

# Health Service Impact from Mass Gatherings: A Systematic Literature Review

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**Conflicts of interest/funding:** This research was funded partially by a St John Ambulance Australia (Sydney, New South Wales, Australia) competitive research grant. The authors declare no conflicts of interest.

## Abstract

**Background:** During a mass gathering, some participants may receive health care for injuries or illnesses that occur during the event. In-event first responders provide initial assessment and management at the event. However, when further definitive care is required, municipal ambulance services provide additional assessment, treatment, and transport of participants to acute care settings, such as hospitals. The impact on both ambulance services and hospitals from mass-gathering events is the focus of this literature review.

**Aim:** This literature review aimed to develop an understanding of the impact of mass gatherings on local health services, specifically pertaining to in-event and external health services.

**Method:** This research used a systematic literature review methodology. Electronic databases were searched to find articles related to the aim of the review. Articles focused on mass-gathering health, provision of in-event health services, ambulance service transportation, and hospital utilization.

**Results:** Twenty-four studies were identified for inclusion in this review. These studies were all case-study-based and retrospective in design. The majority of studies ( $n = 23$ ) provided details of in-event first responder services. There was variation noted in reporting of the number and type of in-event health professional services at mass gatherings. All articles reported that patients were transported to hospital by the ambulance service. Only nine articles reported on patients presenting to hospital. However, details pertaining to the impact on ambulance and hospital services were not reported.

**Conclusions:** There is minimal research focusing on the impact of mass gatherings on in-event and external health services, such as ambulance services and hospitals. A recommendation for future mass-gathering research and evaluation is to link patient-level data from in-event mass gatherings to external health services. This type of study design would provide information regarding the impact on health services from a mass gathering to more accurately inform future health planning for mass gatherings across the health care continuum.

Ranse J, Hutton A, Keene T, Lenson S, Luther M, Bost N, Johnston ANB, Crilly J, Cannon M, Jones N, Hayes C, Burke B. Health service impact from mass gatherings: a systematic literature review. *Prehosp Disaster Med.* 2017;32(1):71-77.

**Keywords:** Emergency Medical Services; emergency rooms; hospitals; mass gathering; paramedic; planned event

## Abbreviations:

EMS: Emergency Medical Services  
ER: emergency room  
PDM: Prehospital and Disaster Medicine  
PPR: patient presentation rate  
RTHR: referral to hospital rate  
TTHR: transport to hospital rate

Received: February 10, 2016

Revised: May 29, 2016

Accepted: June 12, 2016

Online publication: December 12, 2016

doi:10.1017/S1049023X16001199

## Introduction

A mass gathering can be defined as an event where a group of people come together for a common purpose within a particular space or venue, such as a sporting event, music festival, or agricultural show.<sup>1</sup> From a health delivery perspective, Arbon<sup>2</sup> defined a mass gathering as an event “where there is the potential for a delayed response to [health] emergencies because of limited access to patients or other features of the environment and location.” Health services often are provided to participants of a mass gathering by a combination of in-event health services (eg, first aid or medical tent within the event boundaries) and external health services (eg, ambulance services and local hospitals) within a tiered hierarchy of clinical capacity (Figure 1).<sup>3</sup>

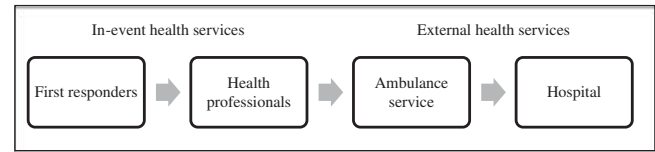
First responders at mass gatherings provide in-event health services at a first aid level of patient assessment and management. First responders have additional first aid training and experience when compared to a lay person. The workload of first responders reported in the literature frequently is represented as a patient presentation rate (PPR).<sup>4</sup> The majority of mass-gathering participants who present for clinical assessment and/or management to dedicated first responders have minor injuries or illnesses and commonly return to the event.<sup>5</sup> On occasion, patients may be referred to in-event health professionals, such as doctors, nurses, and/or paramedics who can provide a higher level of in-event health care.

When the volume of patient presentations or patient acuity exceeds the capability of the in-event health services, there is a reliance on local health community resources external to the mass gathering. Patients may require clinical assessment, management, and transportation by paramedics of the local Emergency Medical Services (EMS) or ambulance service to an acute care facility.<sup>6</sup> The transport to hospital rate (TTHR) specific to a mass gathering represents the workload of ambulance services from a mass gathering.<sup>7,8</sup> If patient transport is required from a mass gathering, the local hospitals are the most likely destination for this definitive care. Mass-gathering participants also may attend a local hospital by using transport other than an ambulance service, such as a private car or public transport. The referral of participants to hospitals from a mass gathering is reported as a referral to hospital rate (RTHR).<sup>7</sup>

Overall, in-event health services aim to maximize the efficiency in responding to health emergencies at a mass gathering, while minimizing the disruption to the normal operational capacity of the external health services in the surrounding community, including the EMS or ambulance service and hospital services.<sup>3,7,9</sup> By their nature, mass gathering are unusual events in that patients from these events may place an unusual or excessive demand on community health services. However, the impact on external health services from mass gatherings is not well understood.

## Aim

This literature review aimed to develop an understanding of the impact on health services from mass gatherings pertaining to in-event and external health services. This research will provide a valuable step in the broader agenda of mass-gathering health service planning, health service provision, health workforce appropriateness, and health service impact. The research question for this systematic review was: What is the impact of a mass gathering on in-event and external acute health services, such as ambulance services and hospitals?



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**Figure 1.** Hierarchy of Clinical Care at Mass Gatherings (Modified from Lund, et al; 2014).

Mass Gathering	EMS/Ambulance Services	Hospital
Mass gathering	Emergency Medical Services	Hospitals
Mass-gathering medicine	Paramedic	Emergency medicine
Mass-gathering health	Ambulance diversion	Emergency treatment
Event	Transportation of patients	Emergency room
Major event	Pre-hospital emergency care	Emergency departments
Planned event		Accident and emergency departments
		Hospitalization

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**Table 1.** Search Terms

Note: “OR:” will be used to combine keywords in the same column; “AND:” will be used to include keywords between columns.

## Methods

### Design

A systematic literature review design based on the Preferred Reporting Items of Systematic reviews and Meta-Analysis (PRISMA) guidelines<sup>10</sup> was conducted to answer the research question.

### Search Strategy and Data Collection

Databases and search engines, including OvidSP (Ovid Technologies; New York, New York USA); MEDLINE [Medline Industries, Inc.; Mundelein, Illinois USA]; PsycINFO [American Psychological Association; Washington DC, USA]; and DARE [Rutgers University Libraries; New Brunswick, New Jersey USA], CINAHL (EBSCO Information Services; Ipswich, Massachusetts USA); Pubmed (National Center for Biotechnology Information; Bethesda, Maryland USA); and Scopus (Elsevier; Amsterdam, Netherlands) were used for this review. The search strategy included different combinations of Medical Subject Headings (MeSH) terms and keywords that were relevant to mass gatherings, EMS/ambulance services, and hospitals. All keywords are outlined in Table 1.

In addition to the search strategy used above, manuscripts were obtained directly from the journal *Prehospital and Disaster Medicine* (PDM; Madison, Wisconsin USA). The journal PDM is known to have numerous publications relating to mass-gathering health.<sup>8</sup> The table of contents for each issue of PDM was screened

Inclusion Criteria	Exclusion Criteria
<ul style="list-style-type: none"> <li>● Real world events.</li> <li>● Description of in-event health services at a mass gathering (eg, first aid and/or health professionals).</li> <li>● Description of external health services resulting from a mass gathering (eg, ambulance and/or hospital).</li> <li>● Published inclusive of the period 2005 through 2014.</li> <li>● Published in English in a peer-reviewed journal.</li> </ul>	<ul style="list-style-type: none"> <li>● Editorials.</li> <li>● Discussion papers.</li> <li>● Theoretical papers.</li> <li>● Reports on mass casualty and disaster incidents that occurred at mass gatherings.</li> </ul>

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Table 2. Inclusion and Exclusion Criteria

for papers relating to mass gatherings. Specific inclusion and exclusion criteria were applied to determine the appropriateness of each manuscript to answer the review question (Table 2).

### Data Analysis

Information extracted from each paper was entered into a Microsoft Word 2010 table (Microsoft Corporation; Redmond, Washington USA). This information included: author(s), year of publication, country where the mass gathering took place, type of mass-gathering event, reported PPR, if in-event health professionals were present, reported TTHR, and reported RTHR.

### Results

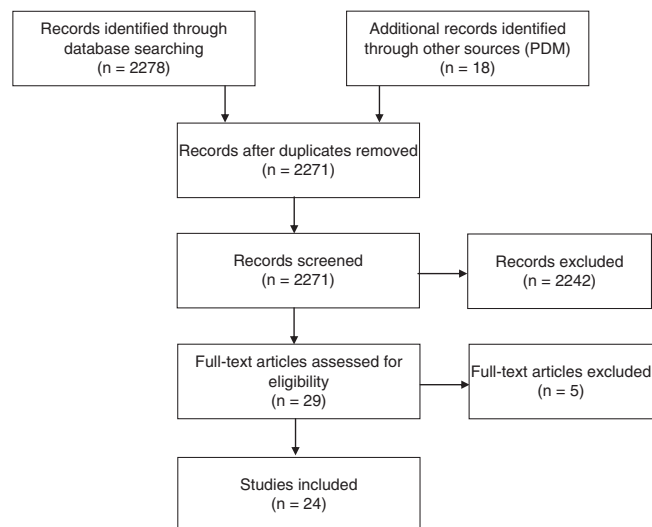
In total, 24 studies met the criteria for inclusion (Figure 2). Data extracted to inform this literature review are displayed in Table 3.<sup>11-33</sup>

#### In-event Health Services

The majority of studies ( $n = 23$ ; 96%) included in this review discussed patient presentations to in-event first responders. Of these, 13 reported the PPR, which ranged between 0.013/1,000 and 198.93/1,000. The remaining 11 studies reported the raw number of patient presentations rather than a rate. The majority of the studies ( $n = 22$ ; 92%) stated that in-event health professionals were present at the mass gathering. However, there was variation in the reporting of the number and type of health professionals. Broadly, health professionals included Medical Officers, Nurses, Nurse Practitioners, Physiotherapists, and Paramedics.

#### External Health Services

All studies included in this review reported that some patients required transfer by ambulance to hospital. Of these, most ( $n = 16$ ; 67%) studies reported this as a raw number. The remaining ( $n = 8$ ; 33%) studies reported the TTHR, which varied between 0.0035/1,000 and 0.99/1,000. In terms of hospital services impact, less than one-half of studies ( $n = 9$ ; 38%) included the number of patients presenting to hospital. Only one study reported the number of patients presenting to hospital as an RTHR ( $n = 1$ ; 4.5%); one study was unclear about the actual numbers of patients presenting to hospital ( $n = 1$ ; 4.5%); and the remaining ( $n = 7$ ; 29%) reported a raw number.



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Figure 2. PRISMA Flow Diagram.<sup>10</sup>

### Discussion

This literature review is, as far as the authors are aware, the first to focus exclusively on the impact of mass gatherings on local health services. In particular, this review highlights two aspects of health service provision associated with mass gatherings: the uptake of in-event health services and the impact on external health services.

#### In-event Health Services

It is well-established that patient presentations to first responders at mass gatherings vary depending on biomedical, environmental, and psychosocial factors.<sup>4</sup> The results from this review, coupled with previous discussions, have shown that reporting PPR rather than raw patient numbers is critical to allow for comparison and meta-analysis in mass-gathering research and evaluation.<sup>7,8</sup> Further, the literature pertaining to first responder in-event health services remains varied in reporting, focusing on single case studies and the characteristics of patient presentations. Reporting only on patient presentations and patient presenting problems lacks the detail required to assess the impact of in-event first responder services adequately at mass gatherings.

The presence of in-event health professionals was mentioned in all studies. However, the explicit detail of the number of health professionals, discipline area, clinical skill level, and duration of the shift scantily was reported. The type of health professionals present may be directly related to the TTHR. The literature pertaining to in-event health professionals requires development to provide insight into the impact of in-event health professionals at mass gatherings, such as the effect of having health professionals at mass gatherings on patient outcomes and ambulance and hospital avoidance. Future datasets for the research and evaluation of in-event health professionals at mass gatherings should contain information such as the number and skill mix of health professionals as well as the clinical interventions they performed. Possible future data points aimed at capturing the impact of health services are outlined in Table 4. Additionally, a description of the clinical governance structures and decision making of in-event health professionals would be useful to compare the health professional contexts between mass gatherings.

Author/s	Nation	Event Type	In-event Health Services		External Health Services	
			PPR (Per 1,000)	In-event Health Professionals	TTHR (Per 1,000)	RTHR (Per 1,000)
Grissom et al [11] 2006	USA	Winter Olympic Games 2002	2.6	Yes	6 <sup>b</sup>	26 <sup>b</sup>
Hiltunen et al [12] 2007	Finland	World Championship Games in Athletics	1.6	- <sup>a</sup>	0.052	25 <sup>b</sup>
Yazawa et al [13] 2007	Japan	Suwa Onbashira Festival	0.013	Yes	0.0035	- <sup>a</sup>
Dutch et al [14] 2008	Australia	2006 Commonwealth Games	0.86	Yes	0.2	- <sup>a</sup>
Nguyen et al [15] 2008	USA	Marathon	252 <sup>b</sup>	Yes	17 <sup>b</sup>	- <sup>a</sup>
Tang et al [16] 2008	USA	Baltimore Marathon: 2002-2005	1,144 <sup>b</sup>	Yes	16 <sup>b</sup>	- <sup>a</sup>
Agar et al [17] 2009	United Kingdom	Outdoor endurance challenge	251 <sup>b</sup>	Yes	9 <sup>b</sup>	- <sup>a</sup>
Boeke et al [18] 2010	USA	Cycling event	419 <sup>b</sup>	Yes	190 <sup>b</sup>	- <sup>a</sup>
Grant et al [19] 2010	USA	Fair	0.48	Yes	0.27	- <sup>a</sup>
Nguyen et al [15] 2010	USA	Marathon	- <sup>a</sup>	- <sup>a</sup>	15 <sup>b</sup>	- <sup>a</sup>
Wood et al [20] 2010	United Kingdom	Festival events	227 <sup>b</sup>	Yes	24 <sup>b</sup>	- <sup>a</sup>
Gutman et al [21] 2011	Canada	World Police and Fire Games	109.4	Yes	0.52	13 <sup>b</sup>
Jennings et al [22] 2011	Australia	Australian Formula 1 Grand Prix 2011	69 <sup>b</sup>	Yes	1 <sup>b</sup>	- <sup>a</sup>
Lyons et al [23] 2011	United Kingdom	Cricket matches	2.4	Yes	7 <sup>b</sup>	Unclear
Blank et al [24] 2012	Austria	Winter Youth Olympic Games 2012	267 <sup>b</sup>	Yes	89 <sup>b</sup>	- <sup>a</sup>
Bledsoe et al [25] 2012	USA	Burning Man 2011: Outdoor arts festival	2,307 <sup>b</sup>	Yes	33 <sup>b</sup>	- <sup>a</sup>
Krul et al [26] 2012	The Netherlands	Rave parties	0.5-2.0	Yes	7 <sup>b</sup>	22 <sup>b</sup>
Bortolin et al [27] 2013	Italy	Holy Shroud Exhibition 2010	0.27	Yes	0.039	- <sup>a</sup>
Locoh-Donou et al [28] 2013	United States	Various University events	0.79	Yes	27†	- <sup>a</sup>
McGrath et al [29] 2013	USA	Mountain bike race	30 <sup>b</sup>	Yes	1 <sup>b</sup>	1 <sup>b</sup>
Pakravan et al [30] 2013	UK	County show	2.0	Yes	0.1	- <sup>a</sup>
Williamson et al [31] 2013	United Kingdom	2009 Special Olympics – Great Britain	581 <sup>b</sup>	Yes	12 <sup>b</sup>	20 <sup>b</sup>

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Table 3. Reviewed Manuscripts (*continued*)



Author/s	Nation	Event Type	In-event Health Services		External Health Services	
			PPR (Per 1,000)	In-event Health Professionals	TTHR (Per 1,000)	RTHR (Per 1,000)
Lund et al [32] 2014	Canada	Cycling event	125.66-198.93	Yes	0.69-0.99	1.38-1.99
Sabra et al [33] 2014	USA	Formula One USA Grand Prix	2.13	Yes	22 <sup>b</sup>	22 <sup>b</sup>

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**Table 3** (*continued*). Reviewed Manuscripts

Abbreviations: PPR, patient presentation rate; RTHR, referred to hospital rate; TTHR, transport to hospital rate.

<sup>a</sup>This variable was not reported by the authors.<sup>b</sup>A raw number was presented by the authors as a total number of people, rather than presenting a rate.

### External Health Services

Variation exists in the literature in the reporting of patient transport to hospital by ambulance paramedics. Some papers reported a transport rate whereas others reported a raw number. It has been suggested previously that the reporting of a TTHR should be represented as the number of attendees who are transported to hospital, from an event by ambulance, as a rate per 1,000 participants.<sup>7</sup> Beyond the reporting of the number of patients transported to hospital, there exists a lack of detailed case and/or patient-level data reported, pertaining to ambulance transport from mass gatherings. Therefore, the ability to gain insight into the impact on ambulance services from mass gatherings, as currently reported in the literature, remains unclear.

In order to inform the impact on ambulance services, data to be included in future mass-gathering research and evaluation should include on-scene treatment duration, interventions provided by paramedics, and transport duration (Table 4). Additionally, it may be pertinent to report if the ambulances utilized for the mass-gathering response were diverted from normal community operations or if ambulances were allocated specifically for the purpose of the treatment, management, and transportation of mass-gathering participants. Such information would provide a starting point for future event planning with an aim to minimize the diversion of ambulance services from normal community operations as well as planning for emergency department diversion.

Some work has been undertaken to predict patient presentations to hospital emergency departments/emergency rooms (ERs) from the general community population.<sup>34,35</sup> However, predicting the patient presentations to ERs as a result of mass gatherings is not yet discussed in the literature. Only nine studies were identified in this literature review that included patient referrals and/or presentations to ERs secondary to the mass gathering. This provides some insight into the impact on hospital services from a mass gathering; however, it is not a substantial body of knowledge to enable future planning. As such, future mass-gathering research and evaluation should focus on the actual presentations to hospitals in addition to the currently reported referrals from in-event first responders and health professionals. Furthermore, data could include presenting patient triage category, interventions provided, and patient length of stay. This would provide insight into the ER impact from mass gatherings (Table 4).

Reference to the number of patients admitted to hospital in-patient units was specifically made in one manuscript (from the World Championship Games in Athletics in Helsinki, Finland) where 25 people presented to hospital, with four of these presentations requiring hospital admission.<sup>12</sup> To gain a broader understanding of the impact of mass gatherings on hospital services, hospital admission data need to be included. These data could include the patient length of stay in various in-patient units, interventions performed, and patient outcomes from hospitalizations (Table 4). This type of data would provide a more detailed layer of information for future research and evaluation regarding the impact on hospitals from mass gatherings and should be included in future research and evaluation.

### Limitations

This literature review was restricted to journals published in English. As such, publications in other languages have not been included. Additionally, this literature review only included peer-reviewed literature. As such, non-indexed, or grey literature, was not included in the results of this review. The search terms used in this review were specific. Using additional search terms may have revealed additional publications. Overall, publications from other languages, the non-index literature, and including broader search terms may have produced additional literature and therefore provided further insight into the impact of mass gatherings on health services.

### Conclusion

The international mass-gathering literature on the health service impact from mass gatherings focuses on the in-event health services such as PPR to in-event first responder services. There is limited research regarding the understanding of the impact of in-event health professionals' presence at mass gatherings. Furthermore, the impact on health services external to mass gatherings is reported inconsistently in the literature. Reporting of the requirement of mass gatherings on ambulance services is varied, articulated as either a raw number of patients or as a TTHR, without details of treatment modalities or duration. Additionally, the reporting of hospital presentations is minimal and generally reported as a raw number. Furthermore, the ambulance and hospital presentations reported in the literature do not articulate the financial or workload impact of mass gatherings on these health services. As such, future research and evaluation regarding mass

IN-EVENT HEALTH SERVICES			
Health Professionals	Years of Experience		In Years
	Discipline	1	Physician
		2	Registered Nurse
		3	Enrolled Nurse
		4	Paramedic
		5	Ambulance Officer
		6	Physiotherapist
		7	Pharmacist
		8	Dentist
		9	Other
	Clinical Interventions Performed		List
EXTERNAL HEALTH SERVICES			
Ambulance Service	On-scene Treatment Duration		In Minutes
	Clinical Interventions Performed		List
	Transport Duration		In Minutes
	Was the ambulances diverted from normal community operations?	1	Yes
2		No	
Hospital Service (Emergency Room)	Triage Category		List
	Interventions Provided		List
	Patient Length of Stay		In Minutes
	Patients that did not Wait for Treatment		Rate
	Discharge Destination from the Emergency Room	1	Home
		2	Inpatient Unit
3		Observation Unit	
4		Other	
Hospital Service (Inpatient Unit)	Unit Type		List
	Interventions Performed		List
	Patient Length of Stay		In days
	Patient Outcome	1	Home
		2	Other
		Primary ICD-10 Code	

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Table 4. Potential Patient Data Set and Entry Codes

gatherings should include the impact on external health services and report on actual patient presentations, including duration of treatment, interventions performed, and patient outcomes. Linking patient-level data from in-event mass-gathering presentations and

treatments to external health services would provide a better understanding of the impact of mass gatherings on ambulance and local hospital services. This information will then guide future health planning for mass gatherings across the health continuum.

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