. on the day the PPS were included in the study. However, all one-day admission patients, such as, one-day surgery and endoscopy patients were excluded. Furthermore, patients who were admitted after eight a.m. on the day the PPS were also excluded.

Data analysis

All statistical analyses were performed using IBM SPSS statistics for Windows, version 20.0. (Armonk, NY: IBM Corp). Continuous variables are expressed as the median and range. Categorical variables are expressed as proportions and percentages.

Results

In May 2016, of the 28 MOH hospitals who were approached to participate in the national antibiotic PPS, 26 completed the PPS and were included in the analysis. The mean number of bed capacity was 420 beds (range 130–1351 beds), with a total of 6324 beds. Out of the 26 hospitals, 16 were between 201 to 500 bed capacity, while five possessed more than 500 beds, and the remaining five possessed less or equal to 200 beds.

Out of 4535 eligible patients, 2128 (46.9%) patients were on antibiotics (range 16.7%–76%; Fig. 1) where 1031 (48.4%) of the patients were females, and 1532 (72%) of them were ≥ 18 years old. Of those patients on antibiotics, 510 (24%) were in the ICU, 646 (30.4%) were medically treated, and 972 (45.7%) were in surgical departments.

A total of 3240 antibiotic doses were administered. Of those, 2613 (80.6%) doses were given parenterally. The most commonly prescribed antibiotics were for community-acquired infections ($n = 1013$; 31.3%), followed by surgical prophylaxis ($n = 758$; 23.4%), healthcare-associated infections ($n = 530$; 16.4%), medical prophylaxis ($n = 364$; 11.2%), completely unknown indications (10.5%), and others (3.2%).

Antibiotics selection

The most commonly prescribed antibiotic group was third-generation cephalosporin, with ceftriaxone being the most frequently prescribed antibiotic, representing 68% of third-generation cephalosporins and 11.7% of all prescribed antimicrobials. Table 1 demonstrates the frequency and percentages of all prescribed antibiotics.

Table 2 shows antibiotic prescription pattern by site of infection. Of the identified diagnoses, 597 (26.4%) antibiotic doses were indicated for respiratory site. Almost half of them (279 doses) were prescribed for pneumonia. Out of 2118 antibiotic doses that were given to treat infections, 585 (27.6%) were prescribed for identified pathogen/s, and 371 doses were based on biomarker data.

The process of care

During the PPS, almost one quarter of the indications ($n = 758$) were prescribed for surgical prophylaxis. Of those, 78% were administered for more than 24 hs, while only 10% of the doses were given as a single dose. 1558 (48.1%) doses of antibiotics adhered to the recommended antibiotic guidelines or indications based on advice from infectious diseases physicians. The reasons for almost half of the indications ($n = 1818$; 51.1%) were not documented in the patients' medical records. Furthermore, requests for the time-

Table 2
Antibiotic prescription pattern by site of infection.

Site of infection	Number (%)	Treatment ^a	Prophylaxis
Unidentified ^b	979 (30.2%)	906	173
Respiratory	597 (18.3%)	542	55
Genital	418 (12.9%)	63	355
Intra-abdominal	256 (7.9%)	119	137
Skin and soft tissue	246 (7.6%)	246	–
Bone and Joint	223 (6.9%)	107	116
Neonatal	177 (5.5%)	–	177
Central Nervous System	176 (5.4%)	131	45
Urinary tract infection	101 (3.1%)	52	49
Cardiovascular system	55 (1.7%)	43	12
Eye	12 (0.4%)	9	3
Total	3240	2118	1122

^a Empirical and targeted therapies.

^b Bacteraemia with no clear anatomic site ($n = 12$), sepsis with no clear anatomic site ($n = 284$), Malaria ($n = 1$), pyrexia of unknown origin ($n = 48$), fever in non-neutropenic haematology-oncology patient with no identified source ($n = 18$), fever in the neutropenic patients ($n = 10$), infection of Lymphatic as the primary source ($n = 5$), drug used as medical prophylaxis in general without targeting a specific site ($n = 53$), completely unknown indications ($n = 341$) and antibiotic that were prescribed with documentation for which the diagnosis is not listed ($n = 209$).

frame to stop/review antibiotic usage were only recorded in 56.3% ($n = 1825$) of the indications.

Discussion

An initial objective of the current study was to identify antimicrobial prescribing behaviour in Saudi MOH hospitals. This study is the first of its kind that covers hospitals from all Saudi regions.

The current study found that almost half of the admitted patients were on one or more antibiotics. These results differ from some published studies in Europe, Australia, and Canada, where the antibiotic rates were 20% less than what was found in this study [7–11]. On the other hand, compared with other relatively less developed countries, such as, Vietnam, the rate of patients on antibiotics was almost 20% higher than that seen in our study [12]. Our finding seems to be consistent with other national data from the USA, China, and the neighbouring Arab country, Egypt [13–15]. A possible explanation of the difference in the antibiotic prescribing rates in different countries might be due to the variation of healthcare systems.

Another significant finding was the poor adherence to antibiotic guidelines. This study shows that almost five out of ten of the patients who were on antibiotics received a discordant antibiotic selection. Adherence to antibiotic guidelines is a common challenge around the globe. In France, for example, a PPS conducted in 314 hospitals showed that adherence to local antibiotic guidelines was 62% in 2010 [16].

It is interesting to note that of all antibiotic prescribing, almost 80% of the antibiotics were delivered parenterally, which is far more than what was seen in Europe, where only 60.5% of the prescriptions were administered parenterally [9]. However, in a study conducted in 13 Chinese hospitals, almost all antibiotic orders (98%) were given parenterally [17]. When it comes to antibiotic selection, third-generation cephalosporins became the most commonly prescribed antibiotic, with ceftriaxone leading the group. In their qualitative study, Almatar et al. provided some explanations about the phenomena. Firstly, this result could be due to the fact that ceftriaxone might be perceived as a safe broad-spectrum antibiotic due to the once-daily dosing regimens, which is not the case for most β -lactams [18]. According to the qualitative study, another possible explanation is diagnosis uncertainty, which could influence the use of such broad-spectrum antibiotics to cover common microorganisms in different anatomical sites. Moreover, experience of treatment failures was seen more with

narrower-spectrum antibiotics when it was compared with ceftriaxone. Interestingly, other national data showed that β -lactam, plus enzyme inhibitors, and fluoroquinolones were the most commonly prescribed antibiotic groups. National antibiotic guidelines might have a big influence on those findings. For example, in the case of community-acquired pneumonia (CAP), one of the most common infections, the British Thoracic Society guidelines for the empirical management of CAP recommend an amoxicillin/clavulanic acid-containing regimen, as an initial option for the management of severe CAP. Interestingly, these antibiotics are the most commonly prescribed in Europe [9,19]. On the other hand, a fluoroquinolones-containing regimen is the recommended choice in the USA to manage hospitalised CAP patients; again, these are the most commonly prescribed antibiotics in the USA [15,20]. These factors should be considered for any future antimicrobial stewardship intervention.

It is somewhat surprising that the vast majority of the surgical patients (78%) received prophylactic antibiotics for more than 24 hs despite the recommendations of a single dose for most indications. Compared with other European countries, this rate is considered very poor. For example, in one national survey in French hospitals, the proportion of patients who received antibiotics for surgical prophylaxis and lasted for more than 24 hs was estimated to be one fifth [21]. In the 2009 European PPS, five out of ten received surgical antibiotic prophylaxis for more than 24 hs [9].

Moreover, the results of this study indicate a low level of documentation of the indication, as well as the timeframe to stop or review the prescribed antibiotic/s. Compared with data from Europe, this documentation rate would be considered very low [9].

So far, this is the largest Saudi study that has covered wide geographical areas to assess antibiotic prescribing behaviour in Saudi Arabia. Nevertheless, several limitations to this study need to be acknowledged. Firstly, this data is only limited to MOH hospitals, while other sectors are not included, such as, semi-governmental and private sectors. However, MOH represents the leading healthcare provider in the Saudi healthcare system, as it provides almost 60% of healthcare services in the country [22]. Furthermore, adherence to guidelines was based mainly on the selection of antibiotics, as opposed to the whole regimen, such as, dose, duration, and route of administration. Therefore, these results need to be interpreted with caution. Finally, the collected data was gathered mainly by the hospitals' representative and could not be validated.

Conclusion

The survey has gone some way toward enhancing our understanding of antibiotic prescribing behaviour on a national level. Several areas for improvement were identified, including: high use of broad-spectrum antibiotics, ceftriaxone, in particular; prolonged use of antibiotics for surgical prophylaxis; and poor documentation of reasons, and a stop or review date. Addressing each of these indicators would be pivotal to the success of any governmental intervention designed to enhance the national antimicrobial stewardship program.

Funding

No funding sources.

Competing interests

None declared.

Ethical approval

Not required.

Acknowledgments

The authors would like to express their appreciation to the infection control departments in the following hospitals for contributing in collecting the data: King Saud Medical city; Riyadh, King Salman Hospital; Riyadh, Heraa General Hospital; Mecca, Al Noor Hospital; Mecca, Maternity and Children Hospital; Mecca, King Fahd Hospital; Medina, King Saud Hospital; Al-Qassim, King Fahd Hospital; Al-Qassim, Al Rass General Hospital; Al-Qassim, Dammam Medical Complex; Dammam, Aseer Central Hospital; Abha, Northern Border Hospital; Northern Borders Region, Maternity and Children Hospital; Hail, King Khalid Hospital; Tabuk, King Fahd Hospital; Jazan, King Khalid Hospital; Najran, King Fahd Hospital; Baha, King Fahd Hospital; Jeddah, King Abdul Aziz Specialist Hospital; Taif, King Fahd Hospital; Al-Ahsa, Maternity and Children Hospital; Al-Ahsa, King Khalid General Hospital; Hafar Al Batin, King Abdullah Hospital; Bisha, Al Qurayyat General Hospital; Qurayyat, Al Qunfudah General Hospital; Al Qunfudah and Tabarjal General Hospital; Al Jouf.

References

- [1] Robertson MB, Korman TM, Dartnell JG, Ioannides-Demos LL, Kirsa SW, Lord JA, et al. Ceftriaxone and cefotaxime use in Victorian hospitals. *Med J Aust* 2002;176(June (11)):524–8.
- [2] Pasquale TR, Trienski TL, Olexia DE, Myers JP, Tan MJ, Leung AK, et al. Impact of an antimicrobial stewardship program on patients with acute bacterial skin and skin structure infections. *Am J Health Syst Pharm* 2014;71(July (13)):1136–9.
- [3] Pakyz AL, MacDougall C, Oinonen M, Polk RE. Trends in antibacterial use in US academic health centers: 2002 to 2006. *Arch Intern Med* 2008;168(November (20)):2254–60.
- [4] Adriaenssens N, Coenen S, Versporten A, Muller A, Minalu G, Faes C, et al. European Surveillance of Antimicrobial Consumption (ESAC): outpatient antibiotic use in Europe (1997–2009). *J Antimicrob Chemother* 2011;66(December (suppl.6)):vi3–12.
- [5] Paterson DL. "Collateral damage" from cephalosporin or quinolone antibiotic therapy. *Clin Infect Dis* 2004;38(May (Supplement 4)):S341–5.
- [6] Almasabi M. An overview of health system in Saudi Arabia. *Res J Med Sci* 2013;7:70–4.
- [7] Ansari F, Erntell M, Goossens H, Davey P, ESAC II Hospital Care Study Group. The European surveillance of antimicrobial consumption (ESAC) point-prevalence survey of antibacterial use in 20 European hospitals in 2006. *Clin Infect Dis* 2009;49(November (10)):1496–504.
- [8] Amadeo B, Zarb P, Muller A, Drapier N, Vankerckhoven V, Rogues AM, et al. European Surveillance of Antibiotic Consumption (ESAC) point prevalence survey 2008: paediatric antimicrobial prescribing in 32 hospitals of 21 European countries. *J Antimicrob Chemother* 2010;65(August (10)):2247–52.
- [9] Zarb P, Amadeo B, Muller A, Drapier N, Vankerckhoven V, Davey P, et al. Identification of targets for quality improvement in antimicrobial prescribing: the web-based ESAC Point Prevalence Survey 2009. *J Antimicrob Chemother* 2010;66(November (2)):443–9.
- [10] 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(March (3)):240–6.
- [11] Skoog G, Struwe J, Cars O, Hanberger H, Odenholt I, Prag M, et al. Repeated nationwide point-prevalence surveys of antimicrobial use in Swedish hospitals: data for actions 2003–2010. *Eurosurveillance* 2016;21(25):13–21.
- [12] Thu TA, Rahman M, Coffin S, Harun-Or-Rashid M, Sakamoto J, Hung NV. Antibiotic use in Vietnamese hospitals: a multicenter point-prevalence study. *Am J Infect Control* 2012;40(November (9)):840–4.
- [13] Li C, Ren N, Wen X, Zhou P, Huang X, Gong R, et al. Changes in antimicrobial use prevalence in China: results from five point prevalence studies. *PLoS One* 2013;8(December (12)):e82785.
- [14] Talaat M, Saied T, Kandeel A, El-Ata GA, El-Kholy A, Hafez S, et al. A point prevalence survey of antibiotic use in 18 hospitals in Egypt. *Antibiotics* 2014;3(September (3)):450–60.
- [15] Magill SS, Edwards JR, Beldavs ZG, Dumyati G, Janelle SJ, Kainer MA, et al. Prevalence of antimicrobial use in US acute care hospitals, May–September 2011. *JAMA* 2014;312(October (14)):1438–46.
- [16] Alfandari S, Robert J, Péan Y, Rabaud C, Bedos JP, Varon E, et al. Antibiotic use and good practice in 314 French hospitals: the 2010 SPA2 prevalence study. *Med Mal Infect* 2015;45(November (11–12)):475–80.

- [17] Xie DS, Xiang LL, Li R, Hu Q, Luo QQ, Xiong W. A multicenter point-prevalence survey of antibiotic use in 13 Chinese hospitals. *J Infect Public Health* 2015;8(January (1)):55–61.
- [18] Almatar MA, Peterson GM, Thompson A, Zaidi ST. Factors influencing ceftriaxone use in community-acquired pneumonia: emergency doctors' perspectives. *Emerg Med Australas* 2014;26(December (6)):591–5.
- [19] Lim WS, Baudouin SV, George RC, Hill AT, Jamieson C, Le Jeune I, et al. BTS guidelines for the management of community acquired pneumonia in adults: update 2009. *Thorax* 2009;64(October (Suppl. 3)), iii1–55.
- [20] Mandell LA, Wunderink RG, Anzueto A, Bartlett JG, Campbell GD, Dean NC, et al. Infectious Diseases Society of America/American Thoracic Society consensus guidelines on the management of community-acquired pneumonia in adults. *Clin Infect Dis* 2007;44(March (Supplement_2)):S27–72.
- [21] Robert J, Péan Y, Varon E, Bru JP, Bedos JP, Bertrand X, et al. Point prevalence survey of antibiotic use in French hospitals in 2009. *J Antimicrob Chemother* 2012;67(January (4)):1020–6.
- [22] Alraga S. Comparative analysis of three different health systems Australian, Switzerland and Saudi Arabia. *Qual Prim Care* 2017;25(May (2)).