

**Table 1 Results of literature review (continued)**

Refs	Objective	Hajj year	Study design	Population	Sample Size	Data collection	Results
Memish et al., 2013  Laboratory-confirmed invasive meningococcal disease: effect of the Hajj vaccination policy, Saudi Arabia, 1995 to 2011	Study the incidence and case fatality ratio of invasive meningococcal disease in Saudi Arabia for 1995–2011, and evaluate the effect of polysaccharide quadrivalent ACWY vaccine introduction in 2002	1995–2011	Cross-sectional	Citizens, residents and pilgrims in SA from 1995 to 2011	22 652 297	Ministry of Health database	In the 2000 and 2001 outbreak years, IMD cases from Mecca during the Hajj accounted for 49% of all notified annual IMD cases. In contrast, between 2002 and 2011, only a mean annual 8.1% of all IMD cases were reported from Mecca during the Hajj season.  Since 2006, during Hajj seasons, only 1 case of IMD was reported.  The mean numbers of Hajj-related cases was higher (13.4/yr) during the pre-epidemic than during the post-epidemic years (1.7/yr).
Nicolas et al., 2005  Pharyngeal carriage of serogroup W135 <i>Neisseria meningitidis</i> in Hajjees and their family contacts in Morocco, Oman and Sudan	Determine the spread of serogroup W135 <i>N. meningitidis</i> among pilgrims and their family contacts	2000	Cross-sectional	Pilgrims and their family contacts from Morocco, Oman and Sudan in Hajj 2000	Morocco: 1186 individuals  Oman: 399 individuals  Sudan: 250 individuals	Questionnaires and swab samples	In Morocco: 95 meningococcal strains were isolated from 2.7% of the specimens.  PFGE showed that 32 (33.6%) were identical with the EC.  In Sudan: 5 strains identical with the EC were obtained.  In Oman: among 18 meningococcal strains isolated, 11 (61.1%) belonged to the EC.
Karsany et al., 2013  Patterns of meningococcal infection in Sudan with emergence of <i>Neisseria meningitidis</i> serogroup W135	Follow-up the frequency of outbreaks and pan-endemic waves of meningococcal infection in Sudan and to evaluate the new quadrivalent vaccine for actual application	2004–2006	Cross-sectional	All patients admitted to hospitals in Western, Eastern and Central Sudan	196	Hospitals records	<i>N. meningitidis</i> was identified in 37 (18.9%) patients.  <i>N. meningitidis</i> type A was identified in 29 (78.4%) patients, type C in 3 (8.1%) and <i>N. meningitidis</i> W135 in 5 (15.5%).  The serotyping and molecular diagnosis patterns of <i>N. meningitidis</i> showed the emergence of the new strain, W 135, in patients from the borders of Sudan. These could be related to the movement of pilgrims through the borders to Saudi Arabia in the Hajj season.
Dull et al., 2005  <i>Neisseria meningitidis</i> serogroup W-135 carriage among US travelers to the 2001 Hajj	Investigate the transmission of <i>N. meningitidis</i> among Hajj pilgrims, to understand the molecular epidemiology of meningococcal carriage, and to help in propose recommendations to prevent spread of the disease	2001	Cross-sectional	Hajj pilgrims travelling from JFK International Airport in New York City to Jeddah, Saudi Arabia in 2001	Outbound passengers: 452  Inbound passengers: 844	Questionnaires and swab samples	Out of 452 outbound passengers (all pilgrims): 4 cultures tested positive for <i>N. meningitidis</i> (0.9%); of these, 2 were serogroup Y and 2 were serogroup B.  No <i>N. meningitidis</i> serogroup W-135 isolates were identified.  Out of 844 inbound passengers: 21 positive (2.6%), 18 of them were pilgrims. Of these, 10 were serogroup W-135, 5 were nongroupable, 4 were serogroup B, and 1 was serogroup Y. Four isolates of <i>Neisseria lactamica</i> were recovered from inbound passengers.

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Lemos et al., 2010  Phenotypic and molecular characterization of invasive serogroup W135 <i>Neisseria meningitidis</i> strains from 1990 to 2005 in Brazil	Characterize all available Brazilian <i>N. meningitidis</i> serogroup W135 strains isolated in Brazil from 1990 to 2005	1990–2005	Laboratory-based surveillance	Brazilian with <i>N. meningitidis</i> serogroup W135 strains	216	Series of phenotypic and genotypic approaches	73% of the isolates were clustered in 1 major clone of ST-11 complex/ET37 complex. Strains of this clone had the same STs, serotypes and PorA VR types as found in Hajj-related <i>N. meningitidis</i> serogroup W135 clone.  One of these strains had the Hajj-2000 outbreak strain genotype, including 16S rRNA gene sequence 31 and 84% relatedness by PFGE.
Ceyhan et al., 2013  Acquisition of meningococcal serogroup W-135 carriage in Turkish Hajj pilgrims who had received the quadrivalent meningococcal polysaccharide vaccine	Assess meningococcal carriage acquisition among pilgrims who received polysaccharide vaccine against serogroups A, C, W-135, and Y, and acquisition of meningococcal carriage by household contacts	2010	Prospective cohort	Turkish Hajj pilgrims in 2010 and their household contacts	472	Nasopharyngeal swabs before and after the Hajj	Of the 472 pilgrims before the Hajj, 63 (13%) were positive for meningococcal carriage, of which 52 (83%) were serogroup W-135.  In the 296 pilgrims tested after the Hajj, 81 (27%) were positive for meningococcal carriage, including 74 (91%) with W-135.  In 11 family members of pilgrims who acquired W-135 carriage at the Hajj, 10 (91%) had acquired carriage of serogroup W-135.
Alborzi et al., 2008  Meningococcal carrier rate before and after Hajj pilgrimage: effect of single dose ciprofloxacin on carriage	Determine the meningococcal carriage rate in pilgrims (before and after hajj), evaluate the entrance of new serogroups, and evaluate the effect of a single dose of ciprofloxacin taken by pilgrims 24 h before returning to the Islamic Republic of Iran from SA	2003	Cross-sectional	Iranian pilgrims in Hajj 2003	674	Swab samples	Carriage rates of <i>N. meningitidis</i> in group 1 were 5.2% and 4.6% before leaving and after arriving in Iran, respectively, a nonsignificant difference ( $P = 0.65$ ) but entrance of new serogroups (A, Z and Z') was epidemiologically significant as they have the capability to cause outbreaks.  Group 2 had a 8.1% carriage rate before leaving Iran (with serogroups B, C, D, X and Y), which reduced to 0 when they arrived back in the country having taken 500 mg ciprofloxacin 24 h before they returned ( $P = 0.002$ ).
Abdul Rahman et al., 2011  Etiology of upper respiratory tract infection among international pilgrims arriving for Hajj 2010 G	To identify the etiological agents for URTI among pilgrims arriving at King Abdul Aziz International Airport, Jeddah during Hajj season, 1431 H (2010 G), and to describe the distribution of these agents according to their demographic characteristics, presenting symptoms, influenza vaccination status and use of empirical treatment in the study population	2010	Cross-sectional	The study population included any pilgrim who was suffering from 1 of the constitutional symptoms of URTI (fever, headache, myalgia) along with 1 of the local symptoms: runny nose, sneezing, sore throat, cough with or without sputum, and difficulty in breathing	713	Structured questionnaire	Of the study population, 79.9% had fever, 77.0% had headache, 60.4% had myalgia, 81.8% had sneezing, 64.0% had cough, 59.0% had sore throat, 51.6% had runny nose, and 15.3% had difficulty in breathing.  Around 30.2% consumed antibiotics in the preceding 72 h, while 72.7% used antipyretics in the preceding 12 h.  Influenza vaccine had been received by 26.9% during the preceding 6 mo.  Pathogenic microorganism from throat swab identified in 213 (29.1%), bacteria represented 18.8% and viruses 11.1%.  Isolated agents included streptococci (11.5%), meningococci (7.3%), RSV (3.1%), IAV/H1N1 (3.1%), IBV Sichuan (2.1%), IAV/H3N2 (1.7%) and IBV/Hong Kong (1.1%).  Pilgrims from sub-Saharan Africa show the most prominent carriage of meningococci (14.7%).

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Wilder-Smith et al., 2005  High risk of <i>Mycobacterium tuberculosis</i> infection during the Hajj pilgrimage	Assess the risk of <i>M. tuberculosis</i> infection among Hajj pilgrims	2002	Prospective	Singaporean pilgrims in Hajj 2002	501	Questionnaire and blood sample (1 mo before Hajj and 3 mo after)	<p>202 (55.3%) complained of prolonged cough (&gt; 1 wk) during the Hajj. 346 (96.4%) reported that they had received BCG vaccination.</p> <p>8 subjects were excluded from the subsequent analysis because of current history of TB (on treatment) or recent history of TB in a family member.</p> <p>Quantiferon prior to the Hajj was negative in 149 (41.7%), positive in 152 (42.6%), conditionally positive in 49 (13.7%), and indeterminate in 7(1.9%).</p> <p>Of the 149 pilgrims who had a negative result prior to the Hajj, 15 (10%) had a conversion indicative of a new <i>M. tuberculosis</i> infection.</p> <p>Of the 152 subjects who were positive prior to the Hajj, 13 (8.6%) had a reversion on the post-Hajj testing.</p>
Alherabi, 2009  Road map of an ear, nose, and throat clinic during the 2008 Hajj in Mecca, Saudi Arabia	Provide a road map for the ENT Clinic during Hajj	2008	Prospective cohort	All patients presenting to the ENT Clinic at Al-Noor Specialist Hospital, Mecca in Hajj 2008	1047		<p>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.</p> <p>URTI including diagnosis of pharyngitis, viral URTI, and tonsillitis represented 85.2% of the total diagnosis.</p> <p>24 patients were admitted, with admission conversion rate of 2.3%, and average admission rate was 2 patients/d.</p> <p>Admission in relation to URTI represented 46% of the total admitting diagnosis.</p> <p>In treating these patients, 992 patients (94.7%) received antibiotics.</p>
Al-Asmary et al., 2007  Acute respiratory tract infections among Hajj medical mission personnel, Saudi Arabia	Estimate the prevalence of ARTI among personnel serving in 2 Hajj mission hospitals in Mecca, and determine the effectiveness of protective measures against ARTI	2005	Nested case-control	All Hajj mission members of the Al-Hada and Taif Military Hospitals for the year 2005	250	Questionnaire and hospital records	<p>The attack rate for ARTI among members of the mission during Hajj season or within two weeks of returning was estimated as 25.6% (64/250).</p> <p>Smokers were found to have 2.5-fold greater risk of developing ARTI compared to non-smokers.</p> <p>Direct contact with pilgrims during healthcare services carried an extremely high risk of acquiring ARTI.</p> <p>No significant association was found between ARTI and occupation or vaccination against influenza.</p> <p>Using facemasks intermittently carried more risk of acquiring ARTI than using facemasks all the time.</p> <p>Medical personnel who never used alcohol for hand disinfection developed ARTI 5 times more often compared to those who practiced regular alcohol hand disinfection.</p>

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Choudhry et al., 2006 Hajj-associated acute respiratory infection among hajjis from Riyadh	Assess the incidence of Hajj-related ARTIs among domestic hajjis, and identify the risk factors associated with these illnesses	2002	Prospective cohort	Hajjis travelling from the capital of Saudi Arabia, Riyadh city in Hajj 2002	1027	Questionnaire before Hajj and phone interview after Hajj	<p>39.8% Hajjis developed symptoms of ARTI.</p> <p>The incidence of ARTI was not statistically significantly associated with age, sex, educational status or smoking.</p> <p>The risk of illness was significantly higher among diabetics, Hajjis who stayed longer in the Hajj area and who prayed at Namera Mosque.</p> <p>Use of a facemask by men, but not use of a face cover by women, was a significant protective factor against ARTI.</p> <p>During the Hajj, 477 hajjis (46.4%) never used a facemask while 550 (53.6%) used a facemask, i.e., 340 (33.1%) used it most of time and 210 (20.4%) used it some of the time.</p> <p>The risk of ARTI was higher for hajjis who travelled by bus (44.0%) or car (47.8%) compared with hajjis who used the airplane (35.3%).</p>
Alzahrana et al., 2012 Pattern of diseases among visitors to Mina health centers during the Hajj season, (2008 G)	Determine the pattern of diseases among pilgrims seeking medical services in Mina primary health care centers during the Hajj season in 2008	2008	Cross-sectional	Pilgrims who attended 13 randomly selected Mina PHCCs during Hajj 2008	4136	Medical records	<p>Most patients were men (70.7%), and most were aged 45–64 yr (42.8%).</p> <p>20.2% of patients suffered from multiple diseases.</p> <p>Respiratory diseases were the most common (60.8%), followed by musculoskeletal (17.6%), skin (15.0%) and gastrointestinal (13.1%) diseases.</p> <p>Diabetes, asthma and hypertension each constituted &lt; 3% of the total diseases.</p> <p>Respiratory diseases were the most common independent of nationality or the day of visit, while the frequency of the other diseases varied according to nationality and the day of visit.</p> <p>The most frequently prescribed drugs were analgesics, antipyretics, antibiotics and cough syrups.</p>
Rashid et al., 2008 Influenza and respiratory syncytial virus infections in British Hajj pilgrims	Establish the burden of influenza and RSV in symptomatic British pilgrims	2005	Cross-sectional	UK pilgrims with symptoms of URTI attending the Hajj in the year 2005	205	Questionnaire and nasal swabs	<p>37 (18%) were positive for either IV or RSV.</p> <p>IAV (H3) accounted for 54% (20/37) of the virus-positive samples, followed by RSV 24% (9/37), IBV 19% (7/37), and IAV (H1) 3% (1/37).</p> <p>Of the influenza-positive cases, 29% (8/28) had recent influenza immunization.</p> <p>Influenza was more common in those who gave a history of contact with a pilgrim with a respiratory illness than those who did not (17 vs 9%).</p> <p>Overall rate of RSV was 4% (9/202).</p> <p>This study confirms that IV and RSV cause acute respiratory infections in British Hajj pilgrims.</p>

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Refs	Objective	Hajj year	Study design	Population	Sample Size	Data collection	Results
Rashid et al., 2008  Influenza and respiratory syncytial virus infections in British Hajj pilgrims	Compare the rates of IV, rhinovirus, RSV, human MPV, adenovirus and parainfluenza virus infection among UK and Saudi pilgrims suffering from URTI during the Hajj 2006	2006	Compare the rates of IV, rhinovirus, RSV, human MPV, adenovirus and parainfluenza virus infection among UK and Saudi pilgrims suffering from URTI during the Hajj 2006	2006	260	Nasal swab	<p>38 (25%) UK pilgrims and 14 (13%) Saudi pilgrims had respiratory infections.</p> <p>In the UK group, there were 19 (13%) cases of rhinovirus infection, 15 (10%) of IV infection, 2 (1%) of dual infections with IV and rhinovirus, 1 (3%) of parainfluenza virus infection, and 1 (1%) of RSV infection.</p> <p>56 (37%) UK pilgrims had been vaccinated against IV, with the rates of influenza in the vaccinated and unvaccinated group being 7% and 14%, respectively.</p> <p>In the Saudi group, there were 3 (3%) cases of rhinovirus infection and 11 (10%) of influenza.</p> <p>Only 4 (4%) Saudi pilgrims had been vaccinated against IV, and none of these was infected with IV.</p> <p>Overall, a significantly higher proportion of the UK pilgrims had detectable respiratory infections (25% vs. 13%).</p>
Alborzi et al., 2009  Viral etiology of acute respiratory infections among Iranian Hajj pilgrims, 2006	Determine the incidence of the common respiratory viruses among Iranian pilgrims	2006	Determine the incidence of the common respiratory viruses among Iranian pilgrims	2006	255	Questionnaire and nasal wash sampling	<p>Cough in 213 (83.5%) and sore throat in 209 (82%) were the most common symptoms.</p> <p>83 patients (32.5%) had viral pathogens: IV in 25 (9.8%), parainfluenza virus in 19 (7.4%), rhinovirus in 15 (5.9%), adenovirus in 14 (5.4%), enterovirus in 5 (2%), and RSV in 4 (1.6%), and coinfection with 2 viruses in 1 patient (0.4%).</p> <p>IV was identified more in unvaccinated than in vaccinated pilgrims (16.5% vs 9.2%).</p>
Benkouiten et al., 2013  Circulation of respiratory viruses among pilgrims during the 2012 Hajj pilgrimage	Elucidate the dynamics of viral circulation among pilgrims	2012	Elucidate the dynamics of viral circulation among pilgrims	2012	165	Face-to-face interview before returning to France or via telephone after returning to France.  Anterior nares swabs.	<p>Of 165 participants sampled before departing to the SA, 8 (4.8%) were positive for at least 1 virus (5 rhinovirus, 1 ICV, 1 adenovirus, and 1 enterovirus).</p> <p>70 symptomatic pilgrims underwent additional nasal swabs during their pilgrimage in SA, of which 27 (38.6%) were positive for at least 1 virus (19 rhinovirus, 6 IAV, 1 ICV, 1 RSV B, 1 MPV, 1 adenovirus, and 1 enterovirus). This was significantly higher than the 4.8% who were positive before departing for SA.</p> <p>Of 154 pilgrims sampled before leaving SA, 17 (11%) were positive for at least 1 virus (13 rhinovirus, 3 adenovirus, 2 IBV, and 1 enterovirus), which was also significantly higher than the percentage of positive pilgrims (4.8%), before departing for SA.</p>

**Table 1 Results of literature review (continued)**

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Deris et al., 2010  The prevalence of acute respiratory symptoms and role of protective measures among Malaysian hajj pilgrims	Determine the prevalence of respiratory symptoms among Malaysian Hajj pilgrims and the effect of a few protective measures taken by Hajj pilgrims to reduce respiratory symptoms	2007	Cross-sectional	Malaysian Hajj pilgrims at transit centre before flying back to Malaysia in Hajj 2007	394	Questionnaire	<p>Common respiratory symptoms were: cough 91.5%, runny nose 79.3%, fever 59.2%, and sore throat 57.1%.</p> <p>Prevalence of pilgrims with triad of cough, subjective fever, and sore throat were 40.1%.</p> <p>Only 3.6% did not suffer from any of these symptoms.</p> <p>72% of pilgrims received influenza vaccination before departure and 72.9% wore facemasks.</p> <p>Influenza vaccination was not associated with any of respiratory symptoms but it was significantly associated with longer duration of sore throat. Wearing masks was significantly associated with sore throat and longer duration of sore throat and fever.</p>
Gautret et al., 2009  Common health hazards in French pilgrims during the Hajj of 2007: a prospective cohort study	Evaluate the incidence of common health hazards in French pilgrims during the Hajj 2007	2007	Prospective cohort	French pilgrims in preparation for the Hajj pilgrimage who attended the meningococcal vaccination campaign to fulfil their compulsory vaccination requirement	558	Questionnaires (before and after the Hajj)	<p>A total of 545 of 558 vaccination attendees in preparation for Hajj pilgrimage voluntarily participated in the study.</p> <p>A significant proportion of individuals had chronic medical disorders such as walking disability (26%), diabetes mellitus (21%), and hypertension (21%).</p> <p>A proportion of 59% of travelers presented at least 1 health problem during the pilgrimage and 44% of the cohort attended a doctor during travel; 3% were hospitalized.</p> <p>Cough was the main complaint among travellers (attack rate of 51%), followed by headache, heat stress, and fever. Among French pilgrims, there were only 4.5% who suffered from diarrhoea and 2.4% from vomiting. Cardiovascular diseases, neurological disorders, trauma, skin and gastrointestinal problems were not frequently observed in the survey. Cough episodes were significantly more frequent in individuals &gt; 55 years.</p>
Madani et al., 2007  Causes of admission to intensive care units in the Hajj period of the Islamic year 1424 (2004)	Describe the pattern of diseases, complications, and outcome of pilgrims who required admission to intensive care units during the Hajj (2004)	2004	Cross-sectional	All patients admitted to ICU in 4 hospitals in Mena and 3 in Arafat during the Hajj 2004	140	Medical records	<p>75 (54%) patients were aged &gt; 60 yr.</p> <p>Risk of complications and death increased with age, with the highest risk noticed among pilgrims &gt; 80 yr.</p> <p>94 (67.6%) patients were men.</p> <p>89 (63.6%) patients were admitted with cardiovascular diseases and 37 (26.4%) with infections.</p> <p>Myocardial infarction (25%) and pneumonia (22%) were the most common admitting diagnoses. Trauma accounted for only 6.4% (9 patients) of admissions.</p>

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Asghar et al., 2010 Profile of bacterial pneumonia during Hajj	Determine the most common causes of bacterial pneumonia and relate the findings with clinical conditions	2005	Cross-sectional	Pilgrim patients with suspected pneumonia who were admitted to Mecca hospitals during Hajj season 2005	141	Medical records and sputum and serum samples	<p>63 (45.0%) patients recovered and were discharged or transferred to hospital wards in stable condition; 40 (28.6%) were transferred to tertiary care centers for specialized services; 21 (15.0%) were transferred to tertiary care centers after closure of temporary hospitals in Mena and Arafat; 15 (10.7%) patients died, and 1 (0.7%) patient was discharged against medical advice.</p> <p>76 (53.9%) were confirmed positive by microbiological tests. More than 94% of the confirmed cases were aged &gt; 50 yr, and 56.6% were men.</p> <p>Most frequent isolates were <i>Candida albicans</i> (28.7%) and <i>Pseudomonas aeruginosa</i> (21.8%), followed by <i>Legionella pneumophila</i> (14.9%) and <i>Klebsiella pneumoniae</i> (9.2%).</p> <p>&gt; 1 causative pathogens were isolated in 15 patients (16.3%), and 55% of patients were diabetic.</p>
Mandourah et al., 2012 Clinical and temporal patterns of severe pneumonia causing critical illness during Hajj	Describe the number and temporal onset, comorbidity, and outcomes of severe pneumonia causing critical illness among pilgrims	2009–2010	Prospective cohort	All patients admitted to ICU for at least 4 h during Hajj 2009 and 2010.	452	Medical records	<p>Pneumonia was the primary cause of critical illness in 123 (27.2%) of all ICU admissions during Hajj.</p> <p>Pneumonia was community (Hajj) acquired in 66.7%, aspiration-related in 25.2%, nosocomial in 3.3%, and tuberculous in 4.9%.</p> <p>Pneumonia occurred most commonly in the second week of Hajj, 95 (77.2%) occurred between days 5 and 15 of Hajj, corresponding to the period of most extreme pilgrim density.</p> <p>Mechanical ventilation was performed in 69.1%. Median duration of ICU stay was 4 d and duration of ventilation 4 d.</p> <p>Commonest pre-existing comorbidity included smoking (22.8%), diabetes (32.5%), and COPD (17.1%).</p> <p>Short-term mortality (during the 3-wk period of Hajj) was 19.5%.</p>
Emamian et al., 2012 Respiratory tract infections and its preventive measures among Hajj pilgrims, 2010: a nested case control study	Examine the effects of general preventive measures on respiratory tract infections	2010	Nested case-control	Iranian pilgrims in hajj 2010	338		<p>32 pilgrims (9.5%) were affected by respiratory tract infections other than common colds.</p> <p>69% of the patients received symptomatic treatment and oral antibiotics, and 27.5% required intravenous antibiotics.</p> <p>79.3% of patients fully recovered through the treatment administered in the caravan, but 17.2% were referred to the Hajj Medical Center.</p> <p>3.4% of the total patients were hospitalized in that centre.</p>

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Baharoon et al., 2009  Severe sepsis and septic shock at the Hajj: etiologies and outcomes	Study the incidence, etiologies, complications and outcome of severe sepsis and septic shock among Hajjees patients in 2 major ICUs in Mecca for the Hajj season 2004	2004	Prospective cohort	Pilgrims with clinical diagnosis of severe sepsis/septic shock.	165	Medical records	Severe sepsis and septic shock accounted for 25.4% of ICU admission during Hajj.  Mean age of hajjees was 65.45 yr.  Chronic respiratory illness was the leading comorbidity present in > 70% of hajjees and pneumonia was the leading cause of severe sepsis and septic shock.  Gram-negative organisms were the most frequently isolated pathogens in this subset of patients.  Acute renal failure was common among pilgrims who presented with septic shock, and carried high mortality.
Memish et al., 2006  Carriage of Staphylococcus aureus among Hajj pilgrims	Evaluate the prevalence of MRSA carriage among the pilgrims	2004	Cross-sectional	All Hajj pilgrims visiting the National Guard Health Affairs health facility in Mina, KSA for medical reasons in Hajj 2004	411	Questionnaire and specimen sample	85 (20.6%) were positive for <i>S. aureus</i> , of which only 6 (1.46 %) were MRSA.  None of the pilgrims examined had any risk factors for community-acquired MRSA.  Overall, the prevalence of MRSA in the population of pilgrims examined was found to be low (1.46%) in comparison with most community based studies.
Deris et al., 2010  The association between pre-morbid conditions and respiratory tract manifestations amongst Malaysian Hajj pilgrims	Study the associated factor of influenza-like illness among Malaysian pilgrims in Hajj 2007	2007	Cross-sectional	Malaysian Hajj pilgrims in the year 2007	394	Questionnaire	Allergic rhinitis was significantly associated with sore throat, longer duration of cough and runny nose.  Pilgrims with COPD had significant association with longer duration of cough. Those with diabetes mellitus had significant association with longer duration of sore throat.  Underlying asthma was significantly associated with severe influenza-like illness requiring admission to hospital for further treatment of respiratory symptoms.
Balaban et al., 2012  Protective practices and respiratory illness among US travelers to the 2009 Hajj	Evaluate the effectiveness of recommended behavioural interventions (hand hygiene, wearing a face mask, cough etiquette, social distancing, and contact avoidance) at mitigating illness among travellers during the 2009 Hajj.	2009	Cross-sectional	US residents from Minnesota and Michigan travelling for Hajj 2009	186		Respiratory illness was reported by 76 (41.3%) respondents; 144 (77.4%) reported engaging in recommended protective behaviour during the Hajj.  Reduced risk of respiratory illness was associated with practicing social distancing, hand hygiene, and contact avoidance. Pilgrims who reported practicing more recommended protective measures during the Hajj reported less or shorter duration of respiratory illness.  Noticing IAV (H1N1) health messages during the Hajj was associated with more protective measures and shorter duration of respiratory illness.



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Al-Jasser et al., 2012  Patterns of diseases and preventive measures among domestic hajjis from central, Saudi Arabia	Identify the occurrence of URTI, diarrheal diseases and trauma during the Hajj season, and the practice of some preventive measures by pilgrims	2009	Cross-sectional	Hajjis registered while visiting Primary Health Care Centers of Riyadh, SA to get mandatory meningococcal meningitis vaccination	1507	Standardized telephone-based questionnaire	54.7% developed symptoms; 97% reported upper respiratory tract symptoms, and 9.3% reported diarrheal symptoms.  Those aged < 40 yr were more likely to develop URTI. The incidence of diarrheal diseases or trauma was not significantly associated with age.  No significant difference for educational level was found for URTI or trauma, but there was a significant difference for diarrheal diseases.  There was no significant difference for nationality in relation to diarrheal diseases and trauma, but there was a significant difference for URTI.  There was a significant difference in URTI between pilgrims who used facemasks most of the time and those who used them sometimes.
Gautret et al. 2009  Incidence of Hajj-associated febrile cough episodes among French pilgrims: a prospective cohort study on the influence of statin use and risk factors	Evaluate the incidence of febrile cough episodes among pilgrims travelling from Marseille to SA, and assess the statin use effect on this incidence	2006	Prospective cohort	French pilgrims in preparation for the Hajj pilgrimage enrolled in the meningococcal vaccination campaign to satisfy compulsory vaccination requirements	650	Pre-travel questionnaires and post-travel telephone interview	580 individuals were presented with a questionnaire. 74 travellers (16.6%) experienced fever during their stay in SA (67 attended a doctor), and 271 (60.6%) had a cough (259 attended a doctor); 70 travellers with cough were febrile (25.9%).  70% of the travellers with cough episodes developed their first symptoms within 3 d, suggesting human-to-human transmission with short incubation time.  No demographic and socioeconomic characteristics, underlying diseases or vaccination against influenza significantly affected occurrence of cough.  Diabetes and unemployment correlated with increased risk of febrile cough. Statins had no significant influence on occurrence of cough and/or fever during the Hajj.
Keles et al., 2011  Predictors for the uptake of recommended vaccinations in Mecca travelers who visited the Public Health Service Amsterdam for mandatory meningitis vaccination	Investigate the acceptance of non-required, but advised vaccinations by the Hajj Pilgrims in Amsterdam	2001–2009	Cross-sectional	Pilgrims who visit PHS Amsterdam before departure for a mandatory vaccine	8,372	PHS database	Significantly more women and people aged > 50 years travelled to Mecca.  Since 2007, only 527 of 2156 (24%) of those who were advised to take vaccines accepted the recommendation.  Independent factors for acceptance were being female, younger age, and being less healthy. Specifically, Mecca travellers with heart disorders and liver or gastrointestinal disorders accepted recommended vaccinations more often than those without.

**Table 1 Results of literature review (continued)**

Refs	Objective	Hajj year	Study design	Population	Sample Size	Data collection	Results
Gautret et al., 2009c  Determinants of tetanus, diphtheria and poliomyelitis vaccinations among Hajj pilgrims, Marseille, France	Identify immigration, socioeconomic and sociocultural determinants of vaccination coverage against	2006	Cross sectional	Pilgrims in preparation who attended the Infectious and Tropical Medicine ward in Hospital Nord at Marseille to receive their <i>N. meningitidis</i> vaccine required for travel to Mecca	580	Questionnaire	Total vaccination rates for tetanus (18.9%), diphtheria (14.7%) and poliomyelitis (15.0%) were comparable.  Pilgrims' characteristic lower socioeconomic and social status, in addition to their unifying linguistic, cultural and religious identity defines them as a particularly disadvantaged group in France.  French citizenship, higher level of education, better French fluency and no previous travel to country of origin were the strongest and most significant determinants of TdP vaccination status.
Madani, 2007  Meningococcal, influenza virus, and hepatitis B virus vaccination coverage level among health care workers in Hajj	Assess compliance of HCWs employed in Hajj in receiving meningococcal, influenza, and hepatitis B vaccines	2003	Cross-sectional	Doctors and nurses working in all Mena and Arafat hospitals and primary health care centres who attended Hajj-medicine training programs	392	Questionnaire	323 (82.4%) HCWs received the quadrivalent (ACYW135) meningococcal meningitis vaccine, with 271 (83.9%) receiving it $\geq 2$ wk before coming to Hajj, whereas the remaining 52 (16.1%) received it within $< 2$ wk.  Only 23 (5.9%) HCWs received the current influenza vaccine.  260 (66.3%) HCWs received the 3-dose hepatitis B vaccine series, 19.3% received 1 or 2 doses, and 14.3% did not receive any dose.  There was no significant difference in compliance with the 3 vaccines between doctors and nurses.
Rashid H et al., 2008  Influenza vaccine in Hajj pilgrims: Policy issues from field studies	To estimate the capacity of influenza vaccine to prevent PCR-confirmed influenza infections among Hajj pilgrims	2005–2006	Cross-sectional	UK pilgrims attending the Hajj 2005 and 2006 who presented within 1 wk of onset of symptoms of respiratory illness, such as cough, sore throat, rhinorrhoea or fever were invited to participate	538	2 nasal swabs were taken from each patient	In 538 patients, nasal swabs were analysed and immunization histories confirmed. 115 (21%) were in a high-risk group for influenza; 58 of these were immunized against influenza; 5% of vaccinated at-risk pilgrims compared with 14% of unvaccinated had confirmed influenza. 423/538 (79%) were not a high-risk group for influenza; 90 of these not at high risk for influenza, and were immunized against influenza. Rates of influenza in vaccinated and unvaccinated not-at-risk pilgrims were similar (10% vs 11%). It was concluded that seasonal influenza vaccine was insignificantly protective against influenza in Hajj pilgrims.
Gautret et al., 2013  Camel milk-associated infection risk perception and knowledge in French Hajj pilgrims	Evaluate French pilgrim's potential risk for raw camel milk-associated diseases	2011	Cross-sectional	Hajj pilgrims who attended a travel medicine centre, in Marseilles to obtain required vaccination against meningitis prior to the 2011 Hajj	331	Questionnaire	8.2% had drunk camel milk before, mostly in North Africa (62.9%) and SA (18.5%).  13.9% declared that they knew that drinking raw camel milk could cause diseases and 40.6% said that they would drink it if offered during the pilgrimage.  Given that camel milk consumption in the Middle East is associated with several  zoonotic infections in humans, the study recommend that Hajj pilgrims be cautioned against consuming unpasteurized dairy products.

**Table 1 Results of literature review (continued)**

Refs	Objective	Hajj year	Study design	Population	Sample Size	Data collection	Results
Madani, 2005  Alkhumra virus infection, a new viral hemorrhagic fever in Saudi Arabia	Describe the epidemiological, clinical and laboratory features of the new viral haemorrhagic fever caused by Alkhumra virus	2001–2003	Cross-sectional	All pilgrims' with suspect Alkhumra virus infection and tested for Rift Valley fever		Standardized data collection forms	<p>37 cases were identified in Mecca, and 20 were laboratory confirmed.</p> <p>Acute febrile flu-like illness with hepatitis (100%), haemorrhagic manifestations (55%), and encephalitis (20%) were the main clinical features.</p> <p>The case fatality rate was 25%.</p> <p>The disease seemed to be transmitted from sheep or goats to humans by mosquito bites or direct contact with these animals.</p> <p>The mean age of patients was 33.4 yr.</p> <p>The disease predominantly affected male patients with a male to female ratio of 9: 1.</p>
Khan et al., 2010  Global public health implications of a mass gathering in Mecca, Saudi Arabia during the midst of an influenza pandemic	Study the worldwide migration of pilgrims traveling to Mecca to perform the Hajj in 2008 and assess the implications of influenza H1N1 in pilgrims from limited resources countries	2008		Worldwide migration of pilgrims traveling to Mecca to perform the Hajj in 2008		Data from the Saudi Ministry of Health and international air traffic departing SA after the 2008 Hajj using worldwide airline ticket sales data, and gross national income per capita as a surrogate marker of a country's ability to mobilize an effective response to H1N1	<p>In 2008, 2.5 million pilgrims from 140 countries performed the Hajj.</p> <p>Pilgrims (1.7 million) were of international (non-Saudi) origin; of whom, 91.0% travelled to SA via commercial flights.</p> <p>International pilgrims (11.3%) originated from low-income countries, with most travelling from Bangladesh (50 419), Afghanistan (32 621) and Yemen (28 018).</p>
Memish et al., 2012a  The prevalence of respiratory viruses among healthcare workers serving pilgrims in Mecca during the 2009 influenza A (H1N1) pandemic	Determine the prevalence of different respiratory viruses among healthcare workers who treated pilgrims during Hajj 2009; the year of the influenza A H1N1 pandemic	2009	Cross-sectional	HCWs who treated pilgrims during Hajj 2009	184	Questionnaire and nasal and throat swabs before and after Hajj	<p>Before the Hajj, rates of seasonal influenza vaccination were higher (51%) than rates of pandemic influenza A H1N1 vaccination (22%).</p> <p>After the Hajj, participants reported high rates of maintaining hand hygiene (98%), cough etiquette (89%), and wearing a facemask (90%).</p> <p>Among all the viruses tested, only 2 were detected: rhinovirus in 12.6% and coronavirus 229E in 0.6%.</p> <p>Rhinovirus was detected in 21% of those who had respiratory symptoms during Hajj.</p> <p>IAV (including H1N1), IVB, RSV, other coronaviruses, parainfluenza viruses, human MPV, adenovirus, and human bocavirus were not detected.</p> <p>None of the participants had IAV H1N1 2009; possibly because it was also infrequent among the 2009 pilgrims.</p>

**Table 1 Results of literature review (continued)**

Refs	Objective	Hajj year	Study design	Population	Sample Size	Data collection	Results
Memish et al., 2012b  Detection of respiratory viruses among pilgrims in Saudi Arabia during the time of a declared Influenza A(H1N1) Pandemic	Determine whether pilgrim attendance at the Hajj was associated with an increased risk of acquiring IV and other respiratory viruses, and evaluate compliance of pilgrims with influenza vaccination and other recommended preventive measures	2009	Cross-sectional	Pilgrims participating in the 2009 Hajj	3133	Questionnaires on arrival and departure	519 arriving and 2699 departing pilgrims were examined. Mean age was 49 yr and 58% were male.  30% of pilgrims stated that they had received pandemic influenza A(H1N1) vaccine before leaving for the Hajj and 35% of arriving pilgrims reported wearing a facemask.  50% of arriving pilgrims were aware of preventive measures such as hand hygiene and wearing a mask.  Prevalence of any respiratory virus infection was 14.5% (12.5% among arriving and 14.8% among departing pilgrims).  Main viruses detected (both groups combined) were rhinovirus/enterovirus (12.9%), coronaviruses (0.8%), RSV (0.2%), and IAV (0.2%) including pandemic influenza A(H1N1) (0.1%).  Prevalence of pandemic influenza A (H1N1) was 0.2% among arriving pilgrims and 0.1% among departing pilgrims.  Prevalence of any respiratory virus infection was lower among those who said they received H1N1 vaccine compared to those who said they did not (11.8% vs 15.6%).
Ziyaeyan et al., 2012  Pandemic 2009 influenza A (H1N1) infection among 2009 Hajj pilgrims from Southern Iran: a real-time RT-PCR-based study	Determine the point prevalence of (H1N1) among returning Iranian pilgrims	2009	Cross-sectional	Iranian Hajj pilgrims in 2009	350	Questionnaire and swab sample	Subjects included 132 (43.3%) men and 173 (56.7%) women, aged 24–65 yr.  IAV (H1N1)pdm09 was detected in 5 (1.6%) pilgrims and other IAVs in 8 (2.6%).  All the IAV(H1N1)pdm09 were sensitive to oseltamivir.
Moattari et al., 2012  Influenza viral infections among the Iranian Hajj pilgrims returning to Shiraz, Fars province, Iran	Determine the attack rate of seasonal and pandemic influenza pH1N1 among returning Iranian pilgrims after the 2009 Hajj	2009	Cross-sectional	Returning Iranian pilgrims of Fars province	275	Questionnaire and throat swab	Pilgrims had fever, cough, muscle ache and sore throat in various combinations. 25 (9.1%) had influenza diagnosed by virus culture: influenza B (n = 17), influenza A H3N2 (n = 8) and pandemic H1N1 (n = 5), whereas 33 (12%) had influenza diagnosed by RT-PCR: influenza B (n = 20), influenza A H3N2 (n = 8) and pandemic H1N1 (n = 5).
Alherabi, 2011  Impact of pH1N1 influenza A infections on the otolaryngology, head and neck clinic during Hajj, 2009	Examine possible implications of the 2009 H1N1 influenza A on Hajj, and provide a response plan for the ENT clinic during the Hajj pilgrimage	2009		All patients presenting to the ENT clinic at Al-Noor Specialist Hospital, Mecca, during Hajj 2009	3087	Mecca ENT-Hajj Database (MENT-HD)	1467 patients (47.5%) were hajji and 1620 patients (52.5%) were not. Saudi patients comprised 1602 (51.8%), while non- Saudi's comprised 1485 (48.2%).  URTI including pharyngitis, viral URTI, pH1N1, and tonsillitis represented 92% of diagnoses.  Only 77 suspected pH1N1 cases (2.5%) were observed in the ENT clinic.  Management of 3045 patients (98.6%) included antimicrobials as part of their main therapy.

**Table 1 Results of literature review (continued)**

Refs	Objective	Hajj year	Study design	Population	Sample Size	Data collection	Results
Memish et al., 2014  Prevalence of MERS-CoV nasal carriage and compliance with the Saudi health recommendations among pilgrims attending the 2013 Hajj	Determine the MERS-CoV nasal carriage rate among pilgrims performing the 2013 Hajj and describe the compliance with the Saudi Ministry of Health vaccine recommendations	2013	Cross-sectional	Pilgrims performing the 2013 Hajj	5235	Standardized data collection form and nasopharyngeal samples	<p>Mean age of screened population was 51.8 yr (range: 18–93 yr) with a male/female ratio of 1.17: 1.</p> <p>MERS-CoV was not detected in any of the samples tested (3210 pre-Hajj and 2025 post- Hajj screening).</p> <p>According to vaccination documents, all participants had received meningococcal vaccination and most from at-risk countries were vaccinated against yellow fever and polio.</p> <p>Only 22% of the pilgrims, 17.5% of those ≥ 65 yr and 36.3% of diabetics, had flu vaccination and 4.4% had pneumococcal vaccination.</p>
Laxminarayan. 2014  “Incentives for reporting disease outbreaks	Estimate the effect of external forcing events on the number of countries reporting cases of meningitis to WHO	1966–2002	Analysis of statistical report	54 African countries		WHO reports	<p>Hajj vaccination requirements started in 1988 were associated with reduced reporting, especially among countries with relatively fewer cases reported in 1966–1979.</p> <p>After vaccine provision was in place in 1996, reporting among countries that had previously not reported meningitis outbreaks increased.</p>
Mandourah et al., 2012b  The epidemiology of Hajj-related critical illness: Lessons for deployment of temporary critical care services	Describe patient characteristics, patterns of disease, and critical illness, including episodes of influenza A 2009 (H1N1), therapies delivered, and clinical outcomes	2009	Prospective cohort	All pilgrims attending Hajj who were admitted to ICU of 4 main Hajj hospitals	110	Medical records	<p>Median age was 60.5 yr, 69 (62.7%) were male, and APACHE IV score was 60.5.</p> <p>41 (37.3%) were critically ill due to cardiovascular diseases (23.6% with myocardial infarction); 51 (46.4%) had severe infections (21.8% with H1N1); electrolyte disturbance (21.8%); or pulmonary illness (15.5%).</p> <p>60 patients (54.6%) required ventilation.</p> <p>Median predicted mortality by APACHE IV was 14% while actual short-term mortality was 6.4%. Longer-term mortality may be higher.</p> <p>24 (21.8%) patients had clinical and PCR-confirmed and 8 (7.3%) had probable influenza A (H1N1); 7 had clinical features of influenza, 3 required ventilation, 5 had a history of contact with influenza A (H1N1)-infected persons, and 2 required continuous intravenous vasopressor or inotropic medications.</p> <p>None of the influenza A patients had received H1N1 vaccine.</p> <p>Short-term mortality rate among H1N1</p> <p>ICU patients was 8.3% due to pneumonia-related sepsis.</p>

**Table 1 Results of literature review (continued)**

Refs	Objective	Hajj year	Study design	Population	Sample Size	Data collection	Results
Khan et al., 2006  Pattern of medical diseases and determinants of prognosis of hospitalization during 2005 Muslim pilgrimage (Hajj) in a tertiary care hospital	Document the pattern of medical diseases necessitating admission in a tertiary care hospital during Hajj, and assess the risk factors associated with mortality during hospitalization	2005	Prospective cohort	All Hajj patients admitted to the Department of Medicine during the 2005 Hajj	2759	Questionnaire	<p>689 patients, belonging to 49 countries, with mean age 62 yr and male to female ratio of 1.8: 1 were admitted.</p> <p>220 (31.9%) had diabetes mellitus, 256 (37.2%) hypertension, 219 (31.8%) cardiac disease, and 103 (14.9%) chronic lung disease.</p> <p>Of the 449 (65.2%) patients assessed, 284 (63.2%) had a language barrier, and a translator was not available for 152 (53.5%).</p> <p>Common causes of morbidity were: cardiovascular (n = 235; 34.1%), infectious (n = 137; 19.9%) and neurological (n = 85; 12.3%) diseases.</p> <p>114 (16.5%) patients died, with the common causes being pneumonia (n = 28), acute coronary syndrome (n = 21), and stroke (n = 20).</p> <p>Risk factors associated with higher mortality were older mean age (65 vs 61 yr), history of chronic lung disease, dependence in any activity of daily living, inability to ambulate for 500 m without difficulty, and nonavailability of translator for patients with language barrier.</p>
Azarpazhooh et al., 2013  Incidence of first ever stroke during Hajj Ceremony	Evaluate the incidence of stroke among Iranian pilgrims during the Hajj ceremony	2007–2008	Prospective cohort	Iranian pilgrims in Hajj 2007 and 2008	92 974	Medical records	<p>17 first-ever strokes occurred in the Hajj pilgrims and 40 first-ever strokes occurred in the MSIS group.</p> <p>The adjusted incidence rate of first-ever stroke in the Hajj cohort was lower than that of the MSIS population (9 vs 16/100 000).</p> <p>For age- and gender-specific subgroups, the Hajj stroke crude rates were similar to or lower than in the general population of Mashhad, with the exception of women aged 35–44 and &gt; 75 yr who were at greater risk of having first-ever stroke than the non-pilgrims of the same age.</p>
Hollisaz et al., 2010  Hospital admission due to nephrological conditions during Hajj	Investigate the hospitalization of Iranian pilgrims due to nephrological conditions, addressing causes, healthcare use, and short-term outcomes	2005–2007	Retrospective	Iranian pilgrims admitted to hospitals in Mecca between Hajj 2005 and 2007	600	Hospital records	<p>12 (2.0%) were admitted due to nephrological causes, including kidney calculi (n = 7; 58.4%), acute kidney failure (n = 2; 16.7%), urinary tract infection (n = 1; 8.3%), urinary tract infection and urinary calculus (n = 1; 8.3%), and renal malignancy (n = 1; 8.3%).</p> <p>No patients needed referral to other healthcare centres, and all were discharged in good condition.</p> <p>Length of hospital stay was 1–4 d.</p> <p>There was no association between hospitalization due to nephrological causes and sociodemographic data, healthcare use, and outcome.</p>

**Table 1 Results of literature review (continued)**

Refs	Objective	Hajj year	Study design	Population	Sample Size	Data collection	Results
Razavi et al., 2011 Trends in prevalent injuries among Iranian pilgrims in Hajj	Determine the prevalence of injuries in Hajj period 2004–2008	2004–2008	Cross-sectional	Pilgrims in Hajj season 2004–2008	253 808	Report sheet	<p>The most common injuries were tissue contusions and ruptures (~76/10 000) and tendon lesions (~62/10 000).</p> <p>The most common mechanism of injury was ankle sprain (69/10 000).</p> <p>Prevalence of all fractures was ~49/10 000 and the proportion of burning with hot water or fire was ~40/10 000.</p> <p>Changes in all causes of injury were significant in this study.</p>
Pane et al., 2013 Causes of mortality for Indonesian Hajj pilgrims: comparison between routine death certificate and verbal autopsy findings	Study the patterns and causes of death for Indonesian pilgrims in Hajj 2008	2008	Cross-sectional	Indonesian pilgrims in Hajj 2008	206 831	Surveillance data	<p>There were 446 deaths, equivalent to 1968 per 100 000 pilgrim years.</p> <p>Most pilgrims died in Mecca (68%) and Medinah (24%). There was no discernible difference in the total mortality risk for the 2 pilgrimage routes (Mecca or Medinah first), but the number of deaths peaked earlier for those traveling to Mecca first.</p> <p>Most deaths were due to cardiovascular (66%) and respiratory (28%) diseases.</p>
Meysamie et al., 2006 Comparison of mortality and morbidity rates among Iranian pilgrims in Hajj 2004 and 2005	Compare the incidence of common diseases and accidents among Iranian pilgrims during Hajj 2004 and 2005, and determine the factors affecting the prevalence of each disease	2004–2005	Comparative study	Iranian Hajj pilgrims in 2004 and 2005	105 713		<p>The most common diseases during the 2 seasons were respiratory diseases. Suitable covering of influenza vaccination (88.8%), and incidence of these diseases in Hajj 2005 were twice those in 2004. These findings suggest that another etiological agent apart from IV was been responsible for the disease occurrence.</p> <p>Prevalence of cardiovascular diseases among pilgrims in Hajj 2005 was 142/10 000 and was significantly lower than in Hajj 2004 (288/10 000).</p> <p>There was no significant difference among gastrointestinal, gynaecological, psychological, and other important diseases, in the 2 seasons.</p> <p>Among the 8 types of accidents, the incidence of head and eye injuries during Ramy (one of the components of Hajj rites) in 2005 was significantly lower in 2004 (22/10 000 vs 125/10 000).</p> <p>The mortality rate in 2005 with 24 deaths/100 000 was significantly lower than in 2004 (47/100 000).</p>

**Table 1 Results of literature review (continued)**

Refs	Objective	Hajj year	Study design	Population	Sample Size	Data collection	Results
Al-Salamah. 2005  General surgical problems encountered in the Hajj pilgrims	Evaluate the pattern of general surgical admissions for future planning of staff, cost and other needs of these hospitals	2003–2004	Prospective	All general surgical admissions, except those who died in the emergency room or were received dead	792	Hospital records	<p>177 (22.3%) patients were admitted to both hospitals in 2 Hajj seasons.</p> <p>There were 139 men and 38 women with mean age of 52.7 yr.</p> <p>Acute appendicitis and diabetic foot were the most common cause of admissions.</p> <p>87 (49.1%) patients underwent surgery and 69 (39%) were managed conservatively, while 20 (11.3%) left against medical advice.</p> <p>1 patient was referred to a higher centre immediately after admission.</p>
Noweir et al., 2008  Study of heat exposure during Hajj (pilgrimage)	To evaluate the climatic heat load in Hajj locations during summer of 1995 as well as just before and during the Hajj season of 1997	1995–1997		Pilgrims in Hajj 1995 and 1997		Visual survey and heat stress monitor	<p>Highest WBGTs were at Haram Court, Ghazzah area and Muna housing area, followed by Arafat areas and Muzdalefah, and the lowest at Azizia area.</p> <p>All WBGTs were considerably higher than the ACGIH-TLV for safe heat exposure, particularly during daytime. Heat exposure considerably exceeded the ASHRAE comfort zone at all locations all times.</p> <p>The natural climatic condition is a major contributing factor to the overall heat load; it is potentiated by heat dissipated from Hajj activities, including Hajeej crowds, human activities, and vehicle exhaust.</p> <p>This situation is further synergized by some pilgrims' misbehaviour (e.g. living in open sunny areas, using vehicles without roofs) and lack of awareness of the seriousness of heat exposure.</p>
Madani et al., 2006b  Steady improvement of infection control services in six community hospitals in Mecca following annual audits during Hajj for four consecutive years	Evaluate impact of annual review of infection control practice in all Ministry of Health hospitals in Mecca during the Hajj 2003–2006	2003–2006		All Ministry of Health hospitals Mecca	6 community hospitals in Mecca	Standardized checklists	<p>Deficiencies observed in the first audit included lack of infection control committees, infection control units, infection control educational activities, and surveillance system and shortage of staff.</p> <p>These deficiencies were resolved in the subsequent audits. The average (range) scores of hospitals in 11 infection control items increased from 43% (20–67%) in the first audit to 78% (61–93%) in the fourth.</p>



**Table 1 Results of literature review (continued)**

Refs	Objective	Hajj year	Study design	Population	Sample Size	Data collection	Results
Shakir et al., 2006  Outpatient services during (1423h) Hajj Season	Analyse the pattern of patients attending the outpatient department during the Hajj season with respect to their age, sex, nationality, services provided to them, and most importantly the disease trends and the medication given	2003	Cross-sectional	Pilgrims who sought outpatient service during Hajj 2003		Standard "Blue Form"	<p>3876 patients arrived at outpatient department and 3856 were registered. 1282 (33%) cases were Hajj patients and 873 (22%) were male. The Hajj patients were mostly non-Saudi (30.8%).</p> <p>384 (26.1%) patients were from the Middle East. The largest category, 240 (6.2%), of Hajj patients were aged 51–60 yr.</p> <p>The medical clinic was attended by the maximum number of patients (1675; 43.4%), and respiratory disease cases (1582; 41%), were the commonest. Followed by diseases of genitourinary system (750; 19.5%), injury, poisoning and certain other consequences of extra causes of death (226; 5.9%), diseases of skin and soft tissue (273; 7.1%), diseases of gastrointestinal tract (261; 6.8%), diseases of musculoskeletal system and connective tissue (176; 4.6%), disease of circulatory system (121; 3.1%), infectious and parasitic diseases (89; 2.3%), and the least was diseases of ears and mastoid process (67; 1.7%).</p> <p>Single medication as monotherapy accounted for 3644 (94.5%) patients.</p>
Ghabrah et al., 2007  Assessment of infection control knowledge, attitude and practice among healthcare workers during the Hajj period of the Islamic year 1423 (2003)	Assess hospital infection control KAP of HCWs during the Hajj season 2003	2003	Cross-sectional KAP	Doctors and nurses working in all Mena and Arafat hospitals and primary healthcare centres who were attending Hajj-medicine training programs	392	Questionnaire	<p>315 (80.4%) HCWs worked in hospitals, whereas 77 (19.6%) worked in primary healthcare centres.</p> <p>81.8% of HCWs correctly answered at least 5 of the 11 knowledge statements. However, obvious deficiency of knowledge appeared concerning other important hospital infection control measures.</p> <p>61.9% of HCWs achieved a score of at least 4 out of 7 for attitude statements, with unacceptable attitude for the remaining 3 areas.</p> <p>Response to questions concerning practice showed that nurses tended to be better than doctors, but both groups reported variable compliance to hospital infection control practices in terms of strict or near-strict adherence.</p>
Al-Ghamdi and Kabbash. 2011  Awareness of healthcare workers regarding preventive measures of communicable diseases among Hajj pilgrims at the entry point in Western Saudi Arabia	Determine the level of knowledge of HCWs towards preventive measures for communicable diseases among pilgrims, and to highlight the difficulties faced by HCWs in implementing preventive measures at entry point	2009	Cross-sectional	All HCWs assigned at the Hajj terminals of King Abdulaziz International Airport during the 2009 Hajj season	325	Questionnaire	<p>Difficulties reported by HCWs were refusal of vaccination or chemoprophylaxis by some pilgrims, language barriers, and difficulties in organizing pilgrims.</p> <p>The different items related to meningococcal meningitis were answered correctly by most HCWs, except for paediatric preventive measures.</p> <p>Less than half were aware of the period of validity for yellow fever vaccine certification and measures to be taken for unvaccinated pilgrims.</p> <p>Only 32.9% were aware of preventive measures that should be applied against influenza A (H1N1).</p> <p>Physicians, those reading guidelines, and those with high experience showed significantly better level of knowledge than other categories.</p>

**Table 1 Results of literature review (concluded)**

Refs	Objective	Hajj year	Study design	Population	Sample Size	Data collection	Results
Al-Hoqail et al., 2010  Pilgrims satisfaction with ambulatory health services in Mecca, 2008	Assess the level and correlates of patients' satisfaction with ambulatory health services provided for pilgrims during Hajj period in 2008	2008	Cross-sectional	Pilgrims patients who seek ambulatory health service in Hajj 2008	478	Questionnaire	Total satisfaction score for health facilities was 20.45 (4.03) out of 25. Satisfaction scores were 20.15 (4.7) out of 25 for patient satisfaction with physicians and 21.35 (4.5) for patient satisfaction with paramedical personnel. Overall satisfaction score was 61.5 (4.5) out of 75. There were significant relations between total satisfaction of health facilities with education level and occupation Total satisfaction of patients with physicians was significant only with education level. Overall satisfaction score had a significant relation with occupation, but a borderline relation with education level.
Saeed et al., 2012  Occurrence of acute respiratory infection, diarrhea and jaundice among Afghan pilgrims, 2010	Determine the prevalence of 3 syndromes of interest: diarrhoea, ARTI and jaundice-among Hajjis gathering at the 4 transit sites in Afghanistan before, during, and after their voyage	2010	Cross-sectional	Afghan pilgrims in Hajj 2010	1659	Questionnaire	Occurrence of diarrhoea and jaundice remained constant over time. ARTI increased from 1.4% at pre-transit to 4% at transit area and 37% during the Hajj. ARTI rates among residents from Central and Northern Afghanistan were significantly higher at the post-Hajj stage, at 50% and 69%, respectively. There was no difference in ARTI by sex among Hajjis.
Madani et al., 2006a  Causes of hospitalization of pilgrims in the Hajj season of the Islamic year 1423 (2003)	Identify the pattern of diseases, complications, and outcome of pilgrims who require hospitalization during the Hajj period	2003	Cross-sectional	All patients admitted to 4 hospitals in Mena and 3 in Arafat in the Hajj season of 2003	808	Medical records	79% of patients were aged > 40 years. There was no sex preponderance. 575 (71.2%) patients were admitted to medical wards, 105 (13.0%) to surgical wards, and 76 (9.4%) to ICU. Most patients (84.8%) had 1 acute medical problem. Pneumonia (19.7%), ischemic heart disease (12.3%), and trauma (9.4%) were the most common admitting diagnoses. 39% had comorbid conditions. 644 (79.7%) patients were discharged from the hospital in stable condition to continue therapy in their residential camps; 140 (17.3%) were transferred to other hospitals in Mecca for specialized services or further care; 19 (2.3%) were discharged against medical advice; and 5 (0.7%) died.
Deris et al., 2009  Preference of treatment facilities among Malaysian Hajj pilgrims for acute respiratory tract symptoms	To determine the choice of health facilities among Malaysian Hajj pilgrims for acute respiratory symptoms	2007–2008	Cross-sectional	Madinatual-Hujjaj, Jeddah, and Tabung Haji clinic, Madinah, Saudi Arabian pilgrims stayed on transit before returning to Malaysia	394	Questionnaire	375 of 394 (95.2%) patients had more respiratory symptoms, 355 with cough, 308 with runny nose, 230 with fever, and 222 with sore throat. 61 (16.3) were taking self-medication, and 278 (74.1%) sought treatment from Tabung Haji clinic. 11 (2.9) were admitted to hospital, 62 (16.5%) did not take any treatment for acute respiratory symptoms. Some of them sought more than 1 type of treatment.

ACGIH-TLV = American Conference of Governmental Industrial Hygienists Threshold Limit Value; APACHE IV = Acute Physiology and Chronic Health Evaluation IV; ARTI = acute respiratory tract infection; ASHRAE = American Society of Heating, Refrigerating and Air-Conditioning Engineers; COPD = chronic obstructive pulmonary disease; EC = ; ENT = ear, nose and throat; HCW = healthcare worker; LAV = influenza A virus; IBV = influenza B virus; ICU = intensive care unit; ICV = influenza C virus; IMD = invasive meningococcal disease; IV = influenza virus; KAP = knowledge, attitude and practice; MERS-CoV = Middle East respiratory syndrome-related coronavirus; MPV = metapneumovirus; MRSA = methicillin-resistant *Staphylococcus aureus*; MSIS = Mashhad Stroke Incidence Study; PCR = polymerase chain reaction; PGFE = pulsed-field gel electrophoresis; PHS = public health service; RSV = respiratory syncytial virus; SA = Saudi Arabia; ST = ; TB = tuberculosis; TdP = tetanus, diphtheria, poli; URTI = upper respiratory tract infection; VR = ; WBGT = wet bulb globe temperature.