



Brief Report

Mass-gathering medicine: a descriptive analysis of a range of mass-gathering event types

Samuel Locoh-Donou MS^a, Yan Guofen PhD^b, Melanie Welcher EMT^c, Thomas Berry MPH^c, Robert E. O'Connor MD, MPH^{a,c}, William J. Brady MD^{a,c,*}

^a Department of Emergency Medicine, University of Virginia School of Medicine, Charlottesville, VA, USA

^b Department of Biostatistics, University of Virginia School of Medicine, Charlottesville, VA, USA

^c Special Event Medical Management, Emergency Management, University of Virginia Health System, Charlottesville, VA, USA

ARTICLE INFO

Article history:

Received 19 December 2012

Accepted 18 January 2013

ABSTRACT

Objective: To identify and evaluate the volume, nature, and severity of patient presentations encountered by emergency medical services (EMS) at all mass-gathering events held at or near a southeastern US university. In addition, to compare the existing literature base (single mass-gathering event held in large urban population centers) with a broader variety of events varying in crowd size and locations.

Methods: This was a retrospective review of all EMS records from mass-gathering patient presentations (individual-patient cases) between October 24, 2009, and August 27, 2011. All patrons seen by event-based EMS were included. Events categories included the following: football, concerts, public exhibitions, and nonfootball athletic events. Event volumes were defined as follows: low (<1000 patrons), medium (between 1001 and 15 000 patrons), and large (>15 000 patrons). Case presentation-management categories included the following: trauma, medical, and support (minimal medical intervention required, eg, minor dressing for abrasion, water, etc). Severity categories included the following: mild, moderate, and severe based on the following definitions using both provider assessment and the use of transport to a hospital: minor cases were considered non-life threats and did not result in a transport to a hospital; moderate cases were associated with transports to a hospital; and severe cases were life threats with transport to a hospital.

Results: We studied 79 events over the study period. Event volumes were 16.45% high, 79.75% medium, and 3.80% low. A total of 670 cases presented, with a mean of 8.48 cases/event. The football category had the highest mean number of cases with 37.09 cases/event, for a total of 408 cases. The nonfootball, athletic event category had the lowest mean number of cases at 1.83 cases/event. Most (81.82%) of the football events were classified as large volume. Support cases were the most common presentation (43.13%), followed closely by medical complaints (41.94%). Most cases were mild in severity (95.97%). There were 27 cases requiring transport to hospital, with 3 cases being life-threatening. The average patient age was 33 years, with 60.3% female sex. These features are similar to the published information on large event medical attendance.

Conclusions: In this retrospective, descriptive study of a broad range of event type, the most common patient presentations at mass-gathering events were mild in severity, requiring minimal medical intervention. Both transports from the event to a hospital and the occurrence of life threats were uncommon. Our findings are similar to the data found in the existing medical literature.

© 2013 Elsevier Inc. All rights reserved.

1. Introduction

The definition of a mass-gathering event has traditionally been a group of more than 1000 persons gathered at a specific location for a specific period, but most of the published literature reflects larger events accounting for more than 25 000 participants. The limits of this

definition are evident in that it only considers the size of the crowd, which is but a single descriptor of a rather diverse gathering of human beings at a mass-gathering situation [1]. Arbon [2] suggests a more appropriate definition as follows: a mass-gathering event is a situation during which a large gathering of persons occurs and produces limited access to patients, resulting in a delayed public safety response to medical emergencies.

Most mass events have encountered 0.5 to 2 casualties per 1000 spectators (5–20 per 10 000), depending on the influence of weather, event type, and other factors. Minor issues including illnesses, injuries, and first aid problems have been shown to represent more

* Corresponding author. Department of Emergency Medicine, University of Virginia School of Medicine, Charlottesville, VA 22908, USA.

E-mail address: wb42@virginia.edu (W.J. Brady).

than 75% of presenting complaints in most casualty-type reports. Outdoor events have been expected to have higher incidences of strenuous activity and environmentally related complaints (lacerations, sunburn, heat illness), whereas events such as rock concerts, which attract younger crowds, often result in a high level of illicit drug- and alcohol-related presentations [1]. Cardiac arrest and other significant medical/traumatic events occur much less commonly, yet on-site resuscitation services for certain event types are critical to improve patient outcome [3].

These common—and uncommon—presentation types are considered similar across the international literature. However, much of the existing work is limited to the description of a single mass-gathering event or event type [2,4–9]. Furthermore, the selected mass-gathering events described in the literature have mostly been located in large urban population centers, with very sizeable crowds in attendance [4]. However, these descriptions tend to focus on a single event or single-event types and are thus not reflective of mass events in general.

The current project was developed to analyze in a descriptive fashion multiple events, varying in nature, crowd size, environment, and setting types, ranging from suburban to rural. Our study aims to identify and evaluate the range, nature, and severity of medical presentations for a duration of 2 years for a wide variety of mass gatherings held at or near a southeastern US university community. Our study will capture a diversity of event types, ranging in size from low, through medium, to large attendance volumes, and organized into 4 distinct categories: football, concerts, public exhibitions, and athletic events.

We thus seek to address the current gap in the literature regarding broad, all-encompassing studies of medical events for multiple separate mass-gathering events occurring in a variety of settings. We will thus be able to compare our findings to the current literature and determine similarities and differences that will assist in the planning for medical resource allocation in the future. The data for this study were obtained from the work of the special events team, which is a partnership between local emergency medical service (EMS) and the university emergency department to provide medical staffing for mass-gathering events at the university and in the surrounding areas.

2. Methods

This was a retrospective review of all large event-dedicated EMS field records from mass-gathering patient presentations (cases) between October 24, 2009, and August 27, 2011. All patrons seen by EMS were included. Records were examined for 79 events, accounting for 670 patient presentations. Event categories included the following: football, nonfootball athletic events, concerts, and public exhibitions and gatherings. Because of the large attendance numbers traditionally associated with collegiate football games in the United States, we separated the football category from all other athletic events, creating the nonfootball athletic events; these athletic events included cage fighting, baseball, basketball, soccer, lacrosse, cycling, and polo. Public exhibitions and gatherings included the following: festivals, horse races, graduations, concerts, entertainment events (eg, Cirque du Soleil show, Curious George, and the Harlem Globetrotters), reunions, and animal shows.

Event volumes were defined as follows: low (<1000 patrons), medium (between 1000 and 15 000 patrons), and large (>15 000 patrons). This classification was established according to the sports arena guidelines of the university's attendance data.

Medical case severity categories included the following: mild, moderate, and severe. Moderate cases were defined as resulting in transport to a hospital, whereas mild cases were defined as not resulting in transport to a hospital. Severe cases were defined as life-threatening, always resulting in transport to a hospital (eg, stroke,

Table 1
Patient presentation categories

Trauma	Medical	Support
<ul style="list-style-type: none"> ■ Minor abrasions/lacerations ■ Minor strains/sprains ■ Minor Burns ■ Minor other ■ Major blunt head/trunk ■ Major penetrating ■ Major other ■ Previous injury/trauma 	<ul style="list-style-type: none"> ■ Weakness/Dizziness ■ Syncope ■ Chest pain ■ Dyspnea ■ Abdominal pain ■ Nausea/Vomiting ■ Neurologic complaint ■ Substance intoxication ■ Heat illness ■ Cardiac arrest 	<ul style="list-style-type: none"> ■ Glass of water ■ Band-Aid ■ Other

acute myocardial infarction, cardiac arrest, respiratory failure, acute altered mental status, severe heat illness, multiple trauma, etc).

Emergency medical services patient information from the medical encounters was de-identified and entered into a Microsoft Excel 2003 (Microsoft, Inc, Redmond, WA) database and analyzed using IBM SPSS statistical software. The below-category lists were compiled for the visits. Patient presentation categories included trauma, medical, and support and are defined in Table 1. Traumatic category was defined as a presentation that was primarily caused by a traumatic injury, whereas the medical category was defined as primarily resulting from a nontraumatic, medical event. The support category consisted of nonurgent, nonemergent routine request for basic medication care, such as dressing of minor wounds, resting in a cool location with oral fluids, over-the-counter pain medication for minor pain complaints, and so on.

Several well-recognized key characteristics of mass-gathering events have been described in the literature and have been acknowledged to influence upon medical presentations. These features include the following: weather (temperature and humidity expressed individually or as the heat index), event duration, indoor or outdoor location of the event, crowd seated or mobile at the event, bounded (fenced or contained) vs unbounded event, event type, crowd mood and availability of drugs and alcohol, crowd density, and average crowd age [10].

We examined the following event characteristics for each event category (athletic events, football, concerts, public exhibitions): (1) percentage seating, (2) inside vs outside location, (3) bounded (or contained) vs unbounded event, (4) availability of free (ie, no charge) water, (5) presence of alcohol, (6) event climate control (ie, air conditioning), and (7) heat index (composite indicator of heat and humidity).

3. Results

Over the reviewed study period, 79 events were surveyed, for 670 patient presentations. We recorded an overall mean of 8.48 patient presentations per event, for an overall incidence rate per 10 000 of

Table 2
Summary across event categories of patient presentations by complaints, severity, and incidence

		Total no. of patient presentations	Patient presentations per event, mean (SD)	Incidence rate per 10 000, mean (SD)
Overall		670	8.48 (18.05)	7.98 (9.09)
Complaint categories	Trauma	61	0.77 (1.21)	1.25 (2.38)
	Medical	281	3.56 (7.23)	3.88 (5.59)
	Support	289	3.66 (9.75)	2.72 (5.54)
	Unknown	39	0.49 (1.94)	0.18 (0.67)
Severity categories	Mild	643	8.14 (17.77)	7.44 (8.93)
	Moderate	24	0.30 (1.07)	0.50 (1.64)
	Severe	3	0.04 (0.34)	0.04 (0.31)

Table 3

Patient presentation categories and severities, event sizes and patient demographics across event categories

	All categories	Athletic events	Football	Concerts	Public exhibitions
No. of public events	79	29	11	23	16
Total patient presentations	670	53	408	88	121
Patient presentations, mean (SD)	8.48 (18.05)	1.83 (1.07)	37.09 (33.04)	3.83 (4.74)	7.56 (14.53)
Event size (%)					
Large	16.45	0.00	81.82	0.00	25.00
Medium	79.75	93.10	9.09	100.00	75.00
Small	3.80	6.90	9.09	0.00	0.00
Presentation categories, count (%)					
Trauma	61 (9.10)	16 (30.19)	17 (4.17)	10 (11.36)	18 (14.88)
Medical	281 (41.94)	17 (32.08)	140 (34.31)	55 (62.50)	69 (57.02)
Support	289 (43.13)	20 (37.74)	219 (53.68)	20 (22.73)	30 (24.79)
Unknown	39 (5.82)	0 (0.00)	32 (7.84)	3 (3.41)	4 (3.31)
Severity categories, count (%)					
Mild	643 (95.97)	47 (88.68)	406 (99.51)	84 (95.45)	106 (87.60)
Moderate	24 (3.58)	3 (5.66)	2 (0.49)	4 (4.55)	15 (12.40)
Severe	3 (0.45)	3 (5.66)	0 (0.00)	0 (0.00)	0 (0.00)
Age and sex					
Age (y), average (SD)	33.10 (16.88)	35.20 (18.39)	32.63 (10.19)	32.01 (15.75)	32.98 (19.74)
Female patients, count (%)	404 (60.30)	32 (60.38)	249 (61.03)	55 (62.50)	68 (56.20)

7.98 pooled for 670 individual event incidence rates. The average patient age was 33.10 ± 16.88 years, and 60.30% of patients were female. The most common complaint category in mean was support (289 patients), and the second most common complaint category was medical (281 patients). Most patient presentations were mild in nature (8.14 ± 17.77 patients per event).

The distribution and characteristics of patient presentations across event sizes and categories are presented in Tables 2 and 3. The football category was the highest in patient presentations, with 408 patient presentations for a mean per event of 37.09 ± 33.04 patients. Most mass-gathering events (79.75%) were medium in size (between 1000 and 15 000 patrons). Trauma accounted for 9.10% of patients, with athletic events claiming the highest percentage of trauma patient presentations with 30.19%. Across event categories, most patient presentations (95.97%) were mild in severity and did not require transport. Only 3 patients (0.45%) presented with severe (life-threatening) complaints. The sex distribution was female-dominated across all event categories, with the most pronounced dominance occurring in the concerts category where 62.50% of patients were female. Football events were predominantly large, with 81.82% of all football events having more than 15 000 in attendance. The athletic events, concerts, and public exhibitions categories consisted of mostly medium-sized events (1000–15 000 in attendance).

4. Discussion

Many investigators have described their experiences in the management of patients at mass events of varying types and sizes. These studies are valuable and can provide useful information for event planners. Unfortunately, these studies are rather uniform in that they focus entirely on either a single event or series of similar events. These studies, considered individually, do not describe the broad range of mass-gathering medical care. Taken as a whole, these studies do provide important descriptive information concerning mass-gathering medicine. For instance, in 1992, Bock et al [5] described the demographics of emergency medical care at the Indianapolis 500 Mile Race between 1983 and 1990. This series of events was then argued to be the largest single-day, single-venue sporting event in the world, with an estimated 400 000 people in attendance. The average number of patients treated was 139, and for 8 years, the total number of patients treated was 1113, with a total attendance estimated at 3 200 000 for a patient presentation rate (PPR) of 0.35 per 1000. The average patient age was 30.1

years, with 29% being female. Most presentations were chemical intoxication (16.2%), lacerations (15.4%), preexisting conditions (11.0%), and heat illness (8.5%). A similar description is found in the work of Zeitz et al [6], presenting a 7-year retrospective analysis of patient presentations in urban settings at the agricultural and horticultural 9-day Royal Adelaide Show, in Adelaide, Australia. Total average attendance for the 9 days was 616 629 patrons, with a daily crowd size of $68 514 \pm 17 812$. The most frequent patient presentation categories were minor medical complaints such as headaches, nausea and/or vomiting, and wounds ranging from lacerations to blisters.

Feldman et al [7] described in 2004 a single-day gathering event of a large magnitude: the 2003 “Toronto Rocks!” Rolling Stones Concert, attended by more than 450 000 people, of which 1870 sought medical attention (42/10 000 attendees). The average patient age was 28 ± 11 years, and 61% were female. Common presentations included headache (27%), heat-related complaints (12%), nausea or vomiting (7.6%), musculoskeletal complaints (6.9%), and breathing problems (6.6%). Grant et al [8] provided in 2010 a 5-year retrospective analysis of patient presentations at the massively attended 12-day annual New York State Fair held in Syracuse, NY. Total average attendance for the 12 days was 950 973 patrons from 2004 to 2008, with the most common patient presentations being dehydration/heat-related illness (11.4%), abrasion/laceration (10.6%), and fall-related injury (10.2%). The average PPR from 2005 to 2008 was $4.8 \pm 1.1/10 000$ patrons, the average age of all patients was 34.4 ± 21.6 years, and 58.1% of the patients were female.

Gutman et al [9] published in 2010 a Canadian descriptive study of the British Columbia World Police and Fire Games, an event that brought together 10 599 athletes from 55 countries in urban and suburban settings, over a 10-day period. There were 1462 patient encounters for a PPR of 109.4/1000 (1094/10 000), the majority being for musculoskeletal injuries (53.8%).

Our study attempts to find if the current descriptive literature established largely from a single mass-gathering event held in large urban population centers can be generalized to a broader variety of events varying in crowd size and held across a spectrum of locations ranging from rural to urban settings.

We noted a number of consistent findings when one compares our broad range of event types with the existing literature, focusing on the single large event or series of similar large events. Across all events, our calculated rate, on average, of 7.98 patient presentations per 10 000 spectators falls in line with the findings of the current literature, which are 5 to 20 casualties per 10 000 spectators [1]. Thus, there is a

homogeneity of patient incidence rates for mass-gathering events across multiple settings. Across all events, the average patient was female, in 60.30% of cases and 33.10 ± 16.88 years of age. Once again, these findings agree with the current literature where patients are predominantly female and range in mean age from 28 ± 11 to 34.4 ± 21.6 years. [7,8]

Across all events, we found that the medical and support categories together accounted for more than 80% of patient presentations, and 95.97% of all patient presentations were mild in severity and required no transport. Trauma only accounted for 9.10% of presentations, and high severity presentations occurred in less than 1% of the cases. Our findings agree with the current literature, where respiratory illnesses, minor injuries, minor first aid problems, and heat-related injuries have been shown to represent more than 75% of presenting complaints in most specific casualty-type reports [1]. A limitation of our findings lies in missing complaint category field data for 39 patients (5.82% of patients). Another limitation of our study is the low size of the total patient population (670 patients for 79 events).

5. Conclusion

In conclusion, the findings of our 2-year, multievent survey agree with the findings of the current descriptive literature. Event medical directors across the country can potentially use this information to appropriately budget medical resources for mass-gathering events occurring across a wide variety of settings. Owing to the low power of our study, there is a need for a bigger, multicenter, multisize descriptive study with a much greater number of patients to confirm the homogeneity of the descriptive findings in mass-gathering literature. Moreover, there is a need for a more in-depth correlation analysis, linking event characteristics and PPRs, to determine which

event characteristics significantly predict PPRs. The development of patient load predictive models in mass-gathering medicine will enable a more adept planning and budgeting of medical resources, for better patient care outcomes.

References

- [1] De Lorenzo RA. Mass gathering medicine: a review. *Prehosp Disaster Med* 1997;12(1):68–72PubMed PMID:10166378.
- [2] Arbon P. Mass-gathering medicine: a review of the evidence and future directions for research. *Prehosp Disaster Med* 2007;22(2):131–5PubMed PMID:17591185.
- [3] Wassertheil J, Keane G, Fisher N, Leditschke JF. Cardiac arrest outcomes at the Melbourne Cricket Ground and shrine of remembrance using a tiered response strategy—a forerunner to public access defibrillation. *Resuscitation* 2000;44(2):97–104PubMed PMID:10767496.
- [4] Jaslow D, Yancy II A, Milsten A. Mass gathering medical care National Association of EMS Physicians Standards and Clinical Practice Committee. *Prehosp Emerg Care* 2000;4(4):359–60PubMed PMID:11045418.
- [5] Bock HC, Cordell WH, Hawk AC, Bowdish GE. Demographics of emergency medical care at the Indianapolis 500 mile race (1983–1990). *Ann Emerg Med* 1992 Oct;21(10):1204–7PubMed PMID:1416298.
- [6] Zeitz KM, Schneider DP, Jarrett D, Zeitz CJ. Mass gathering events: retrospective analysis of patient presentations over seven years. *Prehosp Disaster Med* 2002(3):147–50PubMed PMID:12627918.
- [7] Feldman MJ, Lukins JL, Verbeek RP, MacDonald RD, Burgess RJ, Schwartz B. Half-a-million strong: the emergency medical services response to a single-day, mass-gathering event. *Prehosp Disaster Med* 2004;19(4):287–96PubMed PMID:15645624.
- [8] Grant WD, Nacca NE, Prince LA, Scott JM. Mass-gathering medical care: retrospective analysis of patient presentations over five years at a multi-day mass gathering. *Prehosp Disaster Med* 2010;25(2):183–7PubMed PMID:20468001.
- [9] Gutman SJ, Lund A, Turris SA. Medical support for the 2009 World Police and Fire Games: a descriptive analysis of a large-scale participation event and its impact. *Prehosp Disaster Med* 2011;26(1):33–9.
- [10] Milsten AM, Maguire BJ, Bissell RA, Seaman KG. Mass-gathering medical care: a review of the literature. *Prehosp Disaster Med* 2002;17(3):151–62PubMed PMID:12627919.