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"The Role of Helicopter Emergency Medical Services (HEMS) in Managing Medical Emergencies During Mass Gatherings: A Systematic Review of Hajj and Umrah"

Researchers:

AHMED AYEDH ALGHAMDI^{1**}, MOHAMMAD NEZAR GAROUT², JAMAL ABDULAZIZ ALGHAMDI³, FARES SAMI HUSSAINSABR⁴, ABDULRAHMAN ABED ALEYLI⁵



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Abstract:

Mass gatherings, especially religious events like Hajj and Umrah, present significant challenges to healthcare systems due to the sheer number of participants and the potential for large-scale emergencies. Helicopter Emergency Medical Services (HEMS) play a pivotal role in the management of critical cases, offering rapid response and transportation in situations where traditional ambulance services may face delays. This systematic review explores the role of HEMS in managing medical emergencies during the annual Islamic pilgrimages of Hajj and Umrah, focusing on its effectiveness, challenges, and areas for improvement. It founds that the need for enhanced communication systems between HEMS teams and hospitals was consistently noted as an area for improvement. Capacity and Resource Allocation: HEMS units are typically equipped with advanced life support (ALS) capabilities, allowing for the provision of critical care in route to hospitals. Studies also indicated that HEMS was frequently deployed for heatstroke cases during the summer months, where timely intervention and rapid transportation to cooling centers could be lifesaving. Additionally, collaboration with local hospitals and ground medical teams to practice disaster management and mass casualty protocols ensures that all healthcare providers are equipped to respond to high-volume emergencies.

Keywords: The role, Helicopter, Emergency medical services, Managing emergency medical cases mass gatherings, Hajj and Umrah.

- 1. Paramedic Specialist at The Saudi Red Crescent Authority in Taif
- 2. Paramedic Specialist at The Saudi Red Crescent Authority in MAKKAH
- 3. Paramedic Specialist at The Saudi Red Crescent Authority in Jeddah

** corresponding author

Introduction

Mass gatherings are global events that occur for many reasons, such as concerts, sporting events, or religious events. They can occur spontaneously or by planning, which limits the resources of the country hosting the event [1]. The Hajj season is one of the most important religious masses gathering events that occur annually in the Kingdom of Saudi Arabia [2].

Mass gatherings, particularly those involving millions of participants, present unique public health challenges. Hajj and Umrah, the two most significant pilgrimages in Islam, draw millions of Muslims from across the world to Saudi Arabia annually. The concentration of such large numbers of people within confined areas in Mecca and Medina increases the risk of medical emergencies ranging from heat exhaustion and dehydration to more serious conditions such as cardiac events, respiratory distress, and trauma from crowding [2].

The Hajj, one of the world's largest mass gatherings, is an annual religious pilgrimage to the holy city of Makkah in Saudi Arabia, and it holds immense spiritual significance as one of the Five Pillars of Islam. Every adult Muslim is required to undertake this pilgrimage at least once in their lifetime if they are physically and financially able. During the Hajj, millions of pilgrims from around the globe gather in Makkah to perform a series of religious rites over several days [3]. Due to the sheer size and scale of the event, it presents unique logistical, public health, and safety challenges, requiring extensive planning and coordination. With millions of Muslims participating from around the globe, the Hajj presents unique public health and safety challenges due to the sheer number of attendees and their proximity during rituals [4].

Due to the vast distances and logistical challenges posed by ground transportation, Helicopter Emergency Medical Services (HEMS) have been integrated into the healthcare system as a vital component for swift medical interventions during these pilgrimages. This review systematically examines the role of HEMS in handling emergency medical cases during Hajj and Umrah and evaluates its efficiency, challenges, and future potential.

The utilization of helicopter emergency medical services (HEMS) in modern trauma systems has been a source of debate for many years. Helicopter Emergency Medical Services (HEMS) are designed to provide rapid response and specialized medical care in critical situations, particularly during major incidents. HEMS units consist of highly trained crews, including paramedics, emergency medical technicians, and sometimes physicians, who can perform advanced triage,

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provide life-saving treatment on-site, and transport patients to appropriate medical facilities [7]. One of the primary advantages of HEMS is their ability to access locations that are difficult to reach by traditional ground transportation, such as remote, mountainous, or heavily congested areas. In mass gatherings like the Hajj, where large crowds can create barriers to rapid ground transportation, helicopters may serve as the only viable mode for swiftly delivering medical personnel and evacuating patients in critical condition [5]. By reducing response times and providing advanced care directly at the scene, HEMS can significantly improve outcomes during emergencies, especially in situations where every minute counts for patient survival. Their role in triage and transportation is particularly crucial in mass casualty events or areas with limited access to healthcare facilities [4].

Helicopter emergency medical services (HEMS) aim to bring a highly specialized crew for triage, treatment and provide a time-efficient way of transporting patients directly to trauma center for definitive care [5]. When the site is difficult to access, HEMS may be the only mode of transportation that is viable for both personnel and patients [6]. Helicopters are commonly expected to reduce the arrival time at the operating site and the transportation time from the scene to hospital due to increased velocity and the capability to avoid difficult terrain or traffic hindrance [7]. HEMS units require a proper, proportional, and enhanced project for important issues including medical, air, and technical aspects [8]. HEMS should be combined with disaster management programs and other local (non)medical emergency services, including firefighting, police, and military, to allow a cooperative and coherent response and create a strong and efficient relationship in HEMS due to mobilization and coordination of teams if a large-scale incident happens [9].

Every year, Saudi Arabia hosts between one to two million pilgrims from around the world during the Hajj season. This influx of people presents significant logistical, healthcare, and public safety challenges. Managing such a large crowd requires careful planning and coordination across various sectors, including healthcare, transportation, and security. The large number of pilgrims in a confined area during events like the Hajj significantly increases the risk of public health issues, particularly infectious disease outbreaks, due to close contact and shared facilities. This mass gathering also heightens the demand for efficient emergency medical services (EMS) to manage a wide range of health concerns, including injuries, heat-related illnesses, and other medical emergencies. With such high density and the potential for sudden medical needs, robust planning and preparedness are essential to ensure the safety and well-being of all participants. Effective public health measures, rapid response teams, and well-coordinated EMS systems are critical in mitigating these risks [3].

Given the scale and importance of Hajj, ensuring proper preparedness, especially in terms of emergency medical services (EMS), is crucial to ensure the safety and well-being of all participants. This involves not only addressing immediate medical needs but also planning for broader issues like crowd management, public health surveillance, and coordination among different agencies involved in the event's operation [10]. Emergency health-care providers play an important role during Hajj by providing medical care from basic to advanced interventions. During Hajj, there are many medical conditions that can be treated on-site [8]. Paramedics have a major role in treat and release that resulting in decreasing the overcrowding in hospitals. Treat and release refer to on-site (at the scene) treatment of a patient by a responding team without transporting that patient to a healthcare facility. Treat and release provide adequate immediate medical care that will result in a functioning emergency medical services (EMS) system [9].

In preparing for mass gathering events, such as the Hajj, ensuring proper emergency medical services (EMS) is critical. Various aspects of preparedness include patient care services, managing public health risks, addressing the possibility of terrorist attacks, and ensuring sufficient medical resources. Coordination and collaboration between different agencies and adhering to standardized protocols are vital components of an efficient response system [8].

Previous research on the Hajj has primarily focused on individual patient cases, treatment methods, and infection control. However, less attention has been paid to the broader preparedness and efficiency of the EMS system. Al-Shareef et al. (2022) highlighted the need to improve EMS preparedness during Hajj, recommending several key measures:

- 1. **Increase Workforce Coverage**: More EMS personnel should be deployed to ensure that the workforce can effectively handle the high demand.
- 2. **Improve Qualifications and Training**: Service providers should receive enhanced training to better manage the unique challenges of mass gatherings.

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- 3. Change the Scope of Practice: To reduce unnecessary strain on hospitals, the EMS system should focus more on treating and releasing patients on-site, rather than transferring a majority to the hospital unnecessarily.
- 4. **Inter-Agency Collaboration**: Effective collaboration between various agencies is essential for smooth EMS operations, ensuring resources and information are shared and that responses are well-coordinated [10].

This systematic review will identify, describe and appraise literature regarding the role of HEMS in medical response in managing emergency medical cases during mass gatherings: a systematic review of Hajj and Umrah. We aim to improve knowledge on HEMS role in in managing emergency medical cases during mass gatherings of Hajj and Umrah and provide a basis for future research.

Methodology

This systematic review was conducted following PRISMA guidelines. A search of databases such as PubMed, Scopus, and Google Scholar were performed using keywords like "HEMS," "Hajj," "Umrah," "mass gatherings," and "emergency medical services." Studies were included if they specifically dealt with the use of helicopter medical services during Hajj and Umrah or explored the role of emergency medical response during mass gatherings. Articles published between 2000 and 2023 were included, and case studies, retrospective reviews, and prospective analyses were considered.

Results

- 1. Rapid Response and Patient Transfer: One of the primary advantages of HEMS during Hajj and Umrah is its ability to rapidly transfer critically ill or injured patients to specialized hospitals. Ground ambulances, while essential, can face significant delays due to road congestion, crowd density, and the need to navigate narrow streets around the holy sites. HEMS, on the other hand, offers an efficient alternative for reaching patients in remote or congested areas, especially during peak pilgrimage seasons when traditional transportation may be obstructed. Studies showed that HEMS reduced the time from initial contact with a critically ill patient to definitive care by up to 50% compared to ground transportation. This rapid response time was particularly important in cases of trauma, cardiac arrest, and other time-sensitive conditions, where early intervention is crucial for survival.
- 2. Airspace Management and Coordination: Effective airspace management is critical in ensuring the success of HEMS operations. During Hajj and Umrah, air traffic control plays an important role in coordinating the movement of helicopters in the crowded airspace over Mecca and Medina. Several studies highlighted the need for precise coordination between air traffic controllers, HEMS operators, and ground medical teams to minimize delays and ensure patient safety. One key challenge identified in this review was the need for improved communication protocols between different emergency services and hospital systems to streamline patient transfers. While HEMS can deliver patients quickly, delays in patient admission and handoff at receiving hospitals can undermine the benefits of rapid air transport.
- **3.** Capacity and Resource Allocation: HEMS units are typically equipped with advanced life support (ALS) capabilities, allowing for the provision of critical care in route to hospitals. During Hajj and Umrah, where cases of respiratory distress, cardiac emergencies, and trauma are prevalent, the availability of ALS equipment and trained personnel is vital. However, several studies pointed out limitations in the availability of helicopters during peak periods. With millions of pilgrims participating, the demand for emergency medical services can exceed available HEMS capacity. Moreover, the financial costs of operating and maintaining a robust fleet of helicopters during these events remain a significant consideration for healthcare planners.
- 4. Medical Case Spectrum: The medical emergencies encountered during Hajj and Umrah range from minor injuries and heat exhaustion to severe cardiac events, strokes, and traumatic injuries. The unique environmental and cultural factors associated with these pilgrimages—such as extreme heat, the physical demands of rituals, and crowding—create a spectrum of medical cases requiring urgent attention. The review revealed that HEMS has been particularly effective in managing severe cardiac and trauma cases. Time-sensitive interventions such as defibrillation for cardiac arrest and trauma stabilization in the field were significantly enhanced by the presence of HEMS personnel who could initiate care while en route to hospitals. Studies also indicated that HEMS was frequently deployed for heatstroke cases during the summer months, where timely intervention and rapid transportation to cooling centers could be lifesaving.
- 5. Training and Preparedness: Training and preparedness are key to ensuring HEMS personnel can operate effectively in the challenging conditions of Hajj and Umrah. Simulation-based training for HEMS crews, focusing on the specific

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medical challenges encountered during the pilgrimage, was found to enhance the quality of care provided. Additionally, collaboration with local hospitals and ground medical teams to practice disaster management and mass casualty protocols ensures that all healthcare providers are equipped to respond to high-volume emergencies. The integration of these teams with HEMS improves coordination during large-scale incidents.

Challenges

While HEMS plays a critical role during Hajj and Umrah, several challenges remain. The high operational costs, limited availability of helicopters, and difficulties in navigating crowded airspace were identified as key issues. Additionally, the need for enhanced communication systems between HEMS teams and hospitals was consistently noted as an area for improvement. Finally, ensuring equitable access to HEMS services for all pilgrims, regardless of their location or nationality, is an ongoing concern for healthcare planners.

Recommendations and Future Directions

To enhance the effectiveness of HEMS during Hajj and Umrah, several recommendations have been identified:

- 1. **Expand HEMS Capacity:** Increasing the number of helicopters available during peak pilgrimage times can help address the overwhelming demand for emergency services.
- 2. **Improve Air Traffic Coordination:** Implementing advanced air traffic management systems and communication protocols can reduce delays and improve patient outcomes.
- 3. **Invest in Training Programs:** Continuous training for HEMS personnel, with a focus on mass casualty scenarios and pilgrimage-specific health challenges, is essential.
- 4. **Enhance Hospital Coordination:** Streamlining the handoff process between HEMS and hospital teams through better communication technologies and protocols can improve patient care.

Conclusion

HEMS is a vital component of the emergency medical response during mass gatherings such as Hajj and Umrah. Its ability to provide rapid medical intervention and transport critically ill patients to specialized care facilities makes it indispensable in managing the vast numbers of medical emergencies that occur during these events. However, improvements in capacity, coordination, and training are necessary to fully realize the potential of HEMS in managing medical cases during mass gatherings. As the number of pilgrims continues to rise, the importance of HEMS in safeguarding the health and safety of participants will only grow.

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