

# Health services in Saudi Arabia during hajj pilgrimage

## Abstract

The Hajj pilgrimage significantly impacts Saudi Arabia, particularly in healthcare. Saudi Arabia offers free healthcare to pilgrims via hospitals and health centers, essential for managing millions of pilgrims. The high demand during Hajj drives nursing reforms, integrating advanced medical technologies, professional development, and international standards.

**Purpose:** This study examines Hajj's influence on healthcare services and nursing reforms, aligning with Saudi Vision 2030 goals. **Patients and methods:** This study is a nationwide census survey conducted the analysis of the selective indicators during mass gatherings like the "Hajj Pilgrimage". The study employs secondary data of six selected indicators (visits to PHCs; emergency encounters; visits to outpatient departments; admissions to hospital; heat exhaustion cases; heat stroke cases and efficacy of nurses' performance).

**Results:** Analyzing data from 2015-2019, the study shows a consistent increase in healthcare professionals, with nurses crucial in patient care. The study highlights the importance of non-human resources like health facilities and emergency departments in meeting pilgrims' healthcare needs. Professional development programs have significantly improved nursing performance, with job satisfaction rates among nurses reaching over 85% by 2022.

**Conclusion:** Findings underscore the necessity for early preparations, continuous training, and strategic resource allocation to enhance nursing care during mass gatherings like Hajj. This comprehensive approach supports Vision 2030, aiming to create a flexible, responsive healthcare infrastructure capable of meeting large-scale event demands, ensuring the health and safety of all pilgrims.

**Keywords:** nursing reforms, healthcare services, Saudi vision 2030, hajj pilgrimage, mass gathering, public health preparedness

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## Introduction

The planned annual Hajj to the sacred shrines of Makkah, Saudi Arabia, is one of the world's most significant recurring religious mass gatherings. It represents one of the world's greatest peaceful gatherings embracing globalization in an environment of diversity.<sup>1</sup> The Hajj pilgrimage holds unparalleled significance for Saudi Arabia, serving as a cornerstone of Islamic faith and a critical aspect of the country's cultural and historical identity. In the broader context of the transformative Saudi Vision 2030, the importance of the Hajj pilgrimage has become even more pronounced. The pilgrimage not only symbolizes spiritual devotion but also plays a central role towards the Kingdom's strategic planning, particularly in the healthcare sector.<sup>2</sup>

The provision of health care facilities to 2.5 million people who congregate for a short period of time in a very compact region is a significant challenge to government officials.<sup>3</sup> Mass gatherings where social distancing and contact avoidance are difficult because pilgrims are required to perform various rituals in close proximity with others, in a sequential manner, either daily or weekly, as per their religious tenets, necessitating the development of safety procedures by local authorities to mitigate the challenges of keeping attendees safe.<sup>4</sup> The growing number of pilgrims poses a challenge to global health security, as well as housing, food, water, transportation, communication, sanitation, crowd control, and security.<sup>1</sup> Supporting pilgrims with temporary accommodations; meeting the pilgrims' chronic and acute health needs, the provision of clean and safe food and water adequate for millions of pilgrims transported to the Hajj sites (pilgrims are prohibited from preparing food themselves due to fire and infection risk), and the expansion of the Kingdom's existing

health infrastructure to meet the needs of the surge of pilgrims stationed in the three-month Hajj season all necessitate intense multifaceted multi-agency planning.<sup>5</sup> Despite the Saudi government's annual investments in infrastructure to avoid overcrowding and crowd crush accidents, as well as technical advancements for crowd monitoring and management, pilgrims remain concerned.<sup>4</sup>

It is widely recognized that mass gatherings with the concentration of a large, diversified population in one location increase the danger of contracting and spreading infectious diseases, particularly respiratory infections.<sup>6-8</sup> Infectious infections in large numbers (53.26%) present a multifaceted concern during Hajj. Respiratory infections are common and easily transmitted during Hajj, resulting in significant morbidity, an increased burden on existing health facilities, overwhelming costs on health systems, and the global spread of multiresistant pathogens.<sup>1</sup> The high incidence and transmissibility of respiratory diseases in the Hajj setting continue to pose a considerable health risk. The severity of the possible health dangers associated with the Hajj became clear in 2020, when a global coronavirus pandemic was declared.<sup>7</sup> A risk priority score revealed that human stampedes and person-to-person infectious diseases were the most serious threats to pilgrims.<sup>4</sup> COVID-19 has significantly surpassed earlier pandemics that threatened the Hajj, such as SARS and MERS-CoV.<sup>9</sup> Saudi Arabia's position as a top authority on mass gathering medicine has made the country better prepared to confront a possible coronavirus pandemic.<sup>7</sup> Saudi Arabia successfully managed the challenges of the COVID-19 pandemic during the annual Hajj season during the year 2020 & 2021, implementing proactive measures to protect pilgrims. The Saudi Ministry of Health released a series of preventative health measures prior to each Hajj cycle. In addition to these precautions, health information was made available for pilgrims from a variety

of sources prior to their Hajj journey. Studies have consistently demonstrated that pre-travel health preparation, including educational opportunities, improves the health outcomes of overseas travelers.<sup>7</sup> Moreover, the international recognition from the World Health Organization underscored Saudi Arabia's exemplary efforts.<sup>10</sup> The government's commitment to the Hajj season was evident in a significant budget allocation, offering free healthcare to all pilgrims.<sup>11</sup> Overall, Saudi Arabia's success in managing the Hajj season during the pandemic has indeed set a global standard for the organization of large religious events in challenging times.

In fact, congestion, tiredness, occasionally high temperatures, and disruptions in the body's fluid and electrolyte levels have been all considered as contributing factors to variety of diseases during Hajj.<sup>3</sup> According to the study by AlJahdali et al.,<sup>6</sup> the most common health conditions are respiratory disorders, musculoskeletal complaints, and skin diseases. Moreover, heat exhaustion and heatstroke, in addition to cardiovascular illness, and health-related morbidity is worsened when Hajj takes place during the summer months.<sup>12,13</sup> Taibah et al.,<sup>4</sup> discovered that heatstroke, vomiting, diarrhea, pre-existing health issues, and epidemics were all viewed as major health hazards by pilgrims. The study by Alrufaidi et al.,<sup>12</sup> further revealed that cardiovascular disorders were the most common preliminary diagnoses among emergency cases, followed by respiratory diseases. The most prevalent comorbid conditions were hypertension, diabetes, bronchial asthma, and ischemic heart disease. This could be because most Islamic countries' Hajj policies prioritize individual Hajj performance among adults over the age of 40.<sup>3</sup> Elderly pilgrims are more vulnerable to illnesses due to overexertion, insufficient sleep and rest, disruption of dietary routine and food kinds, and the inability to manage major medical conditions due to diminished immune function.<sup>8</sup> The threat of mass casualty disasters has grown dramatically over the years. Stampedes, crashes, fires, and accidents are all examples of mass casualty situations. The occurrence of mass casualty disasters is constantly unpredictable. It is crucial to recognize that various mass casualty incidents have occurred in recent years.<sup>7</sup> Thus to keep local and visiting pilgrims safe from crowds, sunstroke, skin infections, and communicable diseases, the Saudi government must invest heavily in health communication and prevention measures each year.<sup>4</sup>

Throughout the history of Hajj, and in recognition of global advances in health care and public health preparedness, the Saudi government has prepared and addressed the needs of millions of international and domestic pilgrims from the start to the end of the mass gathering.<sup>5</sup> The Kingdom of Saudi Arabia's Ministry of Health places a great value on providing high-quality health services to Hajj and Umrah pilgrims as they complete their rituals. They strive to provide comprehensive and safe health care to pilgrims and Umrah performers by providing the necessary infrastructure, well-equipped medical facilities, and qualified and specialized medical teams.<sup>14</sup> These facilities are outfitted with cutting-edge medical technology and equipment to suit the treatment and health care requirements of pilgrims and Umrah pilgrims.<sup>14</sup> State-of-the-art surgical wards and intensive care units are made specifically available for pilgrims, all medical facilities provide high-quality care, and services are provided free of charge to Hajj pilgrims to reduce the risk of illness to all pilgrims and KSA residents.<sup>13</sup>

The explicit expression of the Vision 2030 goals lies in the Kingdom's aspiration to facilitate Haj pilgrimages, with a target of accommodating up to 30 million pilgrims by 2030 with the ambitious goals of improving pilgrimage and tourism experience in Makkah. These goals were part of a larger push to improve the

country's infrastructure and services, enhancing the spiritual and cultural experiences of visitors to the holy places.<sup>6</sup> Hajj service providers are concerned with delivering high-quality logistical services and eradicating any hurdles that pilgrims may encounter, especially those relating to health and safety. To achieve this, there is a concerted effort to streamline hosting processes emphasizing effective and high-quality healthcare services. Strategically the proactive approach involves optimizing resource allocation, considering healthcare utilization data, demographic factors, and epidemiological trends to effectively address the unique healthcare needs of pilgrims. In accordance with the Kingdom's 2030 vision, the Ministry of Health strives to deliver sophisticated free medical treatments to pilgrims by implementing digital transformation. The goal is to transform service delivery on a high and integrated level, through healthy and innovative environments that continuously support healthcare services and enable sectors to provide speedier as well as cost-effective services.<sup>15</sup> In this respect, Sabr et al.,<sup>14</sup> survey data revealed insights into pilgrims' perceptions (6247) of healthcare services offered during their trip, such as accessibility, quality, and satisfaction levels. Their research findings highlighted the potential benefits of improved healthcare access, enhanced illness surveillance, and prompt emergency response as well as the efficient collaboration among the Ministry of health, the Saudi Commission for Tourism and National Heritage, as well as other health agencies, to guarantee that visitors receive comprehensive and integrated care.

The Hajj pilgrimage has also been a driving force behind Saudi nursing reforms. The sheer volume of pilgrims necessitates a robust and responsive healthcare workforce, highlighting the need for continuous improvement and adaptation in nursing practices. Factors such as the integration of advanced medical technologies, ongoing professional development, and the implementation of international healthcare standards are crucial in shaping the future of nursing in Saudi Arabia. Studies have shown that professional development strategies significantly enhance the quality of nursing care in Saudi Arabia.<sup>16</sup>

The provision of healthcare services, particularly nursing care, is crucial during the Hajj pilgrimage. Nurses played a vital role in overseeing and providing immediate care in crowded and challenging situations. The Saudi Ministry of Human Resources and Social Development said that over 100,000 volunteers help in providing health, organization, and other services during Hajj. These endeavors are a component of the Kingdom's Vision 2030 strategy. Volunteering during Hajj provides nurses with a unique opportunity to serve others, enhance their faith, and obtain significant professional experience in a challenging environment.<sup>17</sup> Interacting with healthcare professionals from other backgrounds encourages the exchange of knowledge and best practices, allowing nurses to improve professionally and gain new skills and insights into global healthcare concerns.<sup>17</sup>

Alrashdi and Al Thobaity's<sup>17</sup> study emphasizes the need of healthcare volunteers, particularly nurses, in supporting the efficient operation of huge events such as the Hajj. The data show that personal satisfaction, career advancement, and spiritual fulfillment are important motivators for volunteering. However, gaps in training and preparation, as well as inconsistencies in the delivery of practical skill workshops, indicate possibilities for development. To improve volunteer readiness and performance, extensive training and practical skill workshops targeted to the volunteers' needs should be provided. Future research should look into the long-term impacts of volunteering on professional development and personal well-being, as well as the efficacy of recruitment and training initiatives. Recognizing the cultural and religious components of volunteering during Hajj can

also assist in tailoring these initiatives. The findings of this study can be applied to volunteer programs in a variety of settings, ultimately helping the larger healthcare community.<sup>17</sup>

The AlKarani<sup>18</sup> study was the first to investigate the motives that cause nurses to participate in the Hajj season, as well as the problems that working nurse's encounter during the Hajj. The goal of this study is to investigate the motivations that drove Saudi nurses to participate in Hajj, as well as the challenges that Saudi nurses face when working as nurses in Hajj. It was shown that helping individuals during religious practices gave nurses a sense of respect and pride. Similarly, a study discovered that professional identity is critical for nurses. As a result, they place a high value on honor and see it as a major source of motivation in their jobs. Furthermore, nurses in this study reported that Islamic values emphasized good deeds. The participants went on to say that their volunteering was motivated by the desire to do good and eventually seek reward from God.<sup>18</sup>

Saudi Arabia's Vision 2030 places significant importance on nursing as a key objective, enabling nursing staff to actively participate in healthcare decisions. Over time, nursing has evolved into a scientific discipline requiring specialized education and advanced clinical skills. The vision also supports the establishment of graduate programs to improve nursing proficiency, aiming to address the global demand for nursing professionals and reduce unemployment.<sup>19</sup>

Based on the MOH's nursing education and training programs preceding the Hajj in 2018; which included a total of 320 trained nurses, the overall nursing satisfaction reached 78.9%, equivalent to a score of 3.95 out of 5. The number of nurses increased to 784 in 2019, achieving a total satisfaction rate of 84%, corresponding to a score of 4.2 out of 5. By 2022, the total nursing workforce expanded to 1,383, achieving a satisfaction rate of 85.2%, equivalent to a score of 4.26 out of 5.20 It is vital to initiate early preparations for implementing nursing performance systems during Hajj, this includes conducting workshops to elucidate the mechanism of statistics and data entry, along with nursing training in the Health Information System (HIS) program well in advance of the Hajj season. Furthermore, it is also essential to increase training opportunities both before and during the Hajj season to enhance nursing performance and raise awareness, ensuring the provision of optimal nursing practices for pilgrims. It is also advised to encourage professionals to pursue advanced specialized courses as part of the comprehensive strategy to improve nursing capabilities and readiness.<sup>19,21</sup> The selection process for nursing staff during Hajj season considered fundamental qualification criteria, including scientific and clinical proficiency in critical departments and possession of basic skills certifications in cardiopulmonary resuscitation to guarantee the safety and quality of nursing care. These criteria encompassed factors such as experience in previous Hajj seasons and clinical proficiency in specialized departments like medical care, critical care, cardiac intensive care, emergency, and operations.<sup>20</sup> To safeguard the health and safety of the diverse group of pilgrims, healthcare services -particularly nursing care- play a crucial role during the Hajj.

## Study Objectives

This study examined Hajj's influence on healthcare services and nursing reforms, aligning with Saudi Vision 2030 goals. The specific aims of this study were:

1. To assess pilgrim accessibility to health services including: PHCs and outpatient departments visits; emergency encounters in the hospital departments; admissions to the hospital departments.

2. To assess heat exhaustion as well as heat stroke cases among pilgrims.
3. To assess the distribution of health professionals during pilgrimage (physicians, nurses, pharmacists, medical assistants).
4. To compare the impact of human resources health indicators such as physicians, nurses, pharmacists, and medical assistants. Additionally, the effect of non-human resources such as permanent and seasonal health facilities, hospitals departments, emergency hospitals departments, outpatient departments, and primary health care centers during mass gathering before and after the Saudi Arabian Vision 2030 implementation.
5. To explore the factors that have an impact on enhancing nursing services reform while also trying to achieve outstanding results.

## Research Questions

How do non-human resources, such as health facilities and emergency departments, contribute to the effectiveness of healthcare services during the Hajj pilgrimage?

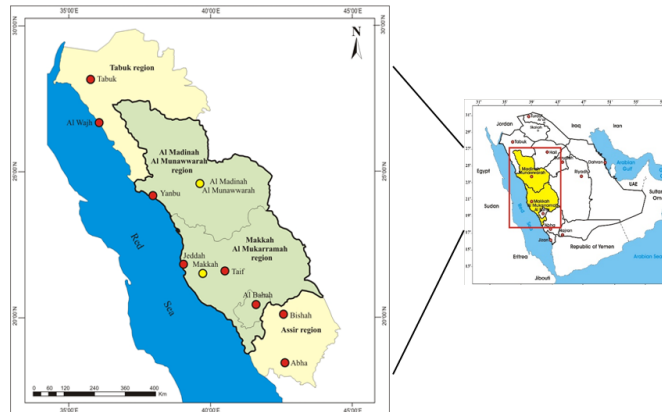
## Material and methods

### Study Design

This study is a nationwide census survey conducted the analysis of the selective indicators during mass gatherings like the "Hajj Pilgrimage" to detect factors that impact the nursing reform and healthcare services. Strengthening the Reporting of Observational studies in Epidemiology (STROBE) guidelines were followed.

### Setting

The study was conducted in Makkah Al-Mukarramah and Al-Madinah Al-Munawarah cities located between the latitudes 17° and 30° North and the longitudes 34°50' and 45° and 45° East (Figure 1).



**Figure 1** Geographic location of the study area.

Makkah is the third most populated city in Saudi Arabia. Al-Madinah is the fourth most populous city in Saudi Arabia. Makkah and Al-Madinah are 70 and 250 km inland from Jeddah on the Red Sea, respectively. They fall in a hot desert climate region. Summers are extremely hot and dry.

### Data Sources and Measures

The study employs secondary data of six selected indicators. First, pilgrim visits to PHCs; secondly, pilgrim visits to emergency encounters in the hospital departments; third, pilgrim visits to the outpatient departments; fourth, pilgrim admissions to the hospital



departments; fifth, heat exhaustion cases among pilgrims; and finally, heat stroke cases. Ethically, the data is anonymous and is freely available on the Internet. The authors acknowledged the data source, and it is adequate, relevant but not excessive. The data was extracted from different data sources. First, it collected from the statistical yearbooks of the last five years 2015-2019.<sup>22</sup> The period 2015-2019 was selected for the major reason that detailed data about the manpower devoted to Hajj period is presented. Next, key health indicators from the statistical yearbook period from 2015 to 2022 were reviewed. The final source is data extracted from an efficiency study about nursing performance during the 2018 and 2019 Hajj seasons. Tables 1, 2, and 3 lists the number of pilgrims from inside and outside the Kingdom;

a summary of selected indicators; and the distribution of manpower devoted to the Hajj period from 2015 to 2019 (Tables1-3).

**Table 1** Total pilgrims from inside and outside the Kingdom of Saudi Arabia during the studied period

Year	Inside Pilgrims	%	Outside Pilgrims	%	Total
2015	567876	29	1384941	71	1952817
2016	537537	29	1325372	71	1862909
2017	600108	26	1752014	74	2352122
2018	612953	26	1758721	74	2371675
2019	634379	25	1855027	75	2489406
<b>Total</b>	<b>2952853</b>	<b>26.8</b>	<b>8076075</b>	<b>73.2</b>	<b>11028929</b>

**Table 2** Ministry of Health manpower devoted to Hajj period

Year	Consultant Physician	Registrar Physician	General Physician	Pharmacist	Nurses	Allied Health Personal	Total Health Providers
2015	953	985	2595	1091	7441	6529	19594
2016	723	1089	2571	1335	8202	6075	19995
2017	795	1221	2740	1403	8764	7020	21943
2018	809	1282	2780	1433	8704	7613	22621
2019	897	1299	2830	1334	8814	7131	22305
<b>Total</b>	<b>4177</b>	<b>5876</b>	<b>13516</b>	<b>6596</b>	<b>41925</b>	<b>34368</b>	<b>106458</b>

**Table 3** The Pilgrims visits for the ministry of health services during Hajj period

Makkah	Madinah	Mena	Arafat and Mozdalifa	Total
87785	-	88705	50334	226824
60689	195712	204759	38276	499436
120305	138986	112786	41161	413238
100172	252137	170677	43633	566619
104370	212415	150491	23266	490542
13877	-	5240	2279	21396
9252	3757	4537	1053	18599
32035	3720	5211	1333	42299
40225	6051	4538	1220	52034
48643	8142	4997	1352	63134
23336	-	38950	8009	70295
14328	13236	44244	7841	79649
25808	3710	40311	8504	78333
33262	12745	37097	7842	90946
1319	9843	36960	6404	54526
2908	694	1990	1307	6899
1652	611	1297	654	4214
3881	845	1349	932	7007
3459	753	1491	550	6253
3779	834	1518	532	6663

Note, these patterns as depicted in table 3, when considered alongside the increasing number of healthcare professionals and high job satisfaction rates among nurses (as reported elsewhere in the study), indicate an overall improvement in the effectiveness and capacity of healthcare services during Hajj from 2015 to 2019.

### Data Analysis

We summarized findings using frequency and percentage for categorical variables and means and standard deviations for numeric variables using SPSS Software 2022. The authors employed various statistical parameters of the descriptive statistics such as central

tendency and the measurements of dispersion to analyze the data. In addition, the Shapiro-Wilk test was used to determine the normality distribution of the data on the number of pilgrims and the health manpower such as consultants, registrars, general physicians, nurses, pharmacists, and allied health personnel. Data distribution of healthcare professionals (e.g., nurses, physicians) was analyzed using descriptive statistics to assess how human resources are allocated during the Hajj and how this aligns with the demands of the pilgrimage. However, data on the availability and usage of health facilities and emergency departments will be analyzed to determine their impact on the overall healthcare service delivery. This analysis will focus on metrics such as patient admissions, service coverage, and capacity utilization. We will also analyze the capacity utilization of health facilities and emergency departments using data on patient admissions and services provided. This analysis will help determine the effectiveness of these resources in managing the health needs of pilgrims.

Moreover, the pilgrims' visits of the different health care services such as hospitals and primary centers located in Makkah, Mena, Arafat, Muzdalifah, and Al-Madinah were analyzed. The spatial distribution of the findings was presented using the mapping and graphic approach.

## Results

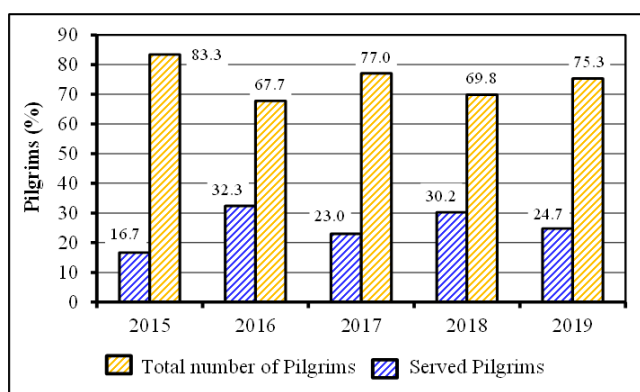
To attain the purpose and objectives of the study, the normality distribution of the selected extracted data was determined using the Shapiro-Wilk test. The data showed normal distribution with p-values greater than 0.05. Table 1 presents the total number of pilgrim visitors, which reached 11,028,929 during 2015-2019, with 2,952,853 from inside the Kingdom and 8,076,076 from outside the Kingdom, equivalent to 26.8% and 73.2% of the total pilgrim visitors during the study period. Nevertheless, the number of pilgrims varied from year to year, ranging between 1,862,909 in 2016 and 2,489,406 in 2019, equivalent to 16.9% and 22.6% of the total cumulative pilgrim count. Table 4 reveals that the number of pilgrims is normally distributed with a significance level of 0.873 for inside pilgrims, 0.155 for outside

pilgrims and 0.233 for the total number of pilgrims at a degree of freedom of 5 (Table 4).

**Table 4** Distribution pattern of the pilgrims visits of the different health care centers during the period 2015-2019

Location		Sig.	df	Null Hypothesis
PHCs	Makkah	0.804	5	Accepted
	Al Madinah	0.36	5	Accepted
	Mena	0.937	5	Accepted
	Mouzdalifh and Arafat	0.561	5	Accepted
	Total	0.58	5	Accepted
Hospitals ER	Makkah	0.591	5	Accepted
	Al Madinah	0.85	5	Accepted
	Mena	0.114	5	Accepted
	Mouzdalifh and Arafat	0.053	5	Accepted
	Total	0	20	Rejected
OPDs	Makkah	0.796	5	Accepted
	Al Madinah	0.348	5	Accepted
	Mena	0.328	5	Accepted
	Mouzdalifh and Arafat	0.161	5	Accepted
	Total	0.017	20	Rejected
Hospitals Departments	Makkah	0.229	5	Accepted

In figure 2, the data illustrated the number of pilgrims served by the health services available in healthcare centers and hospital departments varied from year to year, ranging between 325,414 in 2015 and 715,852 in 2018, equivalent to 16.7% and 30.2% of the total cumulative pilgrim count (Figure 2. Frequency of the pilgrim visits to the MOH services devoted to Hajj).



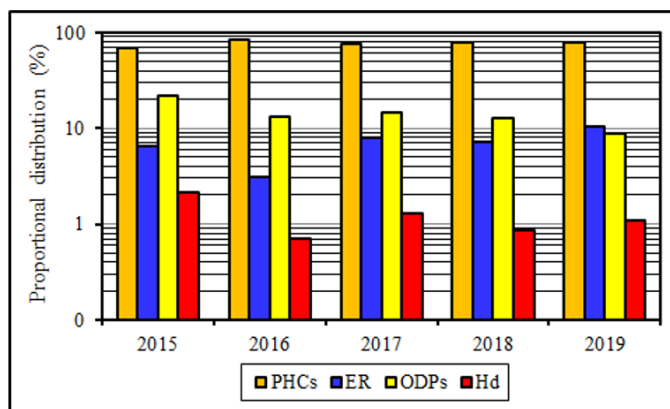
**Figure 2** Frequency of the pilgrim visits to the MOH services devoted to Hajj.

Furthermore, the data illustrated that health services were provided to pilgrims through different healthcare service settings in Table 5 and Figure 2.

**Table 5** Pilgrim victors to ministry of health services devoted to hajj

Health Services		2015	2016	2017	2018	2019	Total
PHCs	N	226824	499436	413238	566619	490542	2196659
	%	69.7	83	76.4	79.2	79.8	78.5
Emergency	N	21396	18599	42299	52034	63134	197462
	%	6.6	3.1	7.8	7.3	10.4	7.1
OPDs	N	70295	79649	78333	90946	54526	373749
	%	21.6	13.2	14.5	12.7	9	13.4
Hospital Departments	N	6899	4214	7007	6253	6663	31036
	%	2.1	0.7	1.3	0.9	1.1	1.1
<b>Total</b>		<b>325414</b>	<b>601898</b>	<b>540877</b>	<b>715852</b>	<b>614865</b>	<b>2798906</b>

The total number of visitors who received health care were 2,798,906. The percentage of visitors who received care from PHCs ranged between 69.7% in 2015 to 79% in 2019 of the total pilgrims' visitors in Makkah, Mena, Arafat, Muzdalifah and Al-Madinah. Meanwhile, the percentage of pilgrims served by EMS available in hospital departments fluctuated from year to year (Figure 3. The distribution of total pilgrims and served pilgrims during 2015-2019). In 2015, it was 6.6% and in 2019, it increased to 10.4% of the cumulative total of pilgrims. Moreover, the OPDs served pilgrims ranging from 70,295 in 2015 to 54,526 in 2019, equivalent to 21.6% to 9.0% of the cumulative total of pilgrims, respectively. On the other hand, the pilgrims' admissions to hospital departments reached a total of 31,036 visitors in the five studied years, ranging between 6,899 in 2015 and 6,663 admissions in 2019.



**Figure 3** The distribution of total pilgrims and served pilgrims during 2015-2019.

Comparison between the human resources and selected indicators during the mass gathering study period from 2015 to 2019 is presented in Table 6.

**Table 6** Distribution pattern of the heat exhaustion and heat stroke cases among pilgrims during the period

Location		Sig.	df	Null Hypothesis
Heat Exhaustion	Makkah	0.156	5	Accepted
	Al Madinah	0.086	5	Accepted
	Mena	0.212	5	Accepted
	Mouzdalifh and Arafat	0.28	5	Accepted
	Total	0	20	Rejected
Heat Stroke	Makkah	0.008	5	Rejected
	Al Madinah	0.421	5	Accepted
	Mena	0.212	5	Accepted
	Mouzdalifh and Arafat	0.041	5	Rejected

The Hajj season coincided during the studied period with August-September (Summer end - Autumn beginning). It was characterized by the normal distribution of the Heat Exhaustion cases in Makkah, Mena, Arafat-Muzdalifah and Al-Madinah. However, the distribution of the cumulative total of Heat exhaustion cases (2015-2019) was different from the normal distribution. In addition, there was a normal distribution of the Heat stroke cases in Al-Madinah and Mena.

However, the distribution of Heat stroke cases in Makkah, Arafat-Muzdalifah, and the cumulative total cases from 2015 to 2019 was different from the normal distribution (Table 7).

**Table 7** Heat exhaustion and heat stroke cases among pilgrims

Heat Exhaustion						
Year	Makkah	Al Madinah	Mena	Arafat-Muzdalifah	Hajj period	Season
2015	7	2	186	214	14-24 sep.	Autumn
2016	38	1	630	345	2-12 sep.	Autumn
2017	15	1	643	307	23 aug- 2 sep.	Summer end
2018	17	8	272	25	12-22 aug.	Mi-Summer
2019	13	16	88	40	3-13 aug.	Mi-Summer
<b>Total</b>	<b>90</b>	<b>28</b>	<b>1819</b>	<b>931</b>		
Heat Stroke						
Year	Makkah	Al Madinah	Mena	Arafat-Muzdalifah	Hajj period	Season
2015	8	1	57	16	14-24 sep.	Autumn
2016	163	2	324	228	2-12 sept.	Autumn
2017	38	0	170	81	23 aug- 2 sep.	Summer end
2018	15	0	30	4	12-22 august	Mi-Summer
2019	10	3	13	4	3-13 august	Mi-Summer
<b>Total</b>	<b>234</b>	<b>6</b>	<b>594</b>	<b>333</b>		

Table 7 and Figure 4 illustrate a cumulative total of 2,868 cases of Heat Exhaustion among pilgrims, with 1,819 cases in Mena, 931 cases in Arafat-Muzdalifah, 90 cases in Makkah, and 28 cases in Al-Madinah, equivalent to 63.4%, 32.5%, 3.1% and 1.0% of the total cases, respectively. The number of Heat Exhaustion cases varied from year to year between 157 cases (minimum) in 2019 and 1,014 cases (maximum) in 2016, equivalent to 5.5% and 35.4% of the total cases, respectively (Figure 4).

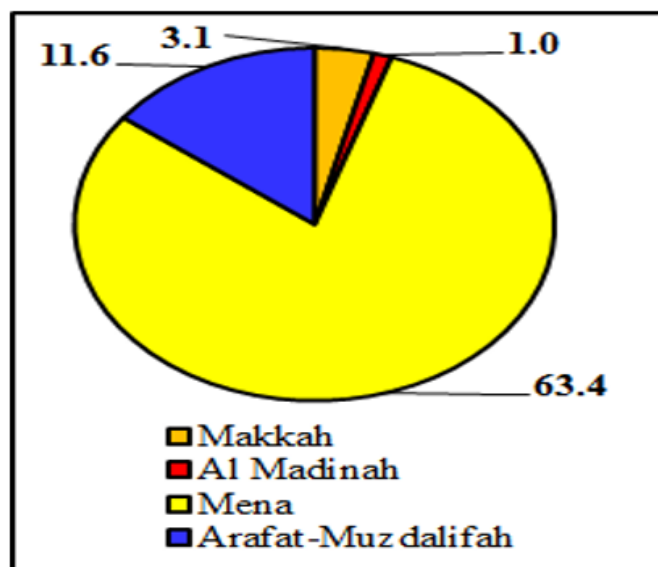
**Figure 4** The proportional distribution of Heat Exhaustion cases among pilgrims.

Figure 5 presents the distribution of Heat Stroke cases, with 57 cases in Mena, 333 cases in Arafat-Muzdalifah, 234 cases in Makkah, and 6 cases in Al-Madinah, equivalent to 50.9%, 28.5%, 20.1% and 0.5% of the total cases, respectively. The number of Heat Stroke cases varied from year to year between 30 cases (minimum) in 2019 and 717 cases (maximum) in 2016, equivalent to 2.6% and 61.4% of the total cases, respectively (Figure 5).

However, the adequacy of health services provided to pilgrims in primary health care centers (PHCs) and hospital departments was assessed. The distribution of health professionals during the

pilgrimage is normally distributed with a significance level ranging from 0.100 to 0.935 at a degree of freedom of 5.

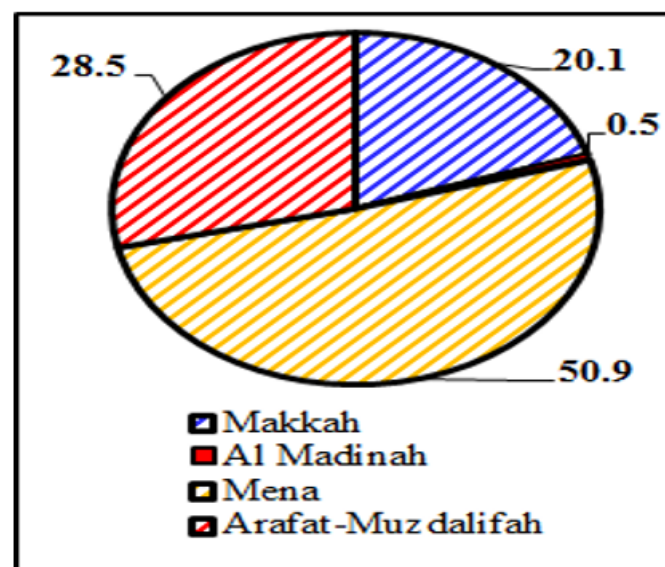
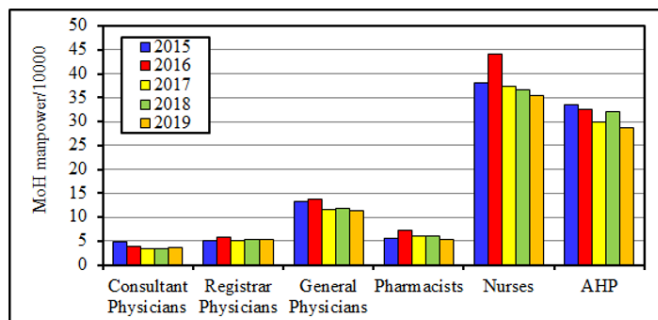
**Figure 5** The proportional distribution of the heat stroke cases among pilgrims.

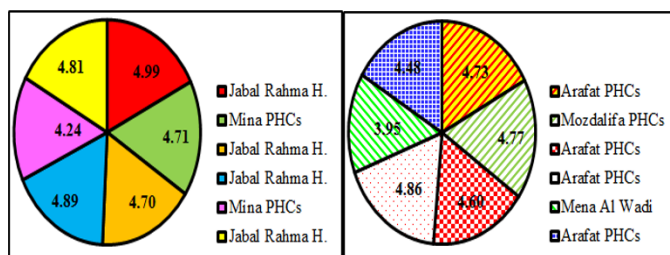
Figure 6 presents the manpower devoted to the Hajj period. It was analyzed by applying the ratio between the total number of pilgrims and the studied health indicators. The adequacy of the MOH's manpower was expressed by the distribution of the consultant physicians (CP), registrar physicians (RP), general physicians (GP), pharmacists, registrar nurses (RN), and allied health personnel (AHP) per 10,000 pilgrims. Consequently, every 10,000 pilgrims were served, on average, by 4 CP, 5 RP, 12 GP, 6 pharmacists, 31 AHP, and 38 nurses. These ratios varied from year to year and had clearly increased from 2016 to 2019 (Figure 6, 7).

To explore the factors that impact enhancing nursing services reform, nursing performance during the 2018 and 2019 Hajj was analyzed. The MOH conducted a study to measure the job satisfaction of employees using a sample of 245 nurse professionals in 2018 and 784 nurse professionals in 2019. Supervision, retention, communication,

nature of work, workload, and colleague relationships were analyzed and presented in Table 8 and Figure 7. The highest scores of 93% were for retention and nature of work (Table 8).



**Figure 6** The distribution of the MOH manpower per 10000 pilgrims.



**Figure 7** Distribution of the highest satisfaction level of nurses during hajj.

**Table 8** The nurses job satisfaction during hajj seasons

Dimensions	2018	2019
Supervision	79%	87%
Retention	86%	93%
Communication	74%	82%
Nature of Work	87%	93%
Workload	69%	66%
Colleagues relationships	79%	84%
<b>Total satisfaction</b>	<b>79.40%</b>	<b>84.00%</b>

Source: Report of Supervisory Al Hajj Committee for years 2018 and 2019.

Based on the spatial distribution of nurses' job satisfaction during the Hajj seasons, the average satisfaction level for nurses reached 4.72 (94.4%) during 2018, with rates ranging between 4.24 (84.8%) for workload and 4.99 (99.8%) for supervision. The average satisfaction level declined to 4.57 (91.4%) during 2019, with rates ranging between 3.95 (79.0%) for workload and 4.77 (95.4%) for retention. In 2019, the lowest score of 2.99 was for workload in Jabal Rahmah as shown in Table 9.

**Table 9** Spatial distribution of nurses job satisfaction during hajj seasons

Dimensions 2018	High	Site	Low	Site
Supervision	499%	Jabal Rahmah H.	3.12	Al Share Jadid H.
Retention	471%	Mena PHCs	3.6	Namirah H.
Communication	470%	Jabal Rahmah H.	2.23	Al Share Jadid H.
Nature of Work	489%	Jabal Rahmah H.	3.44	Namirah H.
Workload	424%	Mena PHCs	3.44	Al Share Jadid H.
Colleagues	481.00%	Jabal Rahmah H.	3.97	Al Share Jadid H.

Table 9 Continued.

relationships

#### Dimensions 2019

Supervision	4.73	Arafat PHCs	3.76	Mena ER H.
Retention	4.77	Muzdalifah PHCs	4.38	Jabal Rahmah H.
Communication	4.6	Arafat PHCs	3.63	Jabal Rahmah H.
Nature of Work	4.86	Arafat PHCs	4.41	Jabal Rahmah H.
Workload	3.95	Mena Al Wadi	2.99	Jabal Rahmah H.
Colleagues	4.48	Arafat PHCs	3.81	Arafat Gen. H.

relationships

From the data of the spatial distribution in Figure 7 of the satisfaction level during 2018, Jabal Rahmah Hospital is characterized by the highest values of supervision, communication, nature of work, and colleague relationships. Meanwhile, the Mena PHC center is characterized by the highest values for retention and workload. On the other hand, Al Share Al Jadid Hospital is characterized by the lowest values of supervision, communication, workload, and colleague relationships. Meanwhile, Mena Hospital is characterized by the lowest values for retention and nature of work.

Furthermore, the spatial distribution of satisfaction levels during 2019 reveals the highest values for supervision, communication, nature of work, and work relations. Notably, Jabal Rahmah Hospital stands out with the highest scores for supervision, communication, work environment, and colleague relationships among the Arafat PHC center. On the other hand, Muzdalifah hospital is characterized by the highest values for retention and workload.

## Discussion

The Saudi government's commitment to providing comprehensive services for all pilgrims is evident in the findings of this study. The results directly address our research questions and objectives, providing valuable insights into the distribution of health professionals, the impact of human and non-human resources on healthcare delivery, and the factors influencing nursing service reform during the Hajj pilgrimage.<sup>23</sup> Many pilgrims may have pre-existing medical conditions such as diabetes, hypertension, or heart disease. Consequently, the health services during Hajj rely heavily on efficient infrastructure and logistics. This includes setting up medical tents, deploying mobile clinics, and ensuring adequate supplies of medications and medical equipment.<sup>24</sup> Moreover, careful logistical planning and coordinating the deployment of resources are well-established to accomplish their duties and responsibilities. Accordingly, the health providers ensure that individuals have access to their medications, monitor their health status, and provide necessary interventions when needed during mass gatherings.<sup>21</sup>

During the Hajj season, the distribution of healthcare professionals is a critical aspect of ensuring the health and safety of pilgrims. Results presented from six selected indicators, (visits to PHCs; visits to EMS encounters in the hospital departments; visits to OPDs; admissions to the hospital departments; heat exhaustion and heat stroke cases) demonstrate that the distribution of healthcare services is meticulously planned to address the high influx of pilgrims. This strategic placement is a direct response to the increased healthcare demands and aims to improve healthcare quality have ensured that these services are not only adequately staffed but also equipped with the necessary tools



and resources.<sup>25,26</sup> For instance, the integration of advanced medical technologies has enhanced the diagnostic and treatment capabilities of these health services, leading to more efficient and effective care for pilgrims. The results show that the majority of pilgrims utilized PHCs as a preventive measure during the Hajj pilgrimage seasons, reflecting proactive public health measures, emergency preparedness, and healthcare capacity planning to ensure the well-being of pilgrims and the host population.

Addressing our first objective, the study reveals a strategic distribution of health professionals during the Hajj pilgrimage. The results show a consistent increase in healthcare professionals from 2015 to 2019, with nurses forming a significant portion of this workforce. This increase aligns with the growing number of pilgrims and the subsequent rise in healthcare utilization, particularly in Primary Healthcare Centers (PHCs) and hospital departments. The data indicates that for every 10,000 pilgrims, there were, on average, 4 consultant physicians, 5 registrar physicians, 12 general physicians, 6 pharmacists, 31 allied health personnel, and 38 nurses. This distribution demonstrates a concerted effort to meet the diverse healthcare needs of pilgrims, from preventive care to emergency services. This trend highlights the ongoing efforts to enhance healthcare services and meet the rising demand for medical care during this period. There is typically an increased presence of physicians during the Hajj season to cater to the large influx of pilgrims. These physicians include general practitioners as well as specialists in fields such as emergency medicine and internal medicine to provide immediate medical attention to pilgrims in need. Similarly, there is a surge in the number of nurses during the Hajj season to support the medical infrastructure and provide essential healthcare services to pilgrims. Nurses play a crucial role in triaging patients, administering medications, providing wound care, and offering health education to pilgrims about preventive measures and hygiene practices.<sup>27,28</sup> In addition, the allied health personnel are augmented to assist physicians and nurses in various capacities, helping to streamline healthcare delivery and ensure efficient operation of medical services during the pilgrimage.<sup>29</sup> The increase in the number of nurses and their high job satisfaction levels indicate that nursing reforms are positively impacting healthcare delivery during Hajj, aligning with the objectives of Saudi Vision 2030.

In response to our second objective, the study highlights the significant impact of both human and non-human resources on healthcare delivery during Hajj. The increase in health professionals, particularly nurses, corresponded with an improvement in healthcare service utilization and outcomes. For instance, the majority of pilgrims utilized PHCs, reflecting the effectiveness of preventive care and health education initiatives, likely spearheaded by nursing staff.

The non-human resources, such as the network of PHCs, hospital departments, and emergency services, played a crucial role in managing the health needs of pilgrims. The study shows that these facilities successfully handled the increased demand, with PHCs managing up to 79% of pilgrim health visits by 2019. This underscores the importance of infrastructure and logistics in supporting the human resources deployed during Hajj.<sup>28</sup> Understanding these indicators can help authorities and organizers better plan and manage healthcare services during pilgrimages to ensure the safety and well-being of participants.<sup>15</sup> Overall, the distribution of health professionals during the Hajj season is carefully planned to meet the healthcare needs of pilgrims, with a focus on providing comprehensive health care, rapid response to emergencies, and promoting public health awareness to ensure a safe and successful pilgrimage experience.

Addressing our third objective and the research question about factors impacting nursing service reform, the study reveals several key findings. The high job satisfaction levels among nurses, particularly in areas such as supervision, communication, nature of work, and colleague relationships, indicate that recent nursing reforms have been effective. For instance, the overall nursing satisfaction reached 85.2% by 2022, a significant improvement from 78.9% in 2018. This increase in job satisfaction correlates with the implementation of professional development programs and improved working conditions, which are key components of the nursing reform initiatives aligned with Saudi Vision 2030.

The study also highlights the critical role of nurses in managing specific health challenges during Hajj, such as heat exhaustion and heat stroke cases. The data shows a reduction in these cases over the study period, which can be attributed in part to the increased presence and effectiveness of nursing staff in preventive care and health education.<sup>20</sup>

The nursing services during the Hajj pilgrimage in Saudi Arabia are of utmost importance due to the massive influx of pilgrims from all over the world. During Hajj, millions of pilgrims gather in holy sites such as Mecca and Medina, creating significant challenges for health services and healthcare providers, including nurses.<sup>17</sup> Nursing services during Hajj must be well-prepared for emergencies. With such a large gathering of people, there is always a risk of stampedes, heat strokes, and other medical emergencies. Nurses play a crucial role in providing immediate medical assistance in such situations.<sup>27</sup> The preventive healthcare measures provided to the majority of pilgrims' care come from PHC centers, where nurses play an effective role in educating pilgrims about hygiene practices, vaccination requirements, and how to prevent common illnesses such as respiratory infections and gastroenteritis.<sup>17</sup> In PHC nurses are responsible for managing these chronic conditions, ensuring that pilgrims have access to their medications, monitoring their health status, and providing necessary interventions.<sup>30</sup>

The prevalence of certain diseases among pilgrims underscores the importance of having a well-prepared nursing workforce. Nursing reforms have emphasized continuous professional development and training, which have significantly improved the nurses' ability to manage and treat these conditions.<sup>18</sup> The implementation of quality healthcare standards has played a crucial role, ensuring that the care provided is of the highest quality.<sup>31</sup> Furthermore, the efficiency of nursing supply during the 2015 to 2019 Hajj seasons had a positive influence on delivering nursing care to all pilgrims. Data from these years show an increase in the number of nurses who successfully provided adequate nursing care, reflecting the enhanced capabilities of the nursing workforce.

Overall, the impact of the Hajj pilgrimage on health indicators in Saudi Arabia underscores the importance of proactive public health measures, emergency preparedness, and healthcare capacity planning to ensure the well-being of pilgrims and the host population. Improvements were observed throughout the years.

## Limitations

Despite the valuable insights gained from this study, it is important to acknowledge its limitations. One significant limitation is the reliance on secondary data as the primary source of information. While secondary data provides a wealth of information, it may be subject to limitations such as incomplete records, inconsistencies, or biases inherent in the original data collection process. Additionally, the scope of available secondary data may constrain the depth of



analysis and limit the ability to explore certain variables in detail. Despite the valuable insights gained from this study, it is crucial to acknowledge and critically examine its limitations, particularly those stemming from the reliance on secondary data as the primary source of information. One significant limitation is the potential for data quality issues. The secondary data used in this study may have gaps or missing information, which could lead to underrepresentation of certain groups or phenomena, skewed results if missing data is not randomly distributed, and reduced statistical power in analyses. However, the census nature of this data provides strengths to the findings.

Another critical limitation is the scope constraints imposed by the use of secondary data. The pre-existing nature of the data limits our ability to dive deeper into specific areas of interest, which may result in a superficial understanding of complex phenomena and an inability to follow up on unexpected or intriguing findings. Furthermore, the available variables in the secondary dataset may not fully capture all relevant factors for our research questions. This limitation could lead to omitted variable bias in statistical analyses and an incomplete understanding of the phenomena under study. As a result, while our findings may be valid within the constraints of the available data, they may fail to capture the full complexity of the subject matter.

The lack of control over the data collection process presents another significant limitation. As the research team had no input into the original data gathering, we couldn't tailor it to our specific research questions. Important contextual information might be missing, and we may lack a detailed understanding of the data collection procedures. This lack of control could result in a mismatch between the available data and our research objectives, potentially limiting the depth and relevance of our findings.

Future research efforts could benefit from complementing secondary data analysis with primary data collection methods to validate findings and enhance the robustness of the study outcomes. A mixed-methods approach would allow researchers to fill gaps in the secondary data and explore emerging trends not captured in existing datasets. Second, using multiple secondary data sources to cross-verify information could increase reliability through triangulation. Third, conducting thorough sensitivity analyses would help assess the impact of potential data quality issues on study results.<sup>24</sup>

## Conclusion

The increase in pilgrim numbers over the study period necessitated a corresponding expansion and enhancement of healthcare services. The study's findings indicate a notable rise in the number of pilgrims from 2015 to 2019, which coincides with an increase in visits to PHCs and hospital departments. This surge in healthcare utilization underscores the critical role of health services in managing the well-being of pilgrims. Specifically, the data highlight the essential contributions of nurses in primary care education, prevention, and treatment, in relation to the reduction in incidence of heat exhaustion and heat stroke cases. The distribution of health professionals and their effectiveness, particularly during the Hajj season, were adequate, with specific staffing rates improving over the years. PHCs and hospital departments successfully managed the increased demand, largely due to the effective deployment of health professionals, especially nurses. The focused efforts on prevention and education in primary care services, facilitated by nurses, played a pivotal role in reducing the number of heat exhaustion and heat stroke cases. The effectiveness of the healthcare system during the Hajj season is further underscored by the high job satisfaction levels among nurses.

## Recommendations

To ensure continued improvement and effectiveness in managing the health needs of pilgrims, it is recommended to extend the investigation to the next five years (2020-2024) to assess trends and improvements over a more extended period. Based on the study's results, there may be a need for specialized training programs for healthcare staff focusing on emergency care, infectious diseases, and mass casualty management specific to the Hajj environment. Regular drills and simulations could be included to better prepare the staff for the unique challenges posed during the pilgrimage. Additionally, upgrading medical equipment and ensuring an ample supply of essential medicines is recommended. This would provide a more comprehensive understanding of the healthcare needs and the effectiveness of interventions during the Hajj season. Moreover, future studies should include a broader range of health indicators beyond heat exhaustion and heat stroke. This expansion could cover other common health issues faced by pilgrims, such as respiratory illnesses, gastrointestinal problems, and injuries, providing a more holistic view of the healthcare system's performance. Furthermore, it is essential to assess the job satisfaction of all healthcare providers, not just nurses. Understanding the perspectives of physicians, pharmacists, allied health personnel, and support staff will offer a more complete picture of the healthcare environment and highlight areas needing improvement.

## Implications for practice

The implications for practice from this research are significant, especially in the context of managing large-scale events like the Hajj. The research highlights the importance of scaling healthcare services in response to increasing demand. For healthcare providers, this underscores the need for proactive resource allocation, including staffing, facilities, and supplies, especially during peak periods. Moreover, Nurses play a critical role in primary care, prevention, and treatment, particularly in managing heat-related illnesses. This suggests that healthcare systems should prioritize training and deploying nurses effectively, emphasizing their role in patient education and preventive care.

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## Conflicts of interest

The authors report that there are no competing interests to declare.

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