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Emergency Medical Services Preparedness and Risk Mitigation in Mass Gathering Health Security Contexts- An Updated Review for Healthcare Security

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Abstract

Background: Mass gathering events pose complex health security challenges due to high population density, diverse risk exposures, and the potential to overwhelm local emergency medical services (EMS).

Aim: This review aims to examine contemporary strategies for emergency medical services preparedness and risk mitigation in mass gathering health security contexts.

Methods: A narrative review approach was employed, synthesizing international guidance, EMS operational frameworks, and evidence derived from prior mass gathering events, with emphasis on preparedness, staffing, resource allocation, and incident command integration.

Results: Findings indicate that effective mass gathering healthcare depends on comprehensive risk assessment, multidisciplinary planning, scalable medical staffing, environmental risk mitigation, and robust communication systems. On-site medical care, physician oversight, and structured use of the Incident Command System substantially reduce unnecessary hospital transports and preserve community healthcare capacity.

Conclusion: Proactive, systems-based medical planning enhances patient safety, EMS efficiency, and overall community resilience during mass gathering events.

Keywords: Mass gatherings, Emergency medical services, Health security, Risk mitigation, Incident command system.

Introduction

The World Health Organization (WHO) characterizes mass gatherings as either spontaneous or planned events that attract large numbers of participants and place exceptional demands on local systems and services [1]. In a complementary manner, the Federal Emergency Management Administration (FEMA) conceptualizes such events as "special events" that involve crowd sizes substantial enough to compromise a community's capacity to respond effectively to major emergencies [2]. These definitions converge on a critical principle, namely that the defining feature of mass gatherings is not merely the absolute number of attendees but the extent to which these events challenge the operational readiness and resilience of essential community resources. Consequently, the emphasis shifts from numerical thresholds toward functional capacity, preparedness, and system adaptability in the face of heightened demand. Although many mass gatherings involve attendance exceeding 25,000 individuals, the concept may reasonably extend to events hosting more than 1,000 participants when local infrastructure and response capabilities are limited or already strained [3]. Core resources affected in these contexts include emergency medical services (EMS), acute care hospitals, transportation systems, and law enforcement agencies, all of which must operate in a coordinated and scalable manner to ensure public safety [1][2][3].

Mass gatherings encompass a broad spectrum of event types, including musical performances, professional and amateur sporting competitions, religious observances, cultural

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festivals, parades, street fairs, and political demonstrations. Each category presents a distinct risk environment shaped by crowd behavior, demographic composition, event duration, and spatial configuration. The physical structure of the event plays a critical role in determining risk exposure. Bounded settings such as stadiums or arenas allow for controlled access points, defined evacuation routes, and centralized medical coverage, whereas unbounded events such as marathons or large-scale pilgrimages extend across wide geographic areas, complicating surveillance, access, and response coordination. The nature of the gathering further influences health and safety risks. Concerts are often associated with increased consumption of alcohol and recreational substances, as well as traumatic injuries linked to crowd surges or high-energy audience behavior. Sporting events may provoke interpersonal violence or crowd aggression, while religious gatherings frequently involve a higher proportion of older participants, introducing greater vulnerability to chronic disease exacerbations and heat-related illness. Beyond event-specific hazards, mass gatherings are associated with a range of systemic risks that can escalate rapidly and unpredictably. These include crowd instability, fires, infrastructure or structural failures, communicable disease outbreaks, deliberate acts of violence or terrorism, stampedes, hazardous material exposures, and environmental emergencies [4]. The concentration of large populations within confined or semi-confined spaces amplifies the consequences of even minor incidents. Vulnerability increases further in the presence of extreme weather, inadequate sanitation, insufficient access to safe food and water, or disruptions to supply chains [5]. Infectious disease transmission represents a particularly significant concern, as mass gatherings create conditions conducive to rapid spread through respiratory droplets, direct skin contact, or contaminated food and water sources [6]. Such dynamics can transform localized health threats into broader public health emergencies, particularly when surveillance and early detection mechanisms are insufficient [4][5][6].

The central feature that distinguishes mass gatherings from routine public events is their capacity to overwhelm local response systems. Even well-resourced communities may experience critical stress when baseline service utilization is high and surge capacity is limited. This challenge becomes more pronounced in the context of a mass casualty incident (MCI), where simultaneous demands for triage, treatment, transportation, and definitive care exceed available resources. Preexisting saturation of EMS units, emergency departments, and inpatient facilities reduces operational flexibility and prolongs response times. These realities underscore the necessity of comprehensive preparedness strategies that integrate risk assessment, interagency coordination, medical surge planning, and real-time situational awareness. Effective management of mass gatherings therefore requires not only logistical planning but also a systems-based approach to resource allocation and emergency readiness, aimed at preserving community resilience under conditions of extreme demand [4][5][6].

Issues of Concern

Goal of Health Care at a Mass Gathering Event

The provision of healthcare services during mass gathering events is guided by clearly defined objectives that prioritize patient safety, system resilience, and coordinated emergency response. According to the National Association of EMS Physicians (NAEMSP), the primary goal of healthcare delivery in these settings is the prompt onsite assessment and stabilization of individuals who experience illness or injury during the event [3]. This includes the administration of appropriate medications, the initiation of necessary therapeutic interventions, and the application of lifesaving procedures within the scope of available resources. Early stabilization at the event site plays a critical role in preventing clinical deterioration and reducing the need for urgent transport to external healthcare facilities. A second core objective is the mitigation of burden on local emergency medical services and surrounding hospitals. Mass gatherings often occur in communities where healthcare resources are already operating near capacity. An unplanned influx of patients from an event can overwhelm EMS units, emergency departments, and inpatient services, compromising care for both event attendees and the local population. By managing a substantial proportion of medical encounters onsite, event-based medical systems function as a buffer that preserves community healthcare capacity. This separation of event-related care from routine community services allows hospitals to maintain operational continuity while ensuring that patients who truly require higher levels of care are appropriately triaged and transported. A further objective emphasized by NAEMSP is the structured use of the Incident Command System (ICS) to enhance preparedness, coordination, and response to potential mass casualty incidents (MCIs) [3]. The integration of ICS principles ensures clear lines of authority, standardized communication, and interoperability among multiple agencies involved in event management. This framework enables rapid escalation of response when conditions deteriorate and facilitates seamless coordination between onsite medical teams, EMS, law enforcement, fire services, and public health authorities. Collectively, these objectives aim to proactively protect the local healthcare system from excessive strain while delivering effective, timely, and organized medical care within the operational capacity of the mass gathering medical infrastructure [3].

Planning

The successful management of healthcare services at mass gathering events is highly dependent on meticulous planning that is both comprehensive and collaborative. Effective planning requires the active involvement of event organizers, sponsors, security leadership, EMS managers, the designated medical director, public health officials, and administrators from nearby hospitals and healthcare systems [4]. This multidisciplinary engagement ensures that medical planning aligns with broader event operations, security strategies, and community emergency response frameworks. Planning is not a single activity but a continuous process that unfolds across several phases, including preplanning, formal planning, operational execution, and post-event evaluation. The planning phase focuses on developing a detailed medical operations plan that addresses anticipated risks, resource requirements, and personnel deployment. This phase includes defining treatment capabilities, determining staffing levels, establishing communication pathways, and securing necessary equipment and supplies. Best practice recommends that event management review and formally approve healthcare plans no less than 30 days prior to the event to allow sufficient time for revisions and interagency coordination. During the operations phase, which spans the duration of the event, medical personnel actively deliver care, monitor evolving risks, and adapt resource deployment in response to real-time conditions. Following the event, a structured post-event review is essential to evaluate performance, identify strengths, and address deficiencies. Lessons learned during this phase inform improvements in planning and execution for future mass gatherings. Resource planning for mass gatherings is inherently complex and must account for a wide range of variables. Each event presents a unique risk profile shaped by factors such as expected attendance, event duration, the number and type of participating agencies, attendee demographics, policies regarding alcohol and substance use, historical patient presentation data, venue characteristics, and anticipated crowd behavior. Outdoor events, concerts, and gatherings with large populations of young adults or older individuals typically require enhanced medical coverage. Planning must also extend beyond direct medical care to include access to potable water, adequate sanitation facilities, food availability, and temporary shelters capable of protecting attendees from adverse weather conditions [4]. The application of a risk stratification scoring model can assist planners in predicting medical demand by incorporating variables such as environmental stressors, crowd density, alcohol consumption, demographic characteristics, and crowd intent [7]. Such models support evidence-based decision-making and promote efficient allocation of limited resources [4][7].

Regulations

Regulatory compliance represents a critical dimension of healthcare planning for mass gathering events. Requirements governing onsite medical services vary considerably across jurisdictions, reflecting differences in state laws, municipal ordinances, and local emergency management policies. These regulations may specify minimum staffing levels, credentialing standards, equipment requirements, and permitting processes. As a result, planners must possess a thorough understanding of applicable local and state regulations to ensure legal compliance and operational legitimacy. In many jurisdictions, medical providers assigned to mass gatherings are required to hold certifications and licenses that conform to local scope-of-practice standards. Some regions also establish recommended or mandated response time benchmarks for medical interventions, such as the provision of Basic Life Support (BLS) within four minutes, Advanced Life Support (ALS) within eight minutes, and patient transport to a definitive care facility within 30 minutes when indicated [8]. These benchmarks serve as performance targets that guide staffing, station placement, and transportation planning. Several states and municipalities, including New York, Pennsylvania, Maryland, Georgia, Iowa, Oregon, and Washington, D.C., have enacted legislation that defines minimum standards for onsite medical resources at mass gathering events [4]. Compliance with these standards is essential not only for patient safety but also for liability mitigation and interagency trust [8].

Venue and Site Mapping

Detailed analysis of the event venue is a foundational element of mass gathering medical planning. Comprehensive site mapping provides a visual and operational framework that supports efficient care delivery and rapid emergency response. Event maps should clearly identify venue boundaries, locations of medical treatment areas, evacuation routes, designated access corridors for emergency vehicles, air medical landing zones, and all points of entry and exit [3]. The design of crowd flow is particularly important, with egress areas ideally being at least twice the capacity of entry points to facilitate rapid evacuation when necessary. Dedicated traffic routes for EMS vehicles must be established to ensure unobstructed movement to and from medical facilities. These routes should be protected from pedestrian congestion and monitored by security personnel. Onsite medical care facilities should be strategically distributed throughout the venue to minimize response times and maximize accessibility. Considerations such as patient privacy, visibility, and clear signage are essential to encourage appropriate utilization of medical services. Additionally, planners

must allocate space for jurisdictional EMS staging areas and coordinate the positioning of security personnel to support both routine operations and emergency response. Effective site mapping enhances situational awareness and contributes to a cohesive, well-coordinated medical response [3].

Staffing, Personnel, and Security

Determining appropriate staffing levels and personnel composition is one of the most critical aspects of mass gathering medical planning. Organizers must define the scope of medical services to be provided and ensure that staffing aligns with anticipated demand. This includes establishing treatment zones, ensuring the availability of both BLS and ALS capabilities, and deploying advanced medical professionals such as physicians and registered nurses when the expected acuity exceeds the typical EMS scope of practice. General staffing recommendations suggest the presence of one physician for every 5,000 to 50,000 attendees, one nurse for every 2,600 to 15,000 attendees, and one emergency medical technician for every 2,600 to 65,000 attendees [2]. These ratios should be adjusted based on event-specific risk factors. Historical data play a vital role in refining staffing estimates. Patient presentation rates (PPR) and transfer-to-hospital rates (TTHR) from prior or comparable events provide valuable insight into expected medical demand. Studies have reported average rates of 0.5 to 2 medical encounters per 1,000 spectators at mass gathering events [9]. EMS workload often increases substantially during evening and nighttime hours, further elevating demand on both onsite and community resources [10]. Underestimation of medical needs can rapidly overwhelm available services, particularly in the event of unforeseen incidents such as infectious disease outbreaks, fires, structural failures, stampedes, or terrorist attacks. Budgetary constraints frequently limit staffing levels, leaving events inadequately prepared for MCIs. Clear visual differentiation between licensed medical personnel and volunteers through uniforms or identification is essential to prevent confusion and ensure accountability [4]. Strategic use of trained volunteers in support roles has been shown to enhance operational efficiency in many events.

Response capabilities at mass gatherings vary according to event scale and risk. First aid stations serve as the primary access point for medical care and enable many patients to receive treatment and return safely to the event. Larger gatherings may require the establishment of field hospitals capable of delivering more advanced care. Mobile medical teams, typically composed of two or more EMT-trained personnel, enhance coverage by navigating the venue on foot, bicycles, motorized vehicles, or watercraft when appropriate [4]. These teams are equipped to provide rapid assessment, initiate treatment, and facilitate patient transport using stair chairs or stretchers. Security is an integral component of medical operations at mass gatherings. Effective security measures protect attendees, reduce the risk of violence, and support crowd management. Security planning should prioritize surveillance, fire and water safety, communication coordination, disaster response integration, traffic control, crowd density management, and infrastructure protection [11]. Close collaboration between medical and security teams is essential to identify emerging threats and respond swiftly to incidents [11].

Environment

Environmental factors exert a profound influence on health risks at mass gathering events and must be carefully integrated into planning. High ambient temperatures and humidity significantly increase the risk of heat-related illnesses, necessitating the availability of water stations, shaded areas, cooling systems, and active heat mitigation strategies. In contrast, cold-weather events require provisions for rewarming, including heated shelters and appropriate medical supplies. Outdoor venues present additional challenges due to uneven terrain, which is associated with a higher incidence of lower extremity injuries [4]. Exposure to environmental hazards such as insects, allergens, and variable air quality further elevates medical risk. Outdoor settings also increase susceptibility to trauma, envenomation, asthma exacerbations, allergic reactions, and dermatologic conditions. Evidence indicates that the most common chief complaints at outdoor mass gatherings include burns, fractures, contusions, and open wounds [12]. These findings underscore the necessity of tailoring medical resources to the specific environmental context of each event. Proactive environmental risk management enhances patient safety, reduces preventable injuries, and strengthens the overall resilience of mass gathering healthcare systems.

Roles of the Medical Director, EMS, and Physicians

The Medical Director occupies a central and authoritative position in the governance of medical services at mass gathering events. This role requires advanced expertise across emergency medical services, clinical decision-making, logistics, operational coordination, and resource management, combined with a comprehensive understanding of time-sensitive emergency conditions. Under the Medical Director's leadership, the primary objective is to ensure rapid triage, effective stabilization, and appropriate disposition of patients presenting with severe illness or injury. Decisions regarding transport to external healthcare facilities are made with careful consideration of clinical acuity, resource availability, and system impact. For patients with minor or self-limited conditions, the emphasis remains on definitive onsite care, which promotes rapid recovery, enhances attendee safety, and preserves the operational capacity of community EMS systems and nearby hospitals. Beyond direct clinical oversight, the

Medical Director holds responsibility for the strategic planning and integration of medical services within the broader event safety framework. This includes the development and approval of the event medical plan, alignment with local emergency response protocols, and coordination with public safety agencies. Credentialing and privileging of EMS clinicians and physicians fall under this role, ensuring that all providers are qualified, authorized, and practicing within defined scopes. The Medical Director also plays a critical role in expanding onsite treatment capabilities through protocol development, equipment selection, and staff training. A key component of this responsibility involves comprehensive preplanning for potential mass casualty incidents, including scenario analysis, surge capacity planning, and integration of the Incident Command System to enable structured escalation of response when required [12].

Emergency Medical Services personnel serve as the operational backbone of medical care at mass gathering events. As mobile first responders, EMS providers are often the earliest point of clinical contact for individuals experiencing acute illness or injury. Depending on event design and local agreements, EMS may function as the primary onsite medical response or operate in a secondary support role alongside private or event-based medical teams. Their duties encompass patient assessment, initiation of treatment, and transport within the venue or to external hospitals when indicated. EMS personnel must navigate complex environments characterized by dense crowds, restricted access, and dynamic hazards, requiring adaptability and situational awareness. Physicians and nurses are increasingly integrated into event-based EMS systems to enhance clinical depth and decision-making capacity. The presence of physicians allows for advanced interventions that extend beyond standard EMS protocols, including complex wound management, procedural sedation, and higher-level diagnostic reasoning. Many mass gathering events employ a treat-and-release model, in which paramedics deliver care and the patient is discharged back to the event without hospital transport. Historically, concerns existed regarding the safety of this approach due to the potential for missed diagnoses or delayed deterioration. Evidence now demonstrates that when physician oversight is incorporated and discharge decisions are formally authorized, the treat-and-release model can be implemented safely and effectively [4]. Clear delineation of roles, responsibilities, and expectations for each provider category is essential, and these parameters must be communicated explicitly during pre-event briefings to ensure coordinated and efficient operations [4].

Effective communication systems underpin all aspects of medical response at mass gathering events. Reliable communication enables rapid information exchange, supports command and control, and is essential for early recognition and management of MCIs. Best practice dictates the establishment of at least two independent communication modalities, most commonly radios and mobile phones, to ensure redundancy and continuity in the event of system failure [2]. These channels facilitate communication between medical oversight and field providers, as well as coordination with external entities such as municipal EMS agencies, fire services, emergency dispatch centers, public safety answering points, and receiving hospitals. A dedicated medical communication channel, separate from general event operations, is essential to prevent congestion and ensure priority access. In addition, a predesignated channel for MCIs must be established to support rapid escalation and interagency coordination during high-impact incidents. Patient transport from mass gathering events requires a structured and flexible approach that balances clinical urgency with system preservation. Both Advanced Life Support and Basic Life Support ambulances should be readily available to facilitate ground transport when required. Air medical transport becomes an important option when geographic distance, traffic congestion, or crowd density significantly delays ground evacuation. Onsite physicians play a decisive role in determining the necessity of transport and selecting the most appropriate modality based on patient acuity and resource considerations. The presence of physicians has been shown to reduce ambulance transports by as much as 89 percent, reflecting improved clinical triage and avoidance of unnecessary hospital referrals [13]. This reduction has substantial implications for preserving EMS availability and minimizing downstream burden on emergency departments.

Accurate and comprehensive documentation remains a fundamental obligation in mass gathering medical operations. Every patient encounter, regardless of perceived severity, must be recorded using a standardized patient care record. Documentation serves multiple purposes, including medicolegal protection, quality assurance, inventory tracking, and potential reimbursement processes [2]. It also provides a critical data source for post-event analysis and future planning. Consistent documentation practices protect both patients and providers while supporting evidence-based improvements in event medical management. Preparation for mass casualty incidents is a defining requirement of mass gathering healthcare systems. MCIs demand a rapid, coordinated response to manage sudden surges in patient volume and acuity. The Incident Command System provides a standardized structure that enables unified command, clear communication, and efficient resource deployment. When an MCI occurs, the event emergency plan is activated, and the command center

is immediately notified with detailed information regarding the nature of the incident, hazards, estimated patient numbers, resource needs, and optimal access routes [8]. The command center coordinates with the local 911 system, triggering regional MCI protocols and alerting surrounding hospitals. Medical personnel transition into predefined MCI roles, and prepositioned disaster supplies are deployed. A standardized triage system using red, yellow, green, and black categories is implemented to prioritize care. Venues hosting mass gatherings should incorporate at least two triage zones, designated ambulance loading areas, and a centralized ambulance staging location [4]. Security personnel play a critical role during MCIs by managing crowd movement and preventing secondary injuries such as stampedes or compressive asphyxia.

Proactive planning is essential to ensure that surrounding hospitals can absorb patient surges during MCIs. This includes advance designation of leadership roles, establishment of disaster communication pathways, coordination with regional healthcare facilities, and development of strategies to conserve local resources. Early notification of jurisdictional authorities is necessary when event medical capacity is exceeded, enabling timely reinforcement and mutual aid activation. Post-event review represents a vital component of continuous quality improvement in mass gathering medicine. A structured evaluation should assess the adequacy of medical staffing, resource deployment, communication effectiveness, and adherence to the pre-event plan. Key performance indicators such as the Patient Presentation Rate, Transport to Hospital Rate, and the frequency of specific medical conditions must be analyzed in detail. Quantitative assessment of medical utilization provides insight into demand patterns and system performance. Measures such as the Medical Utilization Rate and Patient Presentation Rate, typically calculated per 1,000 or 10,000 attendees, offer standardized benchmarks for comparison across events [14]. Evidence indicates that factors including elevated ambient temperatures, alcohol availability, crowd mobility, venue characteristics, and staffing levels influence patient presentation rates [4]. Analysis of EMS data from multiple mass gatherings has shown that the vast majority of patient encounters are of mild severity, with 95.97 percent requiring only minor interventions [15]. Systematic review of successes and failures following each event provides actionable lessons that enhance preparedness, optimize resource allocation, and strengthen the safety and effectiveness of medical care at future mass gatherings.

Clinical Significance

The management of healthcare services during mass gathering events represents a critical domain within public health, emergency medicine, and health security due to the scale, unpredictability, and potential severity of associated risks. These events require a structured and anticipatory approach that prioritizes early stabilization of patients, protection of community healthcare capacity, and readiness for sudden escalation into emergencies. Clinical significance emerges from the need to deliver timely, appropriate care in environments that are often resource constrained, logistically complex, and exposed to multiple hazards. Success depends on deliberate coordination among medical leadership, emergency medical services, public health authorities, security agencies, and event organizers. Clearly defined roles, standardized operational frameworks, and interoperable communication systems form the foundation for effective healthcare delivery and risk mitigation in these settings. Comprehensive planning and systematic analysis of mass gathering events are essential due to the concentration of large populations within limited geographic areas. Such density inherently elevates the likelihood of medical encounters ranging from minor ailments to life-threatening emergencies. Without adequate preparation, even routine medical issues can overwhelm onsite capabilities and spill over into community healthcare systems. Proper planning enables accurate anticipation of medical demand, informed allocation of personnel and equipment, and establishment of protocols that support rapid decision-making. From a clinical perspective, this preparedness reduces response times, improves patient outcomes, and minimizes preventable morbidity. The ability to manage predictable health needs onsite also preserves emergency department capacity and ensures continuity of care for non-event-related patients within the surrounding community [13][14][15].

Mass gatherings also carry a heightened risk of communicable disease transmission due to close physical proximity, prolonged contact, and shared facilities such as sanitation and food services. From a clinical and public health standpoint, understanding and implementing preventive measures is essential to reduce the risk of outbreaks. This includes surveillance for early symptom detection, isolation strategies when indicated, and coordination with public health authorities for reporting and response. Failure to address these risks can result in localized outbreaks with broader regional or national implications. The clinical significance lies in the opportunity to interrupt transmission chains through proactive measures, protecting both event attendees and the wider population. Beyond routine medical and infectious risks, mass gatherings present credible threats related to environmental hazards, natural disasters, and intentional acts of violence. Weather extremes can precipitate heat-related illness or hypothermia, while structural failures, fires, or crowd surges can generate large numbers of casualties within minutes. The possibility of terrorist attacks or

deliberate harm further elevates the stakes for preparedness. Clinically, this necessitates robust emergency planning that includes evacuation strategies, surge medical capacity, triage protocols, and integration with disaster response systems. Effective preparation directly influences survival rates and injury severity during such incidents. The ability of medical teams to transition rapidly from routine care to mass casualty management underscores the clinical importance of training, drills, and predefined command structures [14].

Resource management is another central aspect of the clinical significance of mass gathering healthcare. Events place extraordinary demands on personnel, equipment, transportation assets, and communication infrastructure. Clinicians must operate within finite resources while maintaining standards of care. Strategic allocation of medical assets, informed by data from previous events and real-time monitoring, allows for efficient use of limited resources and prevents unnecessary depletion of local EMS and hospital services. Effective communication channels ensure that information flows seamlessly between onsite providers and external healthcare facilities, enabling coordinated patient disposition and system-wide situational awareness. Clinically, this coordination reduces duplication of effort, prevents delays in care, and enhances overall system performance. Mass gatherings exert measurable impacts on healthcare systems, particularly when preparedness is inadequate. Increased patient volumes can strain emergency departments, extend wait times, and divert attention from critically ill non-attendees. Ambulance services may experience elevated call volumes, longer turnaround times, and reduced availability for community emergencies. These pressures can persist beyond the duration of the event, affecting healthcare delivery at the population level. Recognizing these impacts reinforces the clinical imperative for proactive planning that includes surge capacity strategies, mutual aid agreements, and coordination with regional healthcare networks. Preparedness ensures that healthcare systems remain resilient and capable of absorbing additional demand without compromising patient safety. In clinical practice and health security planning, mass gathering medicine serves as a convergence point for emergency care, public health, disaster medicine, and systems management. The knowledge gained from planning and managing these events extends beyond individual gatherings and informs broader disaster preparedness and emergency response frameworks. Clinicians and healthcare leaders who understand the dynamics of mass gatherings are better equipped to anticipate risks, allocate resources, and protect both individual patients and healthcare systems. Ultimately, the clinical significance of mass gathering healthcare lies in its role in safeguarding lives, preserving system functionality, and ensuring that large-scale events can occur without undue harm to attendees or the surrounding community [14][15].

Enhancing Healthcare Team Outcomes

Optimizing healthcare team outcomes during mass gatherings depends on structured collaboration among clinical professionals and nonclinical stakeholders operating within a shared operational framework. Physicians, nurses, and pharmacists play essential roles in clinical decision-making, medication management, and patient stabilization, yet their effectiveness is closely tied to coordinated engagement with event organizers, security services, EMS leadership, and public health authorities. This interprofessional integration ensures that healthcare delivery aligns with event logistics, security planning, and community emergency response systems. When collaboration is established early and maintained throughout the event lifecycle, healthcare teams are better positioned to respond efficiently to both routine medical needs and high-impact emergencies. Efficient management of medical resources is central to preventing excessive strain on local healthcare systems. Mass gatherings can generate a high volume of patient encounters, many of which can be managed onsite if appropriate personnel, equipment, and protocols are in place. Coordinated resource planning enables healthcare teams to deliver timely care while preserving ambulance availability and hospital capacity for patients requiring advanced intervention. During emergencies, particularly mass casualty incidents, unified action across agencies becomes critical. All stakeholders must function as a cohesive system to conduct rapid triage, deliver life-saving interventions, manage traumatic injuries, and stabilize patients for further care. Fragmented responses or unclear authority can delay treatment and worsen outcomes. Clear delineation of roles and responsibilities is essential to effective team performance. Each healthcare professional must understand their scope of practice, decision-making authority, and reporting structure within the event medical system. Defined leadership, typically under a medical director, supports accountability and ensures clinical decisions are consistent with established protocols. Role clarity also reduces duplication of effort and minimizes operational confusion during high-pressure situations. Pharmacists contribute by ensuring medication safety and availability, nurses support continuous patient monitoring and care coordination, and physicians provide advanced clinical oversight and disposition decisions [12].

Effective communication underpins all aspects of team-based care at mass gatherings. Reliable information exchange between healthcare teams, EMS units, and security personnel supports situational awareness and timely response. Communication is especially critical when

coordinating patient transport. Decisions regarding ground or air transport require close collaboration among onsite clinicians, EMS providers, and receiving facilities to match patient acuity with available resources. Participation in comprehensive emergency planning further strengthens team outcomes. Well-developed plans that address resource deployment, communication pathways, and MCI response protocols enable healthcare teams to operate with efficiency, adaptability, and shared purpose, ultimately enhancing patient safety and event resilience [13][14][15].

Conclusion:

Mass gathering healthcare represents a critical intersection of emergency medicine, public health, and health security planning. The evidence presented in this review underscores that large-scale events, regardless of intent or setting, have the inherent capacity to strain or overwhelm local healthcare systems if not meticulously planned. Effective preparedness relies on early risk stratification, interdisciplinary coordination, and integration of EMS, public health authorities, and security services within a unified operational framework. On-site medical systems capable of triage, stabilization, and treat-and-release play a pivotal role in preserving ambulance availability and hospital capacity. Environmental risk management, clear communication channels, physician oversight, and adherence to the Incident Command System further enhance operational effectiveness. Importantly, post-event evaluation and data-driven analysis support continuous improvement and future readiness. Strengthening mass gathering medical preparedness ultimately protects public safety, improves clinical outcomes, and reinforces healthcare system resilience in the face of predictable and unforeseen threats.

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