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Original Research Article

A prospective antibiotic point prevalence survey in two primary referral hospitals during and after pilgrims stay in Madinah, Saudi Arabia

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Abstract

Purpose: *To assess current patterns of antibiotic use by carrying out two point-prevalence surveys (PPS) in Madinah after the return of hajj pilgrims from Makkah and when Madinah is free from pilgrims.*
Methods: *In September 2016 and November 2016, a prospective PPS was conducted on two separate dates (during the hajj pilgrims stay in Madinah and after they leave). Data on antibiotics use were generated during these two periods. This involved an audit from all the departments of two referral hospitals (King Fahad Hospital (KFH) - 425 beds, and Al Ansar Hospital - 100 beds) of inpatients records. Data were collected using standard forms adapted from the European Centre for Disease Control (ECDC).*
Results: *A total of 675 inpatients were included in PPS; among them, 332 (49.18 %) patients were receiving antibiotic therapy. In September 2016, 168 patients were treated with antibiotics, with a prevalence rate of 50.60 %, whereas, in November 2016, the prevalence rate was 49.40 %. Overall, 198 patients were identified in surgical wards, of which 132 patients (66.6 %) were receiving antibiotic therapy; 121 patients in ICU of which 70 patients (57.8 %) received antibiotics; 13 patients in other wards of which 6 (46.1 %) received antibiotic treatment; and 343 patients in medical wards of which 126 patients (36.7 %) were treated with antibiotics. There was no significant difference in prevalence of antibiotic prescribing between the two surveys (Pearson Chi-square test, p = 0.56) and with regards to patient age between the two surveys (Mann-Whitney U-test, p = 0.32).*
Conclusion: *The results demonstrate that antibiotic use with adherence to hospital guidelines and PPS helps in identifying targets for quality improvement. Moreover, to escalate the prudent use of antibiotics in hospitals, PPS provides a useful tool. Furthermore, this survey provides a background to evaluate antibiotic use by a standardized methodology.*

Keywords: *Point prevalence survey, Antibiotic use, Prescribing practices, Antibiotic resistance, Quality improvement, Antibiotic stewardship, Hajj, Pilgrims*

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INTRODUCTION

Antibiotics are used widely in modern healthcare systems and their demand increased rapidly as they target either bacterial cell reproduction or make necessary changes in cellular process or function, thus treat and prevent bacterial infections. They are the most customarily prescribed drugs in the community as well in hospital settings. The drastic use of antibiotics has shown several critical changes in the field of medicine [1]. The mortality and morbidity rates have shown some serious changes due to the practice of inappropriate use of antibiotics around the world, thus potentially leads to spread and development of adverse effects, high hospital cost and antibiotic resistance [2,3].

Annually, over 2 million pilgrims from across the 180 countries gather every year to perform the Hajj [4]. The hajj statistics of Government of Saudi Arabia illustrated that in 2016, 1.86 million people came to perform hajj rituals [5]. The close contact of pilgrims to themselves during rituals makes them vulnerable to infectious disease (6)]. In these large-scale gatherings, transmission of drug-resistant organisms are of great concern to the society. [7]. The irrational use of antibiotics by healthcare professionals during hajj increases, to overcome the viral and bacterial infections and therefore inappropriate prescribing practices may occur which is a threat to patient safety [8,9]. There is lot of evidence which indicates that healthcare professionals are influenced by lack of accountability, physiological factors, clinical workload. while prescribing antibiotics [9].

Globally, due to the growing demand of resources required for daily monitoring and excess workload it's not deftly possible to collect continuous data on antibiotic prescribing [10]. To overcome this, alternatively, we can collect the data at specific point in time by using point prevalence survey (PPS). In PPS, basic information is gathered from medical records and related documentation of all hospitalized patients regardless of their antibiotic treatment are retrieved [10].

This study aims to assess the prevalence of antibiotics use in two multispecialty hospitals of Madinah, Saudi Arabia. This point prevalence survey (PPS) was categorially performed during the stay of hajj pilgrims in September 2016 from across the globe and after their departure in November 2016 to assess the antibiotic use. Also, this survey offers an opportunity to identify targets for quality improvement of antibiotic prescribing.

METHODS

Study design

This study was conducted in Madinah City of Saudi Arabia. Two acute teaching referral hospitals were used in these two point-prevalence studies and these hospitals represent the primary acute care hospitals in the ministry of health in Madinah. These two hospitals, King Fahad Hospital (KFH, 425 beds) and Al Ansar Hospital (100 beds) provides general medical, acute and surgical services. The Research coordinator wrote to each Hospital inviting their participation in the study, i.e. involvement in two separate point prevalence surveys. Each hospital indicated their agreement to participate in the study. The prospective point-prevalence surveys were conducted on two separate dates. i.e. when the Hajj pilgrims return to Madinah from Makkah City (September 2016) and when Madinah is free from pilgrims (November 2016). During a two-week period in September 2016 and November 2016 data was accumulated in each hospital on a single day.

Patient selection

The patients who were available at 8 am on the days of the surveys (September 2016 and November 2016) in the participating hospitals were included in the study. The patients treated for any reason with an antibiotic in the whole hospital at 8 am, either parenteral or oral, on the day of survey, were identified. Patients were excluded if they were admitted to the ward after 8 am and if temporarily under investigation in the accident and emergency department or in outpatient areas.

Data collection

The pharmacists collected the required data after reviewing the patients prescribing charts and case notes using standard forms adapted from the European Centre for Disease Control (ECDC) [11]. A guideline document was distributed with the audit tool across the participating hospitals, to ensure consistency of data collection. Moreover, to elucidate how the data should be documented, a training program was conducted for the pharmacists who were responsible for data collection. The data collection included the details like patient age, gender, antibiotic agents used (route of administration, dose per administration and number of doses per day), anatomical site of the infection being treated, number of inpatients in each department and duration of surgical

prophylactic antibacterial use (1 day, > 1 day, 1 dose).

Statistical analysis

The results were presented using standard statistical methods such as interquartile, medians, 95 % confidence intervals (CI) and frequency (%). Depending on the characteristics of data, various appropriate univariate tests were used. The Pearson Chi-square (X^2) test was used with the following categorical variables: gender, age groups, type of hospital ward (i.e. intensive care unit I.C.U., surgery, medicine, other wards) and admission source (i.e. other hospitals/department, home). When > 20 % of the anticipated frequency was < 5 then Fisher's exact test was implemented, while the Mann-Whitney U-test was applied with steady variables (i.e., age). The statistical analyses were executed using SPSS for Microsoft Windows (Advanced Statistics Release 26, SPSS® Inc, Chicago).

Ethics

The current survey protocol was approved by the Scientific Research and Ethics Committee of King Fahad hospital (KFH) (approval no. 541/10/14). Furthermore, this survey was conducted according to the international guidelines of World health organization (WHO) methodology for point prevalence survey on antibiotic use in hospitals [10].

RESULTS

Patients' characteristics

Data were recorded for all patients who were admitted as inpatients on the days of the surveys in the participating hospitals. A total of 675 inpatients were surveyed, among them, 332 (49.18 %) were on antibiotics. In September 2016, 60 % of patients receiving antibiotics were male, while in November 2016, 19 % were female patients. The median age was 52 years (range: 31 - 65) in September 2016 and 46 years (range: 28 - 65) in November 2016. There was no statistically significant variation with regards to patient age between the two surveys (The Mann-Whitney U-test, $p = 0.32$). However, there was a statistically significant seasonal difference with regards to gender (Pearson chi-square test; $p = 0.01$). General characteristics of the study population are outlined in Table 1.

Antibiotics prescribed

Throughout the two point-prevalence surveys, different trends in antibiotic usage were found (Figure 1). In September 2016, antibiotic treatments were prescribed to 168 treated patients out of 332, whereas in November 2016, antibiotic treatments prescribed to 164 treated patients out of 332. The most persistent prescribed antibiotics throughout the two PPS were mixture of penicillin's, (20 %, September 2016; 13.5 %, November 2016). These antibiotics were amoxicillin-clavulanic acid (12 %, September 2016; 14 %, November 2016) and piperacillin-tazobactam (88 % in September 2016; 86 % in November 2016). The other most often prescribed antibiotic agents were as follows: during the first point-prevalence survey in September 2016: third generation cephalosporins (16.5 %), second-generation cephalosporins (8.6 %), fluoroquinolones (8.6 %), imidazole derivatives (8.2 %), glycopeptide antibacterials (6.7 %) and macrolides (6.3 %). During the second point-prevalence survey in November 2016, other antibiotics were: third generation cephalosporins (20.6 %), fluoroquinolones (10.5 %), imidazole derivatives (10.5 %), Second-generation cephalosporins (9.0 %), Other antibacterials (7.5 %) and glycopeptide antibacterial (6.3 %; Table 2 and Table 3).

Prevalence of antibiotic prescriptions

The substantial antibiotic prescription rate was 49.18 % (332 of 675 patients). 168 patients were treated with antibiotics, out of 332 patients (September 2016) (prevalence rate = 50.60%), whereas in November 2016, the prevalence rate was 49.40 % (164/332 patients). With consideration to the prevalence of antibiotic usage between the two surveys (Pearson chi-square test, p = 0.56), there was no statistically significant difference.

Targets for quality improvement

Duration of surgical prophylaxis

In the participating hospitals, 151 antibiotic therapy courses for surgical prophylaxis *were received by 132 patients throughout* the two PPS, i.e. 64 patients (Single dose: n = 5; one day: n = 5; > 1 day: n = 48; September 2016) and 68 patients (single dose: n = 12; one day: n = 17; > 1 day: n = 64; November 2016).

Table 1: General characteristics of study population in participating hospitals, in September and November 2016

Characteristic	Participating hospitals				Overall	
	KFH		*Ansar Hospital*			
	Frist PPS	***Second PPS***	***Frist PPS***	***Second PPS***	***Frist PPS***	***Second PPS***
	280	293	48	54	328	347
Number of treated patients, N (%)	136 (48.5)	126 (43)	32 (66.6)	38 (70)	168 (51)	164 (47)
Number of treated pilgrim patients, N (%)	23 (17)	0	22 (68.7)	0	45 (26.7)	0
Median age, treated patients, years (interquartile range)	50 (32-64)	45 (26-66)	55 (34-61)	54 (31-64)	52 (31-65)	46 (28-65)
Male, N (%)	89 (66)	116 (90)	9 (30)	22 (55)	98 (60)	138 (81)
Medicine, N (%)	150 (54)	138 (47)	31 (65)	24 (44)	181 (55)	162 (47)
Surgery, N (%)	77 (27)	103 (35)	4 (8)	14 (26)	81 (24)	117 (34)
Intensive care, N (%)	48 (17)	44 (15)	13 (27)	16 (30)	61 (19)	60 (17)
Other department, N (%)	5 (2)	8 (3)	0	0	5 (2)	8 (2)
Number of prescribed antibiotics	202	203	53	64	255	267

Table 2: Antibiotic agents prescribed and participating hospitals, during the point-prevalence survey in September 2016

Antibiotic prescription	Hospitals (N)		Overall	
	KFH	*Al Ansar*	*Individual (N)*	*Groups, N (%)*
Tetracyclines (J01AA)	-	-	-	5 (2)
Doxycycline	5	0	5	
Penicillin's with extended spectrum (J01CA)	-	-	-	2 (0.8)
Amoxicillin	2	0	2	
Beta-lactamase resistant penicillin's (J01CF)	1	0	1	1 (0.4)
Combinations of penicillin's (J01CR)	-	-	-	51 (20)
Amoxicillin-clavulanic acid	5	1	6	
Piperacillin-tazobactam	42	3	45	
First-generation cephalosporins (J01DB)	-	-	-	5 (2)
Cefazolin	4	0	4	
Cefalexin	1	0	1	
Second generation cephalosporins (J01DC)	-	-	-	22 (8.6)
Cefuroxime	22	0	22	
Third generation cephalosporins (J01DD)	-	-	-	42 (16.5)
Cefotaxime	3	0	3	
Ceftazidime	8	3	11	
Ceftriaxone	11	17	28	
Fourth generation cephalosporins (J01DE)	-	-	-	9 (3.5)
Cefepime	9	0	9	
Carbapenems (J01DH)	-	-	-	12 (4.7)
Imipenem & Cilastatin	3	3	6	
Meropenem	6	0	6	
Macrolides (J01FA)	-	-	-	16 (6.3)
Azithromycin	5	8	13	
Clarithromycin	1	2	3	
Lincosamides (J01FF)	-	-	-	6 (2.4)
Clindamycin	5	1	6	
Aminoglycosides (J01GB)	-	-	-	7 (2.7)
Gentamicin	4	0	4	
Amikacin	3	0	3	
Fluoroquinolones (J01MA)	-	-	-	22 (8.6)
Levofloxacin	3	1	4	
Ciprofloxacin	10	3	13	
Moxifloxacin	4	1	5	
Glycopeptide antibacterials (J01XA)	-	-	-	17 (6.7)
Vancomycin	14	3	17	
Imidazole derivatives (J01XD)	15	6	21	21 (8.2)
Other antibacterials (J01XX)	-	-	-	11 (4.3)
Linezolid	2	1	3	
Colistin (Colomycin)	8	0	8	
Rifampicin (J04AB02)	5	0	5	5 (2)
Triazole derivatives (J02AC)	-	-	-	1 (0.4)
Fluconazole	1	0	1	

The overall period of antibiotic therapy for surgical prophylaxis was remarkably greater than one day in 84.8 % (112/132) of all patients who were undergoing antibiotic prophylaxis treatment (75 % in September 2016 compared with 94.1 % in November 2016).

Combination therapy

Of the 332 patients who were prescribed an antibiotic, 176 (53 %) were treated with one antibiotic, 125 (37.6 %) were treated with two antibiotics, and 31 (9.3 %) were treated with three or more antibiotics simultaneously on the day of the surveys. In September 2019, many patients who were treated with three or more antibiotics (72.2 %) were non-pilgrim patients. The percentages and numbers of antibiotics prescribed by indication are shown in Figure 3. Most cases where two antibiotics were prescribed involved community-acquired infection (32.3 %).

Table 3: Antibiotic agents prescribed, with participating hospitals, during the point-prevalence survey in November 2016

Antibiotic prescription	Hospitals (N)		Overall	
	KFH	*Al Ansar*	*Individual (N)*	*Group, (N, %)*
Penicillins with extended spectrum (J01CA)	-	-	-	9 (3.3)
Ampicillin	1	0	1	
Amoxicillin	8	0	8	
Beta-lactamase resistant penicillin's (J01CF)	1	0	1	1 (0.4)
Combinations of penicillin's (J01CR)	-	-	-	36 (13.5)
Amoxicillin-clavulanic acid	4	1	5	
Piperacillin-tazobactam	28	3	31	
First-generation cephalosporins (J01DB)	-	-	-	4 (1.5)
Cefazolin	4	0	4	
Second generation cephalosporins (J01DC)	-	-	-	24 (9)
Cefuroxime	22	2	24	
Third generation cephalosporins (J01DD)	-	-	-	55 (22.6)
Cefotaxime	4	5	9	
Ceftazidime	2	5	7	
Ceftriaxone	23	16	39	
Carbapenems (J01DH)	-	-	-	11 (4)
Imipenem & Cilastatin	5	4	9	
Meropenem	2	0	2	
Macrolides (J01FA)	-	-	-	16 (6)
Erythromycin	1	0	1	
Azithromycin	5	9	14	
Clarithromycin	0	1	1	
Lincosamides (J01FF)	-	-	-	3 (1)
Clindamycin	2	1	3	
Aminoglycosides (J01GB)	-	-	-	10 (3.7)
Gentamicin	2	0	2	
Amikacin	6	2	8	
Fluoroquinolones (J01MA)	-	-	-	28 (10.5)
Levofloxacin	4	1	5	
Ciprofloxacin	11	3	14	
Moxifloxacin	8	1	9	
Glycopeptide antibacterials (J01XA)	-	-	-	17 (6.3)
Vancomycin	16	1	17	
Imidazole derivatives (J01XD)	22	6	28	28 (10.5)
Other antibacterials (J01XX)	-	-	-	20 (7.5)
Linezolid	4	2	6	
Colistin (Colomycin)	13	1	14	
Triazole derivatives (J02AC)	-	-	-	3 (1)
Fluconazole	2	0	2	
Voriconazole	1	0	1	
Other antimycotics for systemic use (J02AX)	-	-	-	2 (0.7)
Caspofungin	2	0	2	

Route of administration

The proportions of parenteral and oral antibiotic administration during the study overall were 82.7 and 17.3 %, respectively. The percentage parenteral antibiotic use was 81.9 % (n = 209) in September 2016 and 83.5 % (n = 223) in November 2016. In September 2016, the highest rate of parenteral administration was in medical departments (40.6 %), followed by, surgical wards (33.9 %), the intensive care units (24.8 %) and other wards (0.5 %). In November 2016, the highest rate of parenteral administration was in surgical wards (42 %), followed by, the intensive care units (28.7 %), medical wards (28.3 %) and other wards (1 %).

DISCUSSION

The accumulation of Muslims to perform Hajj pilgrimage in Saudi Arabia is the biggest annual gathering on earth [12]. The congregation of pilgrims from various countries considerably inflate the risk of several infectious diseases, resulting in high demand of antibiotic prescribing.

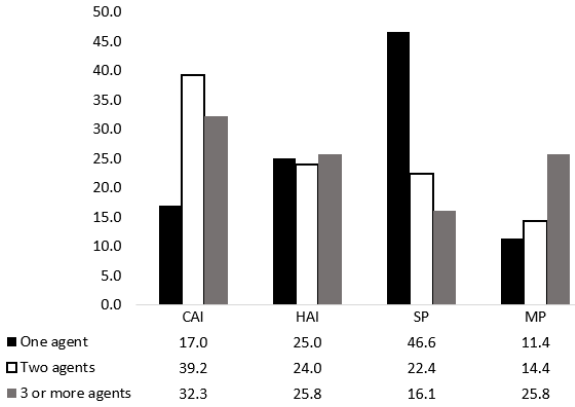

Figure 3: Antibiotic prescribing by indication during the two point-prevalence surveys in September 2016 and November 2016. Community-acquired infection (CAI); Hospital-acquired infection (HAI); Surgery prophylaxis (SP); Medical prophylaxis (MP)

Moreover, high proportion of pilgrims are geriatric with many various chronic health issues [13]. In the present study, during the Hajj season the first point prevalence survey was conducted i.e. in September 2016 and the antibiotic prevalence rate was 50.60 %. Whereas, during the non-pilgrim season i.e. November 2016, the analysis of second PPS with regards to antibiotics use were 49.40 %. The current survey substantiates that the ratio of antibiotic prescribing during and after hajj season is significantly constant.

The vast use of antibiotics leads to its misuse which significantly leads to antibiotic resistance. Hence, the need for identifying area of improvement in hospitals is vital [14]. The initial objective of this present study was to appraise the current patterns of antibiotic prescribing and to distinguish targets for quality improvement including duration of surgery prophylaxis, combination therapy and route of administration. The procedure used in the current study was PPS, which is economical to perform and can furnish very productive data [15]. Comparatively vast differences in antibiotic prescribing were noticed between the two study sites, as the prescribing guidelines weren't constant for the management of infection between the two participating hospitals. The results indicated the variation in the wards types surveyed at each site.

During the pre-operative period, the surgical prophylaxis tended to prevent infections on surgical sites [16]. Generally, a single dose of antibiotic is sufficient and the surgical prophylaxis target duration shouldn't be more than 24 h [17]. Similar efficacy was noted in both the previous studies which compared the use of one dose against 24 h. administration. Previous studies have recommended that healthcare professionals are prone to over-prescribe the antibiotic agents for surgical prophylaxis and due to this the target duration is seldom achieved [18,19].

Antibiotic surgical prophylaxis, which is prolonged have high hospital costs, may increase antibiotic resistance and is considered inefficacious [20]. The overall proportion in this survey, of patients undergoing surgical prophylaxis for more than a single day (84.8 %) was significantly elevated than the proposed target. The result of this study is noticeably high than previous other studies that used identical standardized ESAC tool methodology. These results indicate the demand for comprehensive continuous education interventions that aim at improving the effective approach of surgeons towards adherence to surgical prophylaxis antibiotic guidelines [18].

To treat a single disease, usually multiple pharmaceutical therapies are employed in combination therapy. The antibiotic combination therapy is widely used for treating polymicrobial infections, to prevent the emergence of resistant bacteria and to utilize the synergistic action of antibiotics so as against infections.

Moreover, explicit evidence states that single antimicrobial is very much desirable as combination therapy is more prone to drug interactions, adverse drug reactions and high treatment costs. Thus, several previous studies have considered combination therapy as a target for quality improvement [18,21].

In this study, about a third of patients received more than one antibiotic simultaneously. Although, when compared to a France based study, the percentage results are relatively low [18].

However, in Europe based previous studies similar rates were reported i.e. 32 and 33 % [22]. Other studies have suggested that prior to combination therapy, microbiology tests should be performed to provide culture and sensitivity data before treatment, but in the current study this was not explicitly surveyed [23].

The parenteral antibiotics are a preferable route of administration which needs to be controlled for achieving the target for quality improvement [24]. This will minimize the incidence of catheter-related diseases and lessen the hospital stay duration and reduce the cost [25]. The treatment course can be reassessed after the blood culture results within 2-4 days from parenteral to oral

therapy [26]. In the current survey, parenteral antibiotic constituted 60 % antibiotics used this is similar to the proportion observed in an earlier study (60.5 %) in European countries [22]. For some drugs only a parenteral dosage form is available. However, the analysis of intense usage of parenteral treatment was outside the objectives of this survey.

Limitations of the study

Several limitations are associated with the current study. Since the outline of this research incorporates PPS and the statistics were accumulated only for precise dates, the data on the usage of antibiotics in periods before the real audit days was not accessible. The assessment of antibiotic prescribing in the current study was not performed. Nevertheless, markers of relevant prescribing practice were directed, e.g. span of surgical prophylaxis and proportion of treatment that was being used intravenously.

CONCLUSION

This study substantiates the significance of PPS in distinguishing potential targets for the quality improvement and disclosed beneficial statistics which will act as an objective to work further on antibiotic usage and resistance surveillance. Moreover, the findings of this study concludes that inappropriate prescribing of surgical antibiotic prophylaxis uncovered in the surveys indicate the need for designing and implementing robust antibiotic stewardship in this area of therapy. The finding suggested that microbiological tests should be carried out for better treatment prior to combination therapy and parenteral routes of administration needs to be monitored closely to achieve the target for quality improvement. Overall, results revealed that to evaluate the antibiotic use in the current research employing point prevalence surveys through a standardized methodology (i.e. ESAC audit tools), was relatively feasible, remarkably inexpensive and not conspicuously time-consuming. Furthermore, when compared with previously conducted surveys, this survey reveals a notable improvement in adherence to hospital guidelines.

DECLARATIONS

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Conflict of interest

No conflict of interest is associated with this work.

Contribution of authors

We declare that this work was done by the authors named in this article and all liabilities pertaining to claims relating to the content of this article will be borne by the authors.

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