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A Review on Key Considerations of Mass Gathering Management: Lesson Identified Lesson Learnt

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Abstract:
Introduction: *Mass gatherings, including scheduled events in sports facilities, air shows, rock concerts, outdoor celebrations, and visits by dignitaries, vary in their complexity and demand for medical services.*
Material and Methods: *This review aims to analyses previous cases of disaster at mass gathering events, documenting the lessons identified, to provide considerations when planning for future events. A literature search was carried out using Medline, Cochrane, and Embase. A free-text search was also conducted using Google to link mass gathering events to disaster incidents in order to widen the search beyond peer-reviewed publications. All peer-review literature articles found containing information pertaining to lessons identified from mass gathering crowd disasters were analysed and reviewed.*
Result: *21 reported mass gathering incidents have been reviewed, analysed and abstracted. Main learning points is categorized into 4 key areas for discussion; A. Medical Preparedness, B. Emergency Response, C. Psychosocial consideration and D. Overcrowding and Crowd Control*
Discussions: *Analysis of previous crowd disasters indicates a need for early detailed planning of crowd policies, evacuation procedures and involvement of emergency services which are necessary to promote and provide a successful event. Further studies of mass gathering events are warranted to advance not only the epidemiological knowledge base, but also to gain further lessons of emergency preparedness and response.*
Conclusion: *Generic themes from disasters at mass gathering events emerge from this collection of literature. The key consideration in medical preparedness and emergency responses are overcrowding and crowd control, and early identification and management of psychosocial complication.*
Keywords – *Mass gathering, Disaster, Preparedness, Overcrowding, Emergency response*

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I. Introduction

Mass gatherings require the provision of medical services for large populations who have assembled under unusual circumstances. Mass gatherings, including scheduled events in sports facilities, air shows, rock concerts, outdoor celebrations, and visits by dignitaries, vary in their complexity and demand for medical services.

The definition of a mass gathering itself is not without debate. The National Association of EMS Physicians (NAEMSP) defined it as: "Organized emergency health services provided for spectators and participants at events in which at least 1000 persons are gathered at a specific location for a defined period of time [1], while the WHO describes it as "An organised or unplanned event where the number of people attending is sufficient to strain the planning and response resources of the community, state or nation hosting the event" [2]. The United Nations International Strategy for Disaster Reduction (UNISDR) defines a disaster as "a serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources". In the context of this review of mass gathering incidents, a disaster is to be considered as a calamitous event occurring suddenly and causing great loss of life or damage to surroundings.

Historically, peer-reviewed literature has concentrated on crowd variables that affect the level and types of medical need at a mass gathering event [3], studying patient presentation rates of illness and minor injuries, while also providing possible prediction tools for first-aid providers and local hospitals [4]. However there is a lack of available evidence analysing crowd disasters at mass gathering events providing future suggestions for event organisers, medical resource planners, and emergency services, including local hospital emergency departments.

II. Materials And Methods

This review aims to analyse previous major incidents at mass gathering events, documenting the lessons identified, to provide considerations when planning for future events. With careful assessment of mass gathering events as a whole it will be possible to plan ahead for the potential number of attendees, consider health and safety aspects of planning for a mass gathering, plan for potential disasters and decrease the risk of the happening, provide a more effective allocation of health resources.

This literature review concentrates on crowd disasters at mass gathering events, focusing on predominantly on case reports and literature reviews citing particular lessons identified from previous disasters.

A literature search was carried out using Medline, Cochrane, and Embase. A free-text search was also conducted using Google to link mass gathering events to disaster incidents in order to widen the search beyond peer-reviewed publications which included grey literature (media reports, unpublished reports and commissioned inquiries). All peer-review literature articles found containing information pertaining to lessons identified from mass gathering crowd disasters were analysed and reviewed. Articles describing disasters occurring in extreme weather events such as heat-related illness, and environmental hazards leading to illness such as disease outbreak were not included. Citations within articles were further searched to identify additional references that would inform this review.

III. Results

In total, 50 reported mass gathering incidents from 1971 – 2011, were identified through literature search. While some reports provided valuable information regarding mass gathering disaster occurrence, most cases were descriptive rather than analytical, consequently very few literature reports (only 21) were found to inform subjects of lessons identified from disasters at mass gathering events. 17 of these reports had been only reported in journal publications, with four reports having undergone commissioned inquiries.

21 reported mass gathering incidents have been read, analysed, abstracted, referenced and complied in chronological order and referenced. Main learning points have been identified and further categorized in to 4 key areas for further discussion:

A. Medical Preparedness
B. Emergency Response
C. Psychosocial consideration
D. Overcrowding and Crowd Control

IV. Discussions

A. Medical Preparedness

Provision of on-site physician-level medical care at mass gatherings has been shown to significantly reduce the number of patients requiring transport to hospital and therefore reducing the impact on the local ambulance services. The majority of non-disaster injuries and medical complaints at a mass gathering can be effectively treated on scene, which reduces the number of hospital referrals and patient presentation rates to hospital. [5]

On-site medical care has also dramatically improved following several stampedes occurring during the annual Islamic pilgrimage of the Hajj. The provision of specially equipped medical care facilities, helipads, electronic surveillance, shading and cooling mists have helped to reduce crowd morbidity and mortality. Local hospitals should also be involved with emergency planning in preparation for potential mass gathering disasters. The deficiencies of hospital preparedness include emergency department only first aware when injured arrived, no major incident plan was prepared which led to the emergency department being overwhelmed, hospital command center was not set up, staff reinforcements were unable to be contacted, medical teams were not organised to prioritise mass casualty care, the media arrived, distracting emergency department personnel and supporting hospitals were not involved in a timely manner. [6] [7]

For mass gatherings on larger scale such as Olympic Games, an assessment of terrorism risk assessment might be necessary, with further medical provisions available during these planned events. [8] In particular the pre-hospital training resulted in an excellent hospital-wide response to the multi-casualty event following the explosion of a pipe-bomb in Centennial Park during these 1996 Olympics which resulted in 1 death and 21 injured on scene. [9]

The simplest way to evaluate preparedness to the event would be to use one of numerous available checklists step by step. Such an approach would be highly insufficient because adapting general rules to a particular event is the most difficult task in assessing the preparation for an event. The following should be explicitly taken into consideration such as estimated size, expected demography, duration of the event, crowd density and mobility, local health and hygienic problems, hygienic customs of the visitors and epidemiology of infectious diseases in the country (and county) of event, and in the home countries of visitors. [10]

It would be also very useful to introduce criteria for grading importance of points to be checked as well as of obtained responses. With limited resources prioritization of problems related to the preparation of the events on local and national levels, is crucial for the rational planning of the budget. [11]

B. Emergency Response

An effective emergency medicine service (EMS) is an essential precondition for any cultural, athletic, religious or political gathering regardless of its size or nature. The mass gathering poses a great challenge to the prehospital emergency services not only being able to respond to the conventional demands of a mega event but also in becoming familiar and well equipped with state of the art technology and knowing how to deal with the potential deliberate use of biological and chemical agents or radionuclide material. Similarly, the hospital required extensive adjustment to deal with a wide range of naturally expected but also extreme situations including communicable diseases and the potential deliberate use of material [12].

An EMS operations plan must exist for every mass gathering event including but not limited to contractual relationships (if applicable), scope of medical care to be provided, anticipated duration of medical operations, and geographic limits of medical coverage. The plan must address the relationship of the medical sector to other areas such as fire suppression, security, venue administration, and logistics. It should address how medical care will be provided for celebrities, VIPs and /or high-ranking government figures (if applicable). The plan should address an initial response to an act of terrorism, including the use of weapons of mass destruction or other hazardous materials [13].

All public events should have a formal, written emergency response plan which should be developed in consultation with the appropriate authorities. The plan should have the detail arrangements for on-site emergencies not requiring outside help, specify arrangements to request further police and other emergency services assistance, specify arrangements to hand over control to police and emergency services as required to provide a grid plan of the venue and all services. In any major incident, for the purposes of the law, the venue is considered a crime scene and thus under total control of the police [14].

One analysis of medical care at mass gatherings by Sanders et al suggested that basic first aid within 4 minutes, Advanced Life Support within 8 minutes and evacuation to a medical facility within 30 minutes. However these suggestions are based on only low patient numbers requiring triage, and arose from low-level evidence and expert judgment, which the authors stressed is in need of further research [15]. Standardized triage procedures are essential in providing adequate care to large numbers of people. When developing or revising your triage procedures for mass gatherings, make sure to:

- Perform risk analysis. Prioritize the high risk events. Develop triage procedures for a wide range of risks based on your risk assessment. You identified heat-related illnesses as a significant risk, so this should be one of the priority areas.
- Work as a team. To include agencies outside public health in the procedures. Triage procedures are closely connected to emergency medical services, so plans for ambulances need to be closely linked to your triage plans. Also, all first responders (firefighters, police, medical personnel, etc.) will require training in the use of your triage procedures.
- Encourage volunteerism. An effective response may overwhelm existing staffing for any single public health agency. This is an opportunity to plan for the recruitment and training of volunteers, such as Medical Reserve Corps, if available in your community [16].

Event preplanning using these principles has been described by in relation to the 2010 Love Parade in Germany when major medical preparations were put in place. They reported on patient care delivery at this mass gathering, where following a stampede, 21 died and over 510 were injured. The formation of trauma teams made it possible to control patient flows appropriately to all hospitals. However, even with such well-planned emergency response, adverse consequences occurred which demonstrates again the complexity of planning for such mass gathering events.

C. Psychosocial Consideration

Many mass gathering literatures demonstrates several key characteristics that give rise to consideration in preparedness and efficiency of emergency medical care in every event. A conceptual model proposed by Arbon et al on which to base mass gathering medical care planning includes three domains [17]:

- Psychosocial (individual behaviors, collective social dynamic, and culture);
- Biomedical (aggregate spectator age, pre–even health status of attendees, physical activity levels of participants and spectators, physiology of response to extremes of heat or cold, and extent of substance use in the attendees); and
- Environmental (bounded vs. unbounded venue time-focused vs. extended, seated vs. mobile, local weather, crowd density; type of event; outdoor weather exposure vs. indoor controlled climate).

Understanding the psychosocial aspect of crowd in mass gathering is important as it determines the level of workload of emergency medical service provider. Insufficient concentration to the behavior of the crowd and relation between behavior and system design are major factors of crowd disaster [18, 19] However, individual behavior plays a starting role in creating a cultural atmosphere to a particular event. Au et al. developed the crowd behavior model outline on how individuals interact with each other and combine their motivations into collective behavior [21]. De-individuation, group polarization and groupthink have been identified as the primary processes responsible for converting individual into collective behavior [20]. De-inviduation is the feeling of losing one's individuality or personal identity as the result of being submerged in a group and occurs primarily when people are aroused by being in a large group and feel diminished responsibility for their acts, forming a collective behavior which can be visualized as one presentation [20]. On the other hand, group polarization is the tendency for group involvement to strengthen the average group member's before-involvement inclination. When people discover that others are inclined to feel the same way as they do, they are motivated to shift their opinion further in that direction [20]. Following the model, collective behavior needs to be visualized as an impact which give rise to the two important element in psychosocial domain in Arbon modal traditionally described as 'crowd mood' and crowd type'. Crowd type is a descriptor of the societal sub-culture of a crowd whereas crowd mood is a descriptor of crowd emotion and had been categorized by Berlonghi et al [22].

Crowd mood is the presentation of crowd emotion. It is described as an important element in determining the crowd behavior and is associated with a number of factors [19]. For example in a concert, factors such as the closeness of the people in the crowd, the occurrence of incidents (such as a crowd crush) and/or the effect of the music, the recognition, tempo or rhythm of songs, the type and attitude of the performers or any combination of these have been found to be closely related to changes in crowd behavior. Pines and Maslach [23] founded the method of assessment, developed a matrix that uses the audience profile for assessment of crowd mood. It is used to grade the amount of verbal noise, physical movement and overall audience participation. Zeitz et al [24] found that the assessment of crowd mood is important to assist the preparation of emergency medical care as it can be a measuring tool to predict the medical workload at a mass gathering event.

D. Overcrowding and Crowd Control

Several studies have highlighted that despite venue capacities being completely full, further crowd members still tried to gain access, either due to overselling of tickets or by people turning up just before or after the start of the event. An adequate ticketing system and public address measures to inform crowds of no further access to an event once capacity is reached is essential. Training of stewards and security staff in crowd control should be implemented before an event in an effort to improve crowd safety and avoid panic should overcrowding occur. During a football match in Ellis Park South Africa, tear gas was thrown in to a crowd by event security in an effort to disperse intense overcrowding. This unfortunately served to incite panic and cause stampede [25]

Overcrowding has been linked to the collapse of a temporary stand at a football match in Corsica [26]. While in the UK, the Hillsborough disaster in April 1989 led to a landmark report by Lord Justice Taylor, to change all football stadia in the UK to all-seater venues, improving crowd safety and control as well as removing pitch-side barriers and improving medical facilities on-site. [27]. Two cases at music events have stressed the need to provide 'mosh' pit safety. Since 'moshing is a dance in which participants push or slam into each other in enclosed spaces, primarily during live music events, mosh pit crowd safety guidelines have been implemented, which include isolating the area from the main audience, provision of nearby first aid, and protocols to stop artists performing should crushing develop [28]

There are several key crowd issues to be addressed such as size and demographics. Size is the maximum numbers permitted are often established by regulation for safety reasons while demographics are the composition of the audience, including age and gender mix. If it is identified in advance that a high proportion of the audience will be young children, additional facilities such as child minding, feeding rooms and prams can be considered. For medical staff, audiences of young, children or elderly people tend to require additional medical facilities and children are more susceptible to crush injury. [29][31].

For outdoor concerts, additional considerations such as control and distribution of spectators in the field, minimum space allocation of 0.46 square meters per person on ground with no seats and some form of sectoring and barrier management by security is important. [34][35] [38]. Effective use of barriers can avoid many problems, including congestion in thorough fares. An issue to be considered in the planning phase includes what type of barriers is required. There are two types of barriers which is psychological and physical barriers. Physical barriers are used to control crowd surges while psychological barriers are used to organize orderly crowds. Next, what are the actions to be taken if the barrier is breached or can it be used as an emergency exit for important personnel to evacuate or injured spectators to get proper treatment. [32][33][36].

The prohibition of the sale of alcoholic beverages at events where unruly audiences are expected.. Searches of personal belongings (jackets, purses, bags, etc.) and confiscation of any alcohol, drugs and weapons, further reduces related problems. [30] [38]. The most desirable approach is to discourage patrons from bringing alcohol to the event in the first place. If it has been decided to confiscate prohibited goods, arrangements for the storage and disposal of these goods are required. Different approaches to seized alcohol have been used. In some cases the alcohol has been opened by security personnel and dumped into large drums in front of the patron. This has created a hostile audience and conflict with security and event management before the event has commenced. [35] Such an approach can also be applied to any potential weapons found, if confiscation, for whatever reason, is deemed inappropriate [38].

V. Main Learning Points

Mass gathering events have a potential to place a severe strain on the local health care system, with a mixture of high crowd density, restricted points of access, limited crowd control and lack of sufficient on-site medical care and emergency response can increase the risk of disaster.

Many challenges are faced by mass gathering event organizers, medical resource planners, and emergency services, including local hospital emergency departments in order to provide a safe event. Analysis of previous crowd disasters indicates a need for early detailed planning of crowd policies, evacuation procedures and involvement of emergency services which are necessary to promote and provide a successful event. This review highlights several key considerations that could impact on health resources include:

a. Planning, preparedness, response and mitigation: Preplanning on preparedness, response and mitigations for mass gathering events is the key and should include health management and major incident planning.
b. Safety and security: Adequate crowd security and emergency medical services need to be provided at a mass gatherings taking account of crowd size and factors such as event type and external environmental conditions
c. Training and psychosocial consideration: EMS with adequate training and experience, in the management of multiple medical casualties need to be available. Pre-planning with local hospitals will aid the emergency response.

VI. Conclusion

The main learning points need to be seriously addressed when dealing with mass gathering event. The application of principles of identified main learning points in mass gathering will reduce the mortality and morbidity resulted from major casualty incidents. Generic themes from disasters at mass gathering events emerge from this collection of literature. The key consideration in medical preparedness and emergency responses are overcrowding and crowd control, and early identification and management of psychosocial complication. Further studies of mass gathering events are warranted to advance not only the epidemiological knowledge base, but also to gain further lessons to excel in the management of mass casualty events.

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