

“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



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 finds 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,

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

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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