



## Original article

## Medication utilization pattern among outpatients during the Hajj mass gathering

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## ABSTRACT

**Background:** The Kingdom of Saudi Arabia (KSA) provides free healthcare, including medications, for the over 2 million Muslim pilgrims who attend Hajj every year. Information on drug utilization patterns at the Hajj is important to strengthen the supply chain for medicines, avert stock-outs, identify inappropriate use, and support public health planning for the event.

**Method:** We investigated drug utilization pattern among outpatients in eight seasonal Holy sites hospitals in Makkah, KSA, during the 2018 Hajj. Data on medication prescribed and dispensed were retrieved from the hospitals' electronic records. Data were also used to calculate six of the WHO indicators for drug use at these facilities.

**Results:** A total of 99,117 medications were prescribed for 37,367 outpatients during 37,933 encounters. Outpatients were mainly older males and originated from 134 countries. Twenty medications accounted for 72.8% of the 323 different medications prescribed. These were mainly nonsteroidal anti-inflammatory drugs, analgesics and antipyretics, and antibacterial medicines for systemic use. Outpatients were prescribed an average of 2.6 (SD = 1.2) drugs per consultation and polypharmacy ( $\geq 5$  medications) was observed in 4.8% of the encounters. Antibiotics and an injection were prescribed in 46.9% and 6.5% of encounters, respectively. Nearly 90% of the prescribed drugs were actually dispensed. On average, medications were dispensed 16.4 (SD = 119.8) minutes from the time they were prescribed for the patient. All hospitals had a copy of the essential drugs list available and all of the prescribed drugs appeared on that list.

**Conclusion:** Nonsteroidal anti-inflammatory drugs, analgesics and antibiotics are the most common medications prescribed to outpatient during Hajj. Our results, including the calculated WHO drug use indicators, can form a basis for further investigations into appropriate drug use at the Hajj and for planning purposes. These results could also guide the development of reference values for medications prescribing and use indicators at mass gatherings.

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## 1. Introduction

Each year the Kingdom of Saudi Arabia (KSA) hosts 2–3 million Muslim pilgrims from around the world in the Hajj pilgrimage to Makkah. Most pilgrims spend many days before and after the main Hajj rituals days in Makkah and/or visiting the Holy city of Medina. During the Hajj days, pilgrims move to the Holy site of Mina where they spend a few days including one day in the desert plain of Arafat. KSA provides free healthcare for pilgrims during Hajj through numerous hospitals, primary healthcare centers and other health facilities in Makkah and Medina (Shujaa and Alhamid, 2015; Sindy et al., 2015). This includes doctors' consultations and the medications they prescribe to pilgrims. At the Holy sites of Mina

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and Arafat, eight fully equipped and staffed seasonal hospitals (operational only during Hajj) are available, four of which serve pilgrims during their brief stay in Arafat (Sindy et al., 2015). All seasonal hospitals have a list of all medications available and stocked at each facility before they become operational. The quantities of these medications are allocated for each facility based on previous Hajj utilization patterns and to avoid shortage of medication. There is also an efficient inter-hospital medication supply chain, back-up support from other facilities in Makkah and from a central medication warehouse to avert stock-outs.

Mass gatherings such as the Hajj pose important public health challenges and stress the health system of the host. Therefore, timely and appropriate planning for the event is crucial. KSA authorities use a well-coordinated and inter-sectoral approach to orchestrate the public health planning and management of Hajj (Memish et al., 2014). This includes the provision of health services during the event, part of which is ensuring the availability of needed medications at facilities serving pilgrims. The Ministry of Health of KSA has developed a drug formulary of essential medications for the hospitals and clinics providing care to pilgrims during Hajj including a unified Hajj sub-formulary for hospitals in the Holy sites. However, no study comprehensively reported on the pattern of medication use during Hajj.

Drug utilization studies provide information on how medicines are being used in order to strengthen the supply chain for medicines, avert drug stock-outs and assist public health planning (World Health Organization, 2003). Additionally, trends in drug utilization allow the monitoring of appropriate drug use and provide evidence-base for providing better healthcare in general (World Health Organization, 2003, 1993). Addressing the issue of inappropriate use of medicines at health facilities requires a better understanding of the type, quantity and causes of irrational use of medications. To that end, a number of indicators were developed by the World Health Organization (WHO) in partnership with the International Network of Rational Use of Drugs (INRUD) that can be used to assess drug utilization performance of healthcare facilities in a standardized manner (World Health Organization, 1993). To our knowledge these indicators have not previously been reported in a mass gathering setting.

Here we investigate medication use and pattern among outpatients in the eight Holy sites hospitals during Hajj and we report on the WHO indicators for drug use at these facilities.

## 2. Methods

### 2.1. Study design and setting

This retrospective, descriptive cross-sectional study was carried out in the eight hospitals located at the Hajj Holy sites of Mina and Arafat in Makkah, KSA. These were four hospitals in Mina (Mina Al-Wade (MAW) Hospital, Mina Al-Jesr (MAJ) Hospital, Mina New Street (MNS) Hospital, Mina Emergency (MEM) Hospital) and four hospitals in Arafat (Arafat General (ARG) Hospital, East Arafat (EAR) Hospital, Jabal Al-Rahmah (JAR) Hospital and Namerah (NAM) Hospital). The study period covered the 2018 Hajj season from 7–13th Dhu'l-Hijjah 1439 corresponding to 18–24th August 2018.

### 2.2. Data collection and management

Data on medications prescribed and dispensed during the study period were retrieved from each hospital's electronic pharmacy record. Data included demographic information of the outpatients (age, gender, and nationality), medications' name and dosage, as well as dates and times of medications prescribing and dispensing.

Medications therapeutic classes were assigned based on the Anatomical Therapeutic Chemical (ATC) classification system of the WHO Collaborating Center on Drug Statistics Methodology (<https://www.whocc.no/>).

### 2.3. Data analysis

Data were analyzed using SPSS 22.0 (SPSS Inc., Chicago, USA) statistical package. Descriptive statistics were computed for quantitative (mean, standard deviation (SD), minimum and maximum) and categorical (frequencies and percentages) variables. Based on the available data, prescribing patterns were further evaluated using six of the WHO core drug use indicators for health facilities (World Health Organization, 1993) as follows:

- Patient care indicators*, in the form of the percentage of drug actually dispensed. As data to calculate the average dispensing time indicator were not available, the average time from medication prescribing to dispensing was calculated instead.
- Prescribing indicators*, in the form of: 1) the average number of drugs per encounter, 2) the percentage of drugs prescribed from essential drugs list or formulary, 3) the percentage of encounters with antibiotics prescribed, and (4) percentage of encounters with an injection prescribed.
- Health facilities indicator*, in the form of availability of a copy of essential drug list or formulary.

For the purpose of this study, we defined polypharmacy and excessive polypharmacy as prescribing  $\geq 5$  medications and  $\geq 10$  medications per encounter, respectively (Masnoon et al., 2017).

### 2.4. Ethical consideration

The study was approved by the King Fahad Medical City Ethics Committee and the Institutional Review Board (IRB log #: 18-409E) and was approved as exempt by the University of Washington Human Subjects Division (STUDY00005492) and conducted in accordance with the Ethics Committee's guidelines. Data were de-identified in accordance with the standards to protect the confidentiality of personal health information of patients.

## 3. Results

### 3.1. Patients

Data were captured for 37,367 outpatients who attended the outpatient settings of eight Holy site's hospitals during the study period (Table 1). Outpatients were mostly male (71%) and originated from 134 different countries, mainly India (21.7%), Egypt (18.1%), and KSA (13.0%). Age was reported for just over half of the patients with a mean age of 44.3 years (SD = 14.1, range 18–103 years). Most patients (85%) were seen at the outpatient settings of four Mina hospitals (Table 2), particularly MNS (26.3%) and MAW (23.3%). Most patients were seen towards the end of the Hajj rituals on the 22nd and 23rd of August 2018 (26.9% and 20.1% respectively).

### 3.2. Medications

A total of 99,117 medications were prescribed for the 37,367 outpatients during the study period. Of these, 4.5% were injectable medications and 21.2% were antibiotics. Most of the latter were broad-spectrum antibiotics. In general, the prescribed drugs represented 323 different medications of which 20 accounted for 72.8% of all medications prescribed during the study period. Of the 20

**Table 1**  
Demographic characteristics of the outpatients prescribed medications during the 2018 Hajj.

Variable	n	%
<b>Gender</b>	<b>37,367</b>	
Male	26,543	71.0
Female	10,824	29.0
<b>Age</b>	<b>19,905</b>	
≤39	8086	40.6
40–49	4310	21.7
50–64	5821	29.2
≥65	1688	8.5
<b>Nationality</b>	<b>36,233</b>	
India	7867	21.7
Egypt	6569	18.1
Saudi Arabia	4724	13.0
Pakistan	2301	6.4
Yemen	1828	5.0
Morocco	1720	4.7
Nigeria	1425	3.9
Somalia	1148	3.2
Syria	913	2.5
Sudan	735	2.0
Bangladesh	729	2.0
Iraq	603	1.7
France	442	1.2
Algeria	424	1.2
120 countries < 1%	4804	13.0

most common medications prescribed to outpatients (Table 3), 75% were oral medications and none were injectable. The most prescribed classes of medications were anti-inflammatory and anti-rheumatic products (22.9%), analgesics (22.8%) and anti-bacterials for systemic use (17%). Most medications (85.4%) were prescribed at the four Mina hospitals (Table 2), particularly MNS (25.5%) and MAW (24.8%).

### 3.3. WHO indicators for drug use in healthcare facilities

During the study period, the 37,367 outpatients had 37,933 patient encounters with the eight hospitals where their medications were prescribed (Table 2). WHO drug use in healthcare facilities core indicators that were possible to obtain from the available data are presented in Table 4.

For the prescribing indicators, in the Hajj Holy sites hospitals, patients were prescribed an average of 2.6 (SD 1.2) drugs per consultation. This value ranged between 2.3 (SD 1.5) in the NAM hospital to 2.8 (SD 1.1) in MAW Hospital. In most encounters, 2 or 3 medications were prescribed. The proportions of encounters with 1, 2, 3, and 4 medications prescribed were 15.6%, 35.1%, 32.5%, and 11.9% respectively. Polypharmacy (≥5 medications) and excessive polypharmacy (≥10 medications) were observed in 4.8% and

0.04% of the encounters respectively. Also, in 46.9% of outpatient encounters one or more antibiotics were prescribed, while an injection was prescribed in 6.5% of the consultations (Table 4). The highest percentage of antibiotics and injections prescribing was at MAW (55%) and EAR (15.3%), respectively. In each of the six healthcare facilities, all the prescribed drugs appeared on the essential drug list available in the hospitals. For healthcare facilities indicators, all hospitals had a copy of the essential drugs list available (Table 4).

For the patient care indicators, it was only possible to calculate the percentage of drugs actually dispensed. A total of 89.9% of prescribed drugs were actually dispensed at the hospitals (Table 4). While dispensing time (measure of time that personnel dispensing drugs spend with patients) was not possible to calculate, time between prescribing and dispensing of medication was available. On average, medications were dispensed 16.4 (SD 119.8) minutes from the time they were prescribed for the patient. Most (84.6%) of the medications were dispensed within 10 min of being prescribed, and only 3% were dispensed over one hour from the time they were prescribed. However, there was a marked difference in the average time from prescribing to dispensing between hospitals with the longest average times found in EAR (55.9 min, SD 262.5) and ARG (46.4 min, SD 288.4) hospitals compared to 7.7 min (SD 60.2) in MAW.

## 4. Discussion

In the current study we investigated the pattern of medication prescribing and dispensing for outpatients in Holy site hospitals during Hajj. We report a large number of hospital outpatient visits during the study period primarily by older male pilgrims. This is in agreement with reported outpatient visits to medical clinics and primary healthcare centers in Makkah during Hajj (Alzahrani et al., 2012; Shakir et al., 2006). In our study, outpatients originated from over 130 countries, especially India, Egypt and KSA, and visited mainly Mina hospitals towards the end of the Hajj rituals. Hajj is attended by over 2 million pilgrims from up to 184 countries (Memish et al., 2014), and countries such as KSA, India and Egypt are regularly among the top 10 countries with the largest pilgrims' population. As part of the Hajj rituals, pilgrims spent most of the study period in Mina with only one day in Arafat. This explains why most of outpatient visits, patient encounters and medications prescribed occurred at Mina hospitals.

We found that over 300 different medications were prescribed to outpatients, which reflects the wide variety of medical conditions pilgrims present with at outpatients facilities during Hajj (Alzahrani et al., 2012; Bakhsh et al., 2015; Khan et al., 2018; Shakir et al., 2006). The most common classes of prescribed drugs were anti-inflammatory medicines, analgesics and antipyretics,

**Table 2**  
Distribution of outpatients encounters and prescribed medications per hospital during the 2018 Hajj.

Hospital	Outpatients		Encounters		Medications	
	n	%	n	%	n	%
MNS	9827	26.3	9925	26.2	25,284	25.5
MAW	8717	23.3	8820	23.3	24,582	24.8
MEM	7729	20.7	7837	20.7	20,325	20.5
MAJ	5471	14.6	5561	14.7	14,454	14.6
NAM	2090	5.6	2154	5.7	5042	5.1
ARG	1765	4.7	1805	4.8	4794	4.8
EAR	935	2.5	967	2.5	2588	2.6
JAR	833	2.2	864	2.3	2048	2.1
<b>Total</b>	<b>37,367</b>	<b>100</b>	<b>37,933</b>	<b>100</b>	<b>99,117</b>	<b>100</b>

MAW; Mina Al-Wade Hospital, MAJ; Mina Al-Jesr Hospital, MNS; Mina New Street Hospital, MEM; Mina Emergency Hospital, ARG; Arafat General Hospital, EAR; East Arafat Hospital, JAR; Jabal Al-Rahmah Hospital, NAM; Namerah Hospital.

**Table 3**

The 20 most common medications prescribed to outpatients during the 2018 Hajj.

Rank	Medication name	Form	ATC classification	n	%
1	Paracetamol	Oral	N02 Analgesics	16,462	16.61
2	Diclofenac	Oral/ Topical	M01 Antiinflammatory and antirheumatic products	10,760	10.86
3	Ibuprofen	Oral	M01 Antiinflammatory and antirheumatic products	5759	5.81
4	Amoxicillin	Oral	J01 Antibacterials for systemic use	5569	5.62
5	Dextromethorphan	Oral	R05 Cough and cold preparations	5106	5.15
6	Amoxicillin Clavulanate	Oral	J01 Antibacterials for systemic use	4269	4.31
7	Sodium fusidate	Topical	D06 Antibiotics and chemotherapeutics for dermatological use	2675	2.70
8	Azithromycin or Clarithromycin	Oral	J01 Antibacterials for systemic use	2451	2.47
9	Cetirizine	Oral	R06 Antihistamines for systemic use	2172	2.19
10	Naphazoline hydrochloride & Chlorpheniramine maleate	Nasal	R01 Nasal preparations	2126	2.14
11	Paraffin	Topical	D02 Emollients and protectives	1866	1.88
12	Non-sedating antihistamines	Oral	R06 Antihistamines for systemic use	1825	1.84
13	Ranitidine	Oral	A02 Drugs for acid related disorders	1743	1.76
14	Hydrocortisone	Topical	D07 Corticosteroids, dermatological preparations	1705	1.72
15	Metronidazole	Oral	P01 Antiprotozoals	1393	1.41
16	Hyoscine butylbromide	Oral	A03 Drugs for functional gastrointestinal disorders	1388	1.40
17	Omeprazole or Lansoprazole or Pantoprazole	Oral	A02 Drugs for acid related disorders	1277	1.29
18	Pseudoephedrine HCL	Oral	R01 Nasal preparations	1245	1.26
19	Rehydration salt	Oral	A07 Antidiarrheals, intestinal antiinflammatory/antiinfective agents	1231	1.24
20	Salbutamol	Inhalation	P03 Drugs for obstructive airway diseases	1182	1.19

ATC; Anatomical Therapeutic Chemical.

**Table 4**

WHO core drug use indicators for hospitals in the Hajj Holy sites during the 2018 pilgrimage.

Indicator	Hospital								
	MNS	MAW	MEM	MAJ	NAM	ARG	EAR	JAR	All
<b>Prescribing indicators</b>									
Average number of drugs per encounter ( $\pm$ SD)	2.5 (1.7)	2.8 (1.1)	2.6 (1.1)	2.6 (1.5)	2.3 (1.5)	2.7 (2.2)	2.7 (1.9)	2.4 (1.5)	<b>2.6 (1.2)</b>
Percentage of encounters with an antibiotic prescribed	46.1	55.0	50.5	41.6	27.1	47.1	40.7	32.3	<b>46.9</b>
Percentage of encounters with an injection prescribed	6.4	5.7	4.1	9.7	5.9	8.1	15.3	5.3	<b>6.5</b>
Percentage of drugs prescribed from essential drugs list or formulary	100	100	100	100	100	100	100	100	<b>100</b>
<b>Patient care indicators</b>									
Percentage of drugs actually dispensed	91.3	91.7	95.0	83.4	82.2	91.9	72.7	81.0	<b>89.9</b>
Average time between prescribing and dispensing ( $\pm$ SD)*	17 (139.9)	7.7 (60.2)	14.7 (49.9)	17.3 (117.5)	11.6 (56.1)	46.4 (288.4)	55.9 (262.5)	25.7 (84.1)	<b>16.4 (119.8)</b>
<b>Health facility indicators</b>									
Availability of copy of essential drugs list or formulary	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	<b>Yes</b>

SD; standard deviation, MAW; Mina Al-Wade Hospital, MAJ; Mina Al-Jesr Hospital, MNS; Mina New Street Hospital, MEM; Mina Emergency Hospital, ARG; Arafat General Hospital, EAR; East Arafat Hospital, JAR; Jabal Al-Rahmah Hospital, NAM; Namerah Hospital.

\* Not a WHO drug use indicator.

antibacterials, cough and cold preparations, anti-histamines and drugs for acid related disorders. There are limited data on medication prescribing among outpatients in Hajj or other mass gatherings. A report from an outpatient department at a hospital in Makkah during the 2003 Hajj found that the most common medications dispensed were antibiotics (43.3%), analgesics and antipyretics (25.2%) (Shakir et al., 2006). Data from the Indian medical mission of the 2016 Hajj revealed that analgesics, antibacterials, antacids, antihistamines as well as diabetes and hypertension medications were the most common drugs prescribed to pilgrims (Khan et al., 2018). In one of the few reports of medication utilization in mass gatherings outside Hajj, Stigelund et al. (2019) reported that the most commonly prescribed medication to attendees of the Roskild music festival in Denmark in 2015 was antibiotics. Antiseptics, analgesics and anti-histamines were the most commonly purchased over-the-counter products at the event (Stigelund et al., 2019). These medications were also found to be commonly prescribed for pilgrims in our study.

Hajj involves physically demanding religious activities that include walking long distances in a hot desert environment

(Alfelali et al., 2014; Memish et al., 2014). This can lead to a flaring of a number of conditions such as musculoskeletal conditions, inflammations, allergies, and symptoms of pain and dehydration, especially among the sizeable elderly pilgrim population. Foot injuries are also common during Hajj with up to 31% reporting cut wounds and blisters on their feet (Alfelali et al., 2014; Sridhar et al., 2015). It is therefore not surprising that analgesics, anti-inflammatory products as well as antihistamines were among the most common medications prescribed for outpatients.

The crowded conditions during Hajj, with pilgrims in close contact in a confined area, increase the risk of acquisition and spread of infectious diseases during the event. Respiratory tract infections are the most common infections among pilgrims and are the leading cause of hospitalization and outpatient visits during the event (Al-Ghamdi et al., 2003; Alzahrani et al., 2012; Bakhsh et al., 2015; Shakir et al., 2006). Respiratory symptoms have been reported in 50–90% of pilgrims attending Hajj (Gautret et al., 2015a). For instance, among 387 Malaysian Hajj pilgrims surveyed, the most common respiratory symptoms were: cough 91.5%, runny nose 79.3%, fever 59.2%, and sore throat 57.1% (Deris et al., 2010). These

results are consistent with our findings in that many of the medications prescribed to outpatients were related to treating respiratory tract infections or alleviating their symptoms. These include antibiotics, cough and cold preparations and medications to reduce fever such as paracetamol and ibuprofen.

Gastrointestinal presentations, while lower in frequency than respiratory infections, are also common among pilgrims and outbreaks of food-borne illnesses have regularly been reported in Hajj (Al-Mazrou, 2004). Among 1008 patients who attended two medical centers during the 2013 Hajj, 13.2% were suffering gastrointestinal tract diseases (Bakhsh et al., 2015). A similar proportion was reported among pilgrims seeking medical services in Mina primary health care centers during the 2008 Hajj (Alzahrani et al., 2012). The mean prevalence of diarrhea among Hajj pilgrims was reported at 2%, although much higher numbers (up to 23%) were found in some studies (Gautret et al., 2015b). As such, many medications aimed at treating gastrointestinal diseases were also among the top 20 medications prescribed for pilgrims in the current study.

As part of the Hajj hospitals' operational readiness, all Hajj seasonal hospitals have a list of all medications available and stocked at each facility before they become operational. As such, in relation to the WHO facility-specific indicator, all hospitals had a copy of essential drug list/formulary, which is in line with the proposed norms for this indicator (optimal value is 100%) (Atif et al., 2016a). This is similar to what was reported from Pakistan (Atif et al., 2016a, 2016b), but higher than reported from Egypt, Ethiopia, Bangladesh and non-seasonal hospitals in Saudi Arabia (16–90%) (Akl et al., 2014; Bilal et al., 2016; El Mahalli, 2012; Guyon et al., 1994).

Given the available data and the retrospective design of the study, the only patient-care indicator that could be calculated in our study was the percentage of medicines actually dispensed. This was 90%, which is close to the optimal value of 100%. Inadequate availability of medication is thought to be an important reason for low percentage of actually dispensed drugs (Atif et al., 2016a). However, given the safeguards put in place to avoid shortage of medication at seasonal hospitals during Hajj including the efficient inter-hospital medication supply chain, other factors could have contributed to the less than optimal value of this patient-care indicator, i.e., the percentage of drugs actually dispensed. Reasons might include medications dispensed but not entered into the pharmacy system due to workload and limited time in a mass gathering setting. Also, medication not dispensed for patients who have already been prescribed and dispensed the same medications in previous visits on the same day to the same hospital or other hospitals in the Holy sites. In additions, some pilgrims may have decided to used medications already in their possession from other sources. Nevertheless, our results are higher than those reported in Jordan, Ethiopia and Tanzania (54.7–81.8%) (Nsimba, 2006; Otoom et al., 2002; Sisay et al., 2017) but lower than those reported in Pakistan, Kuwait, Egypt and Niger and non-seasonal hospitals in Saudi Arabia (91–100%) (Akl et al., 2014; Atif et al., 2016a; Awad and Al-Saffar, 2010; El Mahalli et al., 2012; Mallet et al., 2001). Given the available data, we were unable to calculate the WHO indicator; average dispensing time for medications. However, we reported the average time from medications prescribing to dispensing, which can provide valuable information on the medications prescribing and dispensing process for outpatients at the hospitals. This includes the efficiency of the hospital information system, the time patients spent waiting to reach the pharmacist and/or locate the pharmacy, and the time spent dispensing medications for pilgrims. Although pilgrims may not always seek the pharmacy immediately after the medications have been prescribed, in the outpatients setting, most do. In the current study, we report that most medications were dispensed

within 10 min of being prescribed. However, this time was much higher in Arafat hospitals, which is understandable given that these hospitals have a much higher rate of encounters per working hours given that they serve the entirety of the Hajj population for a single day.

For the prescribing indicators, the results of this study show that the average number of medications per encounter was 2.6 (SD = 1.2) which is higher than the proposed admissible range of 1.6–1.8 (Isah et al., 2001). The difference could be explained by the fact that, as a mass gathering, Hajj is a unique setting with a high prevalence of older pilgrims, many with underlying health conditions (Gautret et al., 2015a; Yezli et al., 2017). In general, prescribing of multiple medications is common in an older population with multiple morbidities. Given the unique nature of Hajj and its population, comparison of our findings with other settings is difficult. Nevertheless, studies from developing countries reported an average number of drugs per encounters of 1.3–5.6 (Akhtar et al., 2012; Atif et al., 2016a; Bosu and Ofori-Adjei, 2000). Polypharmacy as defined in our study was observed in a very small proportion of encounters. Polypharmacy is associated with negative outcomes including failure to comply with treatment, adverse drug reactions, mortality, as well as financial implications for national healthcare systems (Dartnell et al., 1996; Herr et al., 2015; Hovstadius and Petersson, 2013; Reason et al., 2012). We found that 100% of the prescribed drugs appeared on the essential drug list available in the hospitals. This is at the higher end of the range reported from other countries (58–100%) (Holloway and Henry, 2014). Our results are not surprising given that physicians only prescribed medications from the list available in the system.

In our study, 21.2% of the medications prescribed to outpatients were antibiotics. Antibiotic use among Hajj pilgrims is common and many of these medications are prescribed empirically especially in outpatients settings. Other studies found that 7–58.5% of pilgrims have used antibiotics during Hajj, with most studies reporting rates towards the upper end of that range (Hoang et al., 2019). The percentage of encounters with an antibiotic prescribed in our study was 47% which is higher than the proposed optimal range (20–26.8%) (Isah et al., 2001) but closer to that reported from an outpatient department in a Makkah hospital during the 2003 Hajj (Shakir et al., 2006). In the Hajj mass gathering context, there may be a tendency to prescribe broad-spectrum antibiotics for outpatients given a limited time to assess them and to cover suspected infections. Knowledge gaps regarding antibiotic resistance among healthcare workers deployed to Hajj and their propensity to prescribe antibiotics could also be a factor (Bokhary et al., 2020; Yezli et al., 2019). Globally, the percentage of patients treated with antibiotics ranged from 21.7% in Malaysia to 73.3% in Kenya (Holloway and Henry, 2014). Over half of the 44 countries investigated had a percentage of over 50%. The same study reported that the percentage of patients treated with an injection was between 10% and 57% in most countries (Holloway and Henry, 2014). In our study this percentage was 6.5%, which is in line with what is documented in Brazil (6.7%) and Oman (6.4%) (Holloway and Henry, 2014) and lower than the proposed optimal range for this indicator (13.4–24.1%) (Isah et al., 2001). In addition to being more costly and uncomfortable for the patient, excessive use of injections, when appropriate oral dosage forms are available, may lead to a higher probability of bloodborne diseases (World Health Organization, 2002).

To our knowledge, this is the first report of some of the WHO indicators for drug use in Hajj healthcare facilities. Given the unique context of Hajj and its population, objective norms for the WHO indicators calculated in this study do not exist. However, they can be considered as initial measures to stimulate further investigations and to guide subsequent action in relation to drug prescribing patterns and use at healthcare facilities during the

event. These indicators can provide valuable information to assess performance and potential issues in drug use by individual health facilities, prioritize and focus improvement interventions and measure their impact, as well as continuous monitoring of drug therapy at specific facilities (World Health Organization, 1993). Importantly, the indicators reported in this study could be used to guide standards for medication prescribing and use during mass gatherings, which are not currently available.

The present study has some limitations. The study was conducted during the Hajj dates only and was limited to the Holy sites' hospitals. Pilgrims may spend weeks in the Holy cities of Makkah and Medina during Hajj and may seek healthcare at the many hospitals and primary healthcare clinics available at these locations. Also pilgrims may acquire medication through their country doctors/healthcare professionals, from private pharmacies or use medication carried by the pilgrims themselves from their countries of origin. Hence, our results reflect only part of the overall medication use and pattern among pilgrims during Hajj. Also, based on the available data, only some of the WHO drug use indicators could be calculated. Finally, we did not include information on medication use among inpatients or in emergency departments as well as from primary healthcare centers in the Holy sites.

In summary, we conducted the first study that comprehensively reports medication prescribing and use patterns among outpatients in Hajj hospitals and related WHO drug use indicators. Non-steroidal anti-inflammatory drugs, analgesics and antibiotics are the most common medications prescribed to outpatient during Hajj. Our results can form a basis for further investigations into appropriate drug use at the Hajj and for planning purposes. Further studies on medication utilization patterns among both inpatients and outpatients at hospitals and primary healthcare centers in both Makkah and Medina for the whole duration of the Hajj season are warranted.

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None to declare.

#### Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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