

Road map of an Ear, Nose, and Throat clinic during the 2008 Hajj in Makkah, Saudi Arabia

Ameen Z. Alberabi, FACS, FRCSC.

ABSTRACT

الأهداف: تقديم تجربتنا في تطوير قاعدة بيانات مكة الالكترونية المحلية و خارطة عيادة الأنف والأذن والحنجرة (ENT) أثناء فريضة الحج.

الطريقة: المجموعة المتوقعة للحالات أجرت بين 28 نوفمبر و10 ديسمبر من 2008 (فريضة حج 1429هـ). تم تسجيل جميع مرضى عيادة الأنف والأذن والحنجرة ENT – مستشفى النور التخصصي – مكة المكرمة – المملكة العربية السعودية.

النتائج: تضمنت هذه الدراسة 1047 مريض. كان متوسط العمر 26 ± 6.4 عام. كان هناك 663 ذكر (63.3%) و 384 أنثى (36.7%). كان 361 مريض (34.5%) حجاج و 686 مريض (65.5%) كانوا غير حجاج. كان المرضى السعوديون 716 (68.4%)، وغير السعوديين كانوا 331 (31.6%). حضر 78.5% من المرضى أثناء الساعات الـ 12 (12 ظهر – 12 صباح). تمثل عدوى المنطقة التنفسية العليا (URTI) (85.2%) من التشخيص الكلي. تم تنويم 24 مريض، بنسبة دخول 2.3%، ونسبة دخول متوسطة 2 مريض باليوم. تمثل التهابات المنطقة التنفسية العليا URTI نسبة 46% من الذين تم تنويمهم بالمستشفى من مجموع التنويم الكلي. أثناء معالجة المرضى 992 مريض (94.7%) احتاجوا إلى المضادات الحيوية كجزء من أو علاجهم الرئيسي.

خاتمة: عيادة الأنف والأذن والحنجرة ENT أثناء فريضة حج كانت عملاً ناجحاً لتحسين العناية بالمرضى وللمساعدة على تخفيف الضغط من قسم الطوارئ بالمستشفى.

Objectives: To present our experience in the development of our own local electronic Makkah Ear, Nose, and Throat (ENT) - Hajj Database, and provide a road map for the ENT Clinic during Hajj.

Methods: This prospective cohort study was conducted between November 28 and December 10, 2008 (1429 Hijri Hajj season). All patients presenting to the ENT Clinic at Al-Noor Specialist Hospital, Makkah, Kingdom of Saudi Arabia were recorded.

Results: A total of 1047 patients were included. The mean age was 26 ± 6.4 years. There were 663 males (63.3%), and 384 females (36.7%). Among them, 361 patients (34.5%) were Hajjis, and 686 patients (65.5%) were non-Hajji. The total number of Saudi patients were 716 (68.4%), and non-Saudi's were 331 (31.6%). A total of 78.5% of the patients presented during the 12 hours shift (12 PM-12 AM). Upper respiratory tract infections (URTI) including the diagnosis of pharyngitis, viral URTI, and tonsillitis represented 85.2% of the total diagnosis. Twenty-four patients were admitted, with admission conversion rate of 2.3%, and average admission rate is 2 patients per day. Admission in relation to URTI represented 46% of the total admitting diagnosis. In treating these patients, 992 patients (94.7%) received antibiotics as part of, or their main therapy.

Conclusion: The ENT Hajj Clinic was a success in improving patient's care, and to help alleviate pressure from the Emergency Department.

Saudi Med J 2009; Vol. 30 (12): 1584-1589

From the Department of Otolaryngology, Head & Neck Surgery, Umm Al-Qura University, and Al-Noor Specialist Hospital, Makkah, Kingdom of Saudi Arabia.

Received 2nd September 2009. Accepted 19th October 2009.

Address correspondence and reprint request to: Assistant Professor Ameen Alberabi, Consultant, Department of Otolaryngology, Head & Neck Surgery, Umm Al-Qura University, Makkah, Kingdom of Saudi Arabia. Tel. +966 503832472. Fax. +966 (2) 5534088. E-mail: herabi@hotmail.com

Hajj represents an annual holy journey performed by Muslim pilgrims from around the world to the holy city of Makkah, Kingdom of Saudi Arabia (KSA). More than 3 million people participate in this mass migration to a small confined area. For most overseas pilgrims, the Hajj celebration is completed over a whole month, but the most intense rituals lasts less than a week (from the 8th-12th day of Thul-Hijjah, the 12th month of the Arabic Hijri (H) calendar). However,

from the viewpoint of medical affairs at Hajj, the first 12 days of Thul-Hijjah is the most important period. Of importance, pilgrims move to the holy land of Mina (8 kilometers from Makkah) on the 8th day of Thul-Hijjah, and return back to the city of Makkah after the 10th day. This religious gathering is unparalleled in scale, and pilgrims face numerous health hazards. The extreme congestion of people and vehicles during this time amplifies health risks, such as those from infectious diseases, especially upper respiratory tract, or ear, nose, and throat (ENT) related infections.¹ The idea of developing an electronic database for the ENT clinic started with Neumann in 1967.² This had evolved according to the development of the medical field and the computer systems. The purpose of this report is to present our experience in the development of our own local electronic Makkah ENT-Hajj Database (MENT-HD), and provide a road map for an ENT clinic during Hajj.

Methods. This prospective cohort study was conducted between November 28 and December 10, 2008 (corresponding to 1-12, Thul-Hijjah, 1429 H) after the creation and development of MENT-HD using Microsoft® Access 2002 (Microsoft Corporation, Seattle, WA, USA) as a collaboration project between Umm Al-Qura University and Al-Noor Specialist Hospital, a tertiary hospital at the holy city of Makkah, KSA, that provides care to both pilgrims and non-pilgrims throughout the year, and become a Hajj hospital during the Hajj season. After obtaining appropriate ethical and administrative approval, and according to an approved Saudi Ministry of Health outpatients data recording form specially designed for Hajj, appropriate patients demographics, diagnosis, and therapy were included in the database (Figure 1). This special ENT Hajj Clinic functioned daily for 24 hours during Hajj season, and is operated by 2 shifts (12 hours each), and composed of an ENT specialist, a resident, and a nurse. The inclusion criteria of this prospective cohort study included all patients of both gender, and all age groups, presenting to the ENT clinic at Al-Noor Specialist Hospital, Makkah, KSA. A total of 1047 patients who met our inclusion criteria were included in this study. The diagnosis of patients was established after the patients have been triaged by the ENT clinic nurse, and then examined by the clinic physician. Recording of the diagnosis was carried out based on the International Classification of Diseases (ICD-10).³ All data were recorded prospectively during the patient clinic encounter by a registered nurse.

Data were presented as means \pm standard deviation for continuous variables, and as percentages for categorical variables. Group comparison was carried out using t test

for continuous variables, and chi-square test for discrete variables. The *p*-value was calculated using chi square test, and a value of <0.05 was considered as statistically significant. Relative risk (RR) and its 95% confidence interval (CI) were also presented when appropriate. Data analysis was carried out using Microsoft® Excel 2002 (Microsoft Corporation, Seattle, WA, USA) and Statistical Package for Social Sciences version 11 (SPSS Inc., Chicago, IL, USA).

Results. The mean age was 26 ± 6.4 years (age range, 1-93 years). The age group distributions are shown on Table 1. There was a statistically significant trend toward young adult age groups presenting to our ENT Hajj Clinic, with age groups 15-44 years old represented 62.2% of the total patients (chi squared for trend = 10.29; $p=0.001$). There were 663 males (63.3%) and 384 females (36.7%), with a male to female gender ratio of 1.7:1, and with significant statistical difference ($p=0.0001$, RR=0.76, 95% CI; 0.70-0.83). Among them, 361 patients (34.5%) were Hajjis (Muslims performing Hajj), and 686 patients (65.5%) were non-Hajji, with a significant statistical difference ($p=0.0001$, RR=0.73, 95% CI; 0.67-0.79). The Saudi patients were 716 (68.4%), and non-Saudi's were 331 (31.6%), of which the non-Saudi Makkah residents were 20 patients (1.9%), and foreigners were 311 patients (29.7%), with a significant statistical difference ($p=0.0001$, RR=0.69, 95% CI; 0.63-0.75). The distribution of all non-Saudi nationalities is shown on Figure 2. The distribution of patients arriving daily during the 12 days of the study period to the ENT Hajj Clinic is shown in Figure 3, with an average daily patients of 87.25. The distribution of patient's time of arrival during the day and night shifts is shown in Table 2. There was a statistically significant trend toward patients presenting to our ENT Hajj Clinic during the 12 hours shift (12 PM-12 AM) representing 78.5% of total patients (chi-squared for trend = 70.76; $p=0.0001$). During the 12 days of the clinic, only 32 patients (3.1%) presented to our ENT Hajj Clinic during the 8 hours period (12 AM-8 AM) with an average of 2.6 patients only per day. The distributions of patient's diagnosis are shown in Table 3. Clinical diagnosis of bacterial and viral upper respiratory tract infections (URTI) including the diagnosis of pharyngitis, viral URTI, and tonsillitis represented 85.2% of the total diagnosis, with a significant statistical difference ($p=0.0001$, RR=2.09, 95% CI; 1.93-2.27). Among the 1047 patients seen through the ENT Hajj Clinic, 24 patients were admitted, with an admission conversion rate of 2.3%, and an average daily admission rate of 2 patients per day. The distribution of patients admitting diagnosis is shown in Table 4. Admission in relation to URTI including the diagnosis of tonsillitis

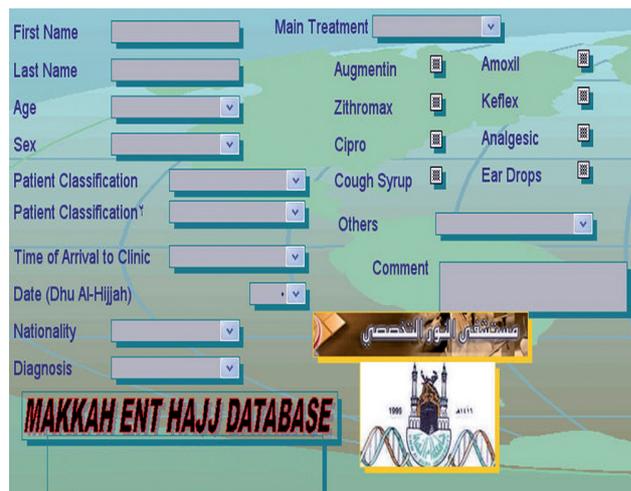


Figure 1 - Makkah Ear, Nose, and Throat-Hajj Database interface showing all included information.

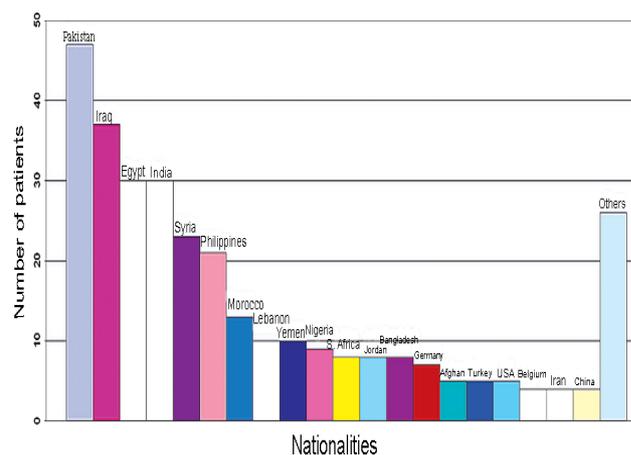


Figure 2 - The distribution of all non-Saudi nationalities of included patients in the Ear, Nose, and Throat-Hajj Clinic study.

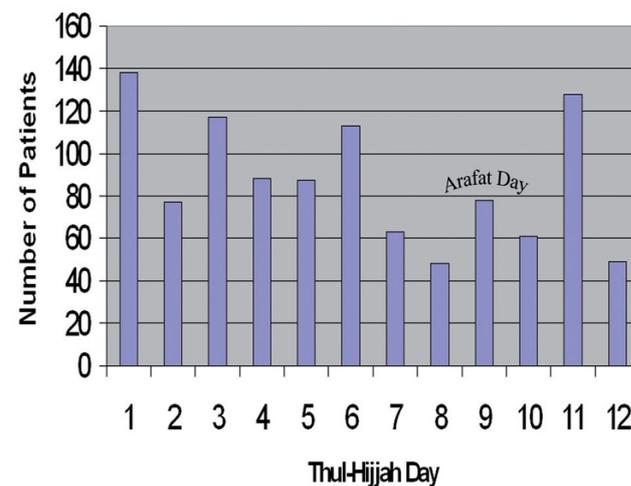


Figure 3 - The distribution of patients arriving daily during the 12 days of the study period to the Ear, Nose, and Throat-Hajj Clinic.

Table 1 - Age group distributions of 1047 patients included in this Ear, Nose, and Throat-Hajj Clinic study.

Age group	Frequency	(%)
0-14	79	(7.55)
15-24	263	(25.1)
25-44	493	(47.1)
45-64	178	(17)
+65	34	(3.25)
Total	1047	(100)

Table 2 - Patient's time arrival distributions of 1047 patients included in this Ear, Nose, and Throat-Hajj Clinic study.

Time of arrival	Frequency	(%)
8 AM - 12 PM	193	(18.4)
12 PM - 4 PM	134	(12.8)
4 PM - 8 PM	286	(27.3)
8 PM - 12 AM	402	(38.4)
12 AM - 4 AM	29	(2.8)
4 AM - 8 AM	3	0.3
Total	1047	(100)

Table 3 - Diagnosis distributions of 1047 patients included in this Ear, Nose, and Throat-Hajj Clinic study.

Diagnosis	Frequency	(%)
Pharyngitis	640	(61)
URTI	196	(18.6)
Tonsillitis	58	(5.5)
Otitis media	23	(2.2)
Vertigo	11	(1.1)
Epistaxis	7	(0.7)
Foreign body ear	7	(0.7)
Wax	6	(0.6)
Foreign body pharynx	5	(0.5)
Nasal trauma	5	(0.5)
Foreign body nose	4	(0.4)
Otitis externa	4	(0.4)
Postoperative	4	(0.4)
Hearing loss	3	
Sinusitis	3	(0.3)
Laryngitis	3	(0.3)
Free of ENT disease	11	(1.1)
Others	57	(5.4)
Total	1047	(100)

URTI - upper respiratory tract infection,
ENT - ear, nose, and throat

and pharyngitis represented 46% of the total admitting diagnosis. Among the 1047 patients seen through the ENT Hajj Clinic including the admitted patients, 94.7% received antibiotics as part of, or their main therapy, with a significant statistical difference ($p=0.0001$, $RR=2.62$, 95% CI; 2.43-2.82). The distribution of antibiotics used is shown in Table 5.

Discussion. At present, many medical and surgical specialties share the management of a Hajji patient, and the fact that such medical care is provided to a huge number of patients in a narrow time window has made such medical services extremely complex.¹ Medical information, diagnostic technology, and modes of therapeutic intervention available for such patients have expanded exponentially.⁴

The national registry for Hajj health services has expanded and improved in recent years, and became a valuable tool in corporate and governmental planning. But, when it comes to rapid analysis of local patient's demographics, treatments, results, follow-ups, and outcomes, local electronic databases are the current best

tool for the task. The MENT-HD is our institutional model for ENT Hajj patient's data management where it is intended to provide an accurate system to identify risk factors, numbers of patients, types of treatment given, and outcomes. In our institution, it was decided to keep all outpatients clinics in all medical and surgical specialties running for 24 hours to help alleviate pressure from the Emergency Department (ER), and help provide a specialized service in a timely fashion. A prospective audit from Birmingham, England published recently⁵ addressing the feasibility of the ENT emergency clinic demonstrated that such a new service significantly reduced patient waiting times, and inappropriate referrals. Also, they concluded that such clinic models provided an effective ENT emergency service.⁵

The average age of patients was 26 years old. This young age likely corresponds in general with the strong physical effort needed to perform Hajj. In this study, the male to female gender ratio (1.7:1) represents a significant deviation toward more male patients. This is despite the fact that Hajj has maintained its usual annual average male to female percentage of 54%.⁶ This is likely contributed by the surprising fact that only 34.5% who attended our ENT Hajj Clinic were true Hajjis, while 65.5% were non-Hajji.

Although, this special ENT Hajj Clinic was intended to serve all Hajji patients regardless of their nationality, and the administrative assumption that such a clinic would be receiving a significant number of Hajji patients from outside the country, the non-Saudi patients constituted 31.6%; of which, the non-Saudi Makkah resident constituted 1.9 %, and non-Saudi out of country constituted 29.7%, while the Saudi patients constitute 68.4%, and this has added a significant burden on the clinic outside its intended purpose.

Excluding Saudi patients, 43.5% of the patients were from Pakistan, Iraq, Egypt, and India; and the rest was distributed over more than 25 other nationalities. These nationalities present a high pilgrimage presence in Makkah every year.⁷

This clinic was designed to serve patients during maximal pilgrim's presence in Makkah during the first 12 days of the month of Thul-Hijjah. During the first 6 days of the clinic, it was working mostly above its daily average of 87.25 patients, but the clinic slowed down below its daily average during days 7, 8, and 9 of Thul-Hijjah, which was expected due to pilgrim's preparation and moving to the land of Arafat.

Examining the daily operation of the clinic, it was clear that most of the work was conducted during the 12 hours shift (12 PM-12 AM), while the 12 AM-8 AM shift proved not to be efficient in terms of human resources utilization considering 3 personnel including an ENT specialist, a resident, and a nurse were assigned

Table 4 - Diagnosis distributions of 24 patients admitted through this Ear, Nose, and Throat-Hajj Clinic study.

Diagnosis	Frequency	(%)
Tonsillitis	6	25
Pharyngitis	5	21
Foreign body pharynx	3	13
Epistaxis	3	13
Nasal fracture	2	8
Dysphagia	2	8
Parotid abscess	1	4
Foreign body nose	1	4
Vertigo	1	4
Total	24	100

Table 5 - Antibiotic therapy distributions of 1047 patients included in this Ear, Nose, and Throat-Hajj Clinic study.

Main therapy	Frequency	(%)
No antibiotic	55	(5.3)
<i>With antibiotic</i>	992	(94.7)
Augmentin	471	(47.5)
Amoxil	421	(42.5)
Ciprofloxacin	41	(4.1)
Cefuroxime	33	(3.3)
Zithromax	16	(1.6)
Others	10	(1)

to operate each clinic, while only 2.6 patients are seen daily during that shift.

The fundamental purpose of this clinic was to address emergency ENT cases, and 2 interesting similar experiences with such a clinic were published. The first study was from France by Herve et al,⁸ where they examined 1237 patients in a similar clinic setup, and found that most of the cases did not correspond to true emergencies (53%), and their predominant pathological situations managed were acute external and middle ear otitis, epistaxis, vertigo, and facial injuries. The second study from England by Wheatley et al,⁹ who found that 75% of the patients seen in such an open access clinic were suitable for waiting until the next day.

In our study, the collective diagnosis of bacterial and viral URTI including the diagnosis of pharyngitis, viral URTI, and tonsillitis represented 85.2% of the total diagnosis. Although these diagnoses are not used in a very distinctive way by many physicians, our viral URTI rate was 18.6%. Many viruses have been implicated including influenza A and B, parainfluenza, respiratory syncytial virus (RSV), adenovirus, herpes simplex virus (HSV), enteroviruses, and rhinovirus.¹⁰⁻¹² The reported incidence of URTI in the Hajj setting is very variable. Choudhry et al¹³ reported 39.8% developed acute respiratory infections out of 1027 Hajjis. Gautret et al¹⁴ reported that out of 580 French Hajjis, 60.6% had cough, and 16.6% experienced fever during Hajj. Another study addressing 248 patients reported that acute respiratory infections and gastrointestinal illnesses were the most common diagnosed diseases during Hajj.¹⁵ Al-Asmary et al¹⁶ reported the prevalence of acute respiratory tract infections among 250 medical personnel serving in a Hajj medical mission was 25.6% out of 250 individuals.

The issues of preventive measures, medical personnel, and infection control are of paramount importance in the Hajj setting, and have been addressed in numerous studies. One study that addressed medical personnel found that contact with pilgrims imposed an extremely high risk of infection (OR=13.2), non-use of alcohol-based hand disinfection carried a more than 8 folds risk of acquiring URTI compared to those who always used alcohol for hand disinfection (OR=8.4), and Saudi nationals were 3 times more likely to acquire URTI than non-Saudis (OR=3.1).¹⁶ Interestingly, a study by Ghabrah et al¹⁷ addressing 392 medical personnel found that nurses tend to be better than doctors in terms of infection control knowledge, attitude, and practice. The protective use of face masks is still controversial, as Al-Asmary et al's¹⁶ study discouraged its use, Choudhry et al's¹³ study found that the use of a face mask was a significant protective factor against URTI. Regarding influenza vaccination, Al-Asmary et al's¹⁶ study showed

that influenza vaccination was associated with a 30% reduction in URTI compared to unvaccinated subjects. Another study of 500 screened Hajjis had 30 cases of confirmed influenza, and the report estimated a possible 24,000 total cases of influenza in 2003 Hajj season. The report recommended that influenza vaccine should be a priority for those attending Hajj.¹⁰ In contrast, Rashid et al¹⁸ showed that rates of influenza out of 538 patients in vaccinated and unvaccinated pilgrims were similar (10% versus 11%), and concluded that seasonal influenza vaccine was insignificantly protective against influenza in Hajj pilgrims. Of all these measures, it is clear that regular hospital infection control audits lead to significant improvement of infection control practice.¹⁹

In our study, out of the 1047 patients seen though the ENT Hajj clinic, 24 patients were admitted, of which 46% were in relation to URTI. This finding correlates well with the expected high incidence of respiratory system affliction during the Hajj season, where it is primarily cold weather as demonstrated by our study. A study by Al-Ghamdi et al²⁰ showed that out of 160 patients admitted during the Hajj in 2003, the respiratory system was the most commonly affected (57%), followed by other medical and surgical conditions. The fact that an ENT clinic will be naturally biased toward URTI out of other diagnoses is understandable. Similar acceptable bias is noted from another study, which was also performed in our institution in 2006, but within the medical department, and found that non-infectious diseases accounted for most morbidity out of 689 admissions to the medical ward.²¹

Another study that examined the global admitting diagnoses during 2003 Hajj season found that out of 808 admissions, 575 (71.2%) patients were admitted to medical wards, 105 (13.0%) to surgical wards, and 76 (9.4%) to intensive care units.²¹ It was also found that diabetes, hypertension, old age, and other chronic medical disorders represent a significant co-morbidity toward hospital admission.^{14,20-22}

In our study, 94.7% received antibiotics as part of, or their main therapy, and this very high percentage is more than expected especially knowing that 18.6% were actually diagnosed as viral URTI. This actually is a well-known prescription phenomenon within the medical community. Khamis et al¹⁵ actually reported that out of 248 pilgrim patients seen during the 2007 Hajj season, analgesics and antibiotics were the most commonly prescribed drugs. Another interesting study from USA included 1952 pediatric patient encountered with a primary diagnosis suggestive of a viral infection found that 33.2% of these patients received antibiotics. Overall antibiotic use was significantly less among the house staff (19.5%) than the staff physicians; among

staff physicians, antibiotic use was greater among those who work in non-teaching (39.6%) compared with teaching hospitals (32.5%).²³

The main limitation of this study was essentially related to the unavailability of previous similar work to build upon, no clear referral pathway for the patients, and minimal coordination between health care agencies, centers, and providers.

In conclusion, the ENT Hajj Clinic was a success in improving patients care, and to help alleviate pressure from the ER. Operationally, the 12 AM-8 AM shift of the ENT Hajj Clinic, was not efficient in terms of human resources uses. Excessive use of antibiotic usage should be discouraged, and preventive measures against URTI including influenza vaccination, hand disinfection, and use of face masks should be encouraged during Hajj. Regular hospital infection control audits are very important for improvement of infection rates. The use of such an electronic database can be linked to computer-based surveillance to identify any outbreak of infectious diseases, such as swine flu.²⁴ A prospective larger scale institutional electronic database is needed to improve local statistics, and therefore, decisions regarding patients care.

Acknowledgment. *The author gratefully acknowledges Mrs. Regina Akhtar, RN, for her help in the data collection.*

References

- Ahmed QA, Arabi YM, Memish ZA. Health risks at the Hajj. *Lancet* 2006; 367: 1008-1015.
- Neumann H. [Electronic data documentation in the ENT clinic] *Arch Klin Exp Ohren Nasen Kehlkopfheilkd* 1967; 188: 532-541. German.
- WHO. ICD-10: International statistical classification of diseases and related health problems. 10th revision. Trieste (Italy): WHO publication; 2007. [update 5 April 2006, accessed 12 October 2008] Available from URL: <http://www.who.int/classifications/apps/icd/icd10online/>
- Health Statistical Year Book for 2006. Riyadh (KSA): Ministry of Health; 2006. p. 317-322.
- Mylvaganam S, Patodi R, Campbell JB. The ENT emergency clinic: a prospective audit to improve effectiveness of an established service. *J Laryngol Otol* 2009; 123: 229-233.
- The Statistical Yearbook for the Kingdom of Saudi Arabia. Riyadh (KSA): Central Department of Statistics & Information; 2007. p. 49.
- Gatrad AR, Sheikh A. Hajj: journey of a lifetime. *BMJ* 2005; 330: 133-137.
- Hervé JF, Wiorowski M, Schultz P, Chambres O, Lannoy L, Rakotobe H, et al. [ENT Resident Activity in the Strasbourg Hospital ENT Emergency Clinic] *Ann Otolaryngol Chir Cervicofac* 2004; 121: 33-40. French.
- Wheatley AH, Temple RH, Camilleri AE, Jones PH. ENT open access clinic: an audit of a new service. *J Laryngol Otol* 1999; 113: 657-660.
- Balkhy HH, Memish ZA, Bafaqeer S, Almuneef MA. Influenza a common viral infection among Hajj pilgrims: time for routine surveillance and vaccination. *J Travel Med* 2004; 11: 82-86.
- Rashid H, Shafi S, Haworth E, El Bashir H, Memish ZA, Sudhanva M, et al. Viral respiratory infections at the Hajj: comparison between UK and Saudi pilgrims. *Clin Microbiol Infect* 2008; 14: 569-574.
- Alborzi A, Aelami MH, Ziyaeyan M, Jamalidoust M, Moeini M, Pourabbas B, et al. Viral etiology of acute respiratory infections among Iranian Hajj pilgrims, 2006. *J Travel Med* 2009; 16: 239-242.
- Choudhry AJ, Al-Mudaimegh KS, Turkistani AM, Al-Hamdan NA. Hajj-associated acute respiratory infection among hajjis from Riyadh. *East Mediterr Health J* 2006; 12: 300-309.
- Gautret P, Yong W, Soula G, Gaudart J, Delmont J, Dia A, et al. Incidence of Hajj-associated febrile cough episodes among French pilgrims: a prospective cohort study on the influence of statin use and risk factors. *Clin Microbiol Infect* 2009; 15: 335-340.
- Khamis NK. Epidemiological pattern of diseases and risk behaviors of pilgrims attending Mina hospitals, Hajj 1427 h (2007 g). *J Egypt Public Health Assoc* 2008; 83: 15-33.
- Al-Asmary S, Al-Shehri AS, Abou-Zeid A, Abdel-Fattah M, Hifnawy T, El-Said T. Acute respiratory tract infections among Hajj medical mission personnel, Saudi Arabia. *Int J Infect Dis* 2007; 11: 268-272.
- Ghabrah TM, Madani TA, Albarrak AM, Alhazmi MA, Alazraqi TA, Alhudaithi MA, et al. Assessment of infection control knowledge, attitude and practice among healthcare workers during the Hajj period of the Islamic year 1423 (2003). *Scand J Infect Dis* 2007; 39: 1018-1024.
- Rashid H, Shafi S, Haworth E, Memish ZA, El Bashir H, Ali KA, et al. Influenza vaccine in Hajj pilgrims: policy issues from field studies. *Vaccine* 2008; 26: 4809-4812.
- Madani TA, Albarrak AM, Alhazmi MA, Alazraqi TA, Althaqafi AO, Ishaq AH. Steady improvement of infection control services in six community hospitals in Makkah following annual audits during Hajj for four consecutive years. *BMC Infect Dis* 2006; 6: 135.
- Al-Ghamdi SM, Akbar HO, Qari YA, Fathaldin OA, Al-Rashed RS. Pattern of admission to hospitals during muslim pilgrimage (Hajj). *Saudi Med J* 2003; 24: 1073-1076.
- Khan NA, Ishag AM, Ahmad MS, El-Sayed FM, Bachal ZA, Abbas TG. Pattern of medical diseases and determinants of prognosis of hospitalization during 2005 Muslim pilgrimage Hajj in a tertiary care hospital. A prospective cohort study. *Saudi Med J* 2006; 27: 1373-1380.
- Madani TA, Ghabrah TM, Al-Hedaithy MA, Alhazmi MA, Alazraqi TA, Albarrak AM, et al. Causes of hospitalization of pilgrims in the Hajj season of the Islamic year 1423 (2003). *Ann Saudi Med* 2006; 26: 346-351.
- Gaur AH, Hare ME, Shorr RI. Provider and practice characteristics associated with antibiotic use in children with presumed viral respiratory tract infections. *Pediatrics* 2005; 115: 635-641.
- Gundlapalli AV, Olson J, Smith SP, Baza M, Hausam RR, Eutropius LJ, et al. Hospital electronic medical record-based public health surveillance system deployed during the 2002 Winter Olympic Games. *Am J Infect Control* 2007; 35: 163-171.