TITLE:
Minimum data set for mass gathering health research and evaluation: A discussion paper

RUNNING TITLE:
Minimum data set for mass gathering health research

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Abstract

This paper discusses the need for consistency in mass gathering data collection and biomedical reporting. Mass gatherings occur frequently throughout the world and having an understanding of the complexities of mass gatherings is important to inform health services about the possible required health resources. Factors within the environmental, psychosocial and biomedical domains influence the usage of health services at mass gatherings. The biomedical domain includes the categorisation of presenting injury or illness and rates such as patient presentation rate, transferred to hospital rate and referred to hospital rate. These rates provide insight into the usage of onsite health services, prehospital ambulance services and hospital emergency department services.

Within the literature these rates are reported in a manner that is varied, haphazard and author dependent. This paper proposes moving from an author dependent practice of collection and reporting of data. An expert consensus approach is proposed as a means of further developing mass gathering theory and moving beyond the current situation of reporting on individual case studies. To achieve this minimum data set with a data dictionary is proposed in an effort to generate conversation about a possible agreed minimum amount and type of information that should be consistently collected for research and evaluation at mass gatherings. Finally, this paper outlines future opportunities that will emerge from the consistent collection and reporting of mass gathering data, including the possibility for meta-analysis, comparison of events across societies and modelling of various rates to inform various health services.

Introduction

Mass gatherings, such as soccer games, pageants and concerts occur frequently throughout the world. Commonly mass gatherings impact health services such as onsite health services, ambulance and prehospital emergency medical services, hospital emergency departments and acute medical care services including operating theatres. Furthermore, mass gatherings are important sites to research health behaviours because they help to understand how to manage large numbers of people in temporary environments.

Throughout the literature the term 'mass gatherings' is defined in many ways. Commonly the defining factor of a mass gathering is related to the number of attendees at an event, such as an event with greater than 25,000 attendees. However, on closer examination, a mass gathering seems more complex than this. An alternative and perhaps more appropriate definition of a mass gathering is: "a situation (event) during which crowds gather and where there is the potential for a delayed response to emergencies because of limited access to patients or other features of the environment and location." This potential delay requires planning and preparation to limit (or mitigate) the hazards inherent in a mass gathering and ensure timely access to appropriate health care is available".[1] Throughout this discussion, the term attendees will be used to describe a spectator or participant of an event.

According to Arbon[2] it has been suggested that there are three distinct domains which influence the health service presentation of patients at mass gatherings: environmental, psychosocial and biomedical. The environmental domain includes factors such as the nature of the event, availability of drugs or alcohol, venue characteristics and meteorological factors. The psychosocial domain includes the crowd mood and behaviour, crowd culture, and reason for attendance. The biomedical domain includes factors such as demographics and health status of spectators and participants.

This paper aims to initiate international discussion of the need for consistency in the reporting of data from mass gatherings, while acknowledging that meaningful data collection and reporting

across societies and mass gatherings needs to be flexible. Presented is the current situation of data collection and reporting, a possible minimum data set, and outlines some future opportunities.

Current Situation

When examining the biomedical domain of the mass gathering literature, the focus is on categorising presenting injury or illness, reporting patient presentations rates (PPR) or medical usage rates (MUR), and exploring other factors, such as transportation to hospital rates (TTHR).

Injury/Illness Categorisation

In the earlier mass gathering literature, authors commonly listed a breakdown of specific types of injuries and illness of patients who presented to health services at mass gathering sites.[3,4] For example Rose et al.,[5] reviewed data from six and a half years of patient presentations at Collegiate Football Games in the United States. However, the authors did not commonly make reference to the origin of these lists of types of injuries and illness, and therefore this patient presentation method becomes author-dependent and cannot be generalized to other mass gathering events.

Another concern when presenting specific levels of data is that some categories may have larger counts than others. For example, in the comparison of injuries and illnesses from U.S. football, baseball and rock concerts, a large amount of presentations (69%) are termed as 'medical-related' with no further explanation.[3] By categorising presentations as 'medical related' the types of presentations are not well defined.

In addition the 2002 FIFA World Cup data illustrated that 'other' and 'unrecorded' consisted of 24.9% and 21.7% of the total presentations respectively.[6] This unspecified data highlights how having large counts in categories such as 'other' limits the insight gained at an event. While reporting at a specific category level, some reduce the number of counts in an 'other' category to represent less than 1%.[4] This strategy is more useful to determine the true types of presentations.

To describe the severity of injury and illness some authors report patient presentations in a broader, non-specific manner. This may include categories such as minor, intermediate and major.[7] Alternative categories have included 'basic-level', 'advanced-level' and 'life-threatening level'.[8] When these broad categories are used, the authors either provide descriptors,[7] or examples[8] of the types of injuries and illnesses included in each category. On occasions, it may be worthwhile having a specific breakdown of injuries and illness which cannot be articulated from non-specific levels of categorisation. Whereas, broad illness and injury categories can be determined from reports of specific levels of categorisation.

Patient Presentation Rates

Within the literature, terms such as 'patient presentation rate' (PPR) and 'medical usage rate' are used interchangeably. These are crude rates[9] which refer to the number of attendees who present to onsite health services, in comparison to the overall number of attendees.

$$\boldsymbol{PPR = \frac{Attendees\ who\ present\ to\ the\ onsite\ health\ service}{Total\ number\ of\ attendees\ at\ the\ event}}$$

PPR provides insight into the onsite health service usage. However, PPR does not always reflect the acuity of individual patients which may influence the onsite health service requirements. Additionally, event duration may be an important factor which is not explicitly considered in PPR, as PPR may vary over hours, days or weeks. In the literature PPRs are presented as either raw numbers, or as presentations per 100, 1000 or 10,000 attendees with no consideration of the length of the event.

Raw numbers are used on occasions to highlight the number of patient presentations.[10,11] During the early development of mass gatherings research and evaluation, authors reported PPR per 100 attendees.[12] Following the 2002 FIFA World Cup, PPR was reported as per 1000 attendees.[6] This trend is similar to others who report per 1000 attendees.[4] In contrast, some have reported PPR as presentation per 10,000 attendees. This paper encourages the standardising of PPR as, presentations to onsite health services per 1000 attendees for generalizability across all events.

$$\boldsymbol{PPR = \frac{Attendees\ who\ present\ to\ the\ onsite\ health\ service}{Total\ number\ of\ attendees\ at\ the\ event} \times 1{,}000}$$

Other Rates

Transport to hospital rate (TTHR) provides insight into the prehospital ambulance or emergency medical service usage. In the literature, TTHR has been reported as a percentage,[13] as 1000 attendees,[4] or as 10,000 attendees.[13] As variability exists in reporting TTHR, this paper encourages the standardised reporting of TTHR as presentations to onsite health services per 1000 attendees.

$$\boldsymbol{TTHR = \frac{Attendees\ who\ are\ transported\ to\ hospital\ by\ ambulance}{Total\ number\ of\ attendees\ at\ the\ event} \times 1{,}000}$$

A rate that has not been widely reported in the literature is the referral to hospital rate (RTHR). This rate includes patients that are transported to hospital (TTHR). Additionally, it includes patients that are referred to hospital and do not travel by ambulance. This rate gives some insight into the usage rate of hospital emergency departments in the vicinity of the mass gathering and the value of onsite care in regards to hospital avoidance.

$$\boldsymbol{RTHR = \frac{Attendees\ who\ are\ referred\ to\ hospital\ by\ all\ means}{Total\ number\ of\ attendees\ at\ the\ event} \times 1{,}000}$$

Other Data Collection

In addition to categorising injury and illness and highlighting various rates, some authors report on patient demographics.[3] This data provides additional insight into the 'type' of patients at mass gatherings. Some authors report on the level of care, making comparison of onsite health resources, such as number of medical officers, nurses, paramedics, volunteers, and ambulances compared to the number and type of patients treated.[14] Additionally, some authors include patient disposition, such as return to the event or transported to hospital.[3]

Minimum Data Set

In collecting biomedical data from mass gatherings, there may be an agreed upon minimum data set.[15] A minimum data set is a tool that can be used to collect de-identified patient-level information for the purpose of making comparisons across societies and individual mass gatherings. It is proposed that there be the introduction of a minimum biomedical data set for mass gathering evaluation and research. The proposed minimum data set (table 1) was developed based on injury and illness categorizations of 1) published authors in the mass gathering literature, 2) the 'injury surveillance national minimum data set' from the Australian Institute for Health and Welfare,[15] 3) the 'Event and emergency first aid minimum data set' from St John Ambulance Australia,[16] and 4) the authors experience of undertaking research, evaluation and as practicing clinicians at mass gatherings.

In addition to presenting a minimum data set, a data dictionary with associated descriptors relating to data entry codes (table 2) is included to assist in differentiating between the various categories and to assist in providing in consistency in reporting.

An example of a data collection tool and data entry using Microsoft Excel, 2010 (Microsoft Corp, Redmond, WA, USA) is shown in Figure 1. This data includes the minimum data set in table 1 and categories from the data dictionary in table 2.

Future Opportunities

Currently, mass gathering data is collected and held by individual persons or organizations undertaking research and evaluation. To enhance understanding of the complexities of mass gatherings, there is a need for consistent collection of data by individuals and organisations. Having consistent data will provide the possibility for meta-analysis of events and comparison of similar events within different societies or the comparison of a single event over time. In addition a consistent data set would better inform health services about their possible involvement and requirements at mass gatherings and inform event managers about health risks and implications of their event.

Retrospective review of a mass gathering data has been argued as an accurate predictor of PPR and TTHR.[11,17] However, when retrospective information about a future mass gathering is not available, being able to compare like-mass gatherings in different societies or different mass gatherings may be sufficient to gain some insight into the likely PPR, TTHR and RTHR. Statistical analysis using odds ratios or Chi square[9] may be a first step in gaining a better understanding of some of the variances between societies and mass gatherings.

Modelling to predict health service requirements at Australian mass gatherings has been published.[18] However, these models are limited as they were generated from Australian populations where attendees at mass gatherings were greater than 25000 attendees and were developed more than a decade ago. Predicting and modelling health service resources are important for health workforce strategies at mass gatherings. In predicting health resources at a mass gathering the PPR, TTHR, RTHR would be considered the outcome (dependant) variables. Explanatory (independent) variables from the biomedical, psychosocial and environmental domains should be included in any modelling. With a consistent data set, it can be argued that predictive modelling would more closely forecast the realities of a mass gathering.[9]

A minimum biomedical data set and agreed method of reporting rates and outcomes associated with mass gatherings will allow for the retrospective comparison of events and prospective predictive modelling of events. The information derived from retrospective comparison and predictive modelling can aid in mass gathering medical services planning. Highlighted above are some possible approaches to data analysis. The specific details of a possible data analysis plan and possible data analyses are not the focus of this paper, however, these should be taken into consideration in any overarching conversation about consistency in a minimum data set.

Conclusion

This paper has highlighted the research and evaluation of the biomedical domain of mass gatherings as being varied, haphazard and author dependent, particularly in terms of data collection and

reporting. This is illustrated in terms of the various data collection and reporting of patient categories, rates and other biomedical related information. It is proposed that a minimum data set and data dictionary be developed to begin discussion of the need for consistency in collecting and reporting data. Moving to a more expert consensus approach and beyond a haphazard, author-dependent approach will allow development of mass gathering, health service research and theory.

REFERENCES

1. Arbon P. Mass-gathering medicine: A review of the evidence and future directions for research. *Prehosp Disater Med.* 2007;22(2):131-135.

2. Arbon P. The development of conceptual models for mass-gathering health. *Prehosp Disater Med.* 2004;19(3):208-212.

3. Milsten AM, Maguire BJ, Bissell RA, Seaman KG. Mass-gathering medical care: A review of the literature. *Prehosp Disater Med.* 2002;17(3):151-162.

4. Zeitz KM, Zeitz CJ, Arbon P, Cheney F, Johnston R, Hennekam J. Practical solutions for injury surveillance at mass gatherings. *Prehosp Disater Med.* 2008;23(1):76-81.

5. Rose WD, Laird SL, Prescott JE, Kuhns GB. Emergency medical services for collegiate football games: A six and one-half year review. *Prehosp Disater Med.* 1992;7:157-159.

6. Morimura N, Katsumi A, Koido Y, Sugimoto K, Fuse A, Asai Y, et al. Analysis of patient load data from the 2002 FIFA World Cup Korea/Japan. *Prehosp Disater Med.* 2004;19(3):278-284.

7. Olapade-Olaopa EO, Alonge TO, Amanor-Boadu SD, Sanusi AA, Alese OB, Omisanjo OO, et al. On-site physicians at a major sporting event in Nigeria. *Prehosp Disater Med.* 2005:21(1):40-44.

8. Yazawa K, Kamijo Y, Sakai R, Ohashi M, Owa M. Medical care for a mass gathering: The Suwa Onbashira Festival. *Prehosp Disater Med.* 2007;22(5):431-435.

9. Pagano M, Gauvreau K. *Principles of biostatistics* (2nd edn.). United States: Duxbury, 2000.

10. Feldman MJ, Lukins JL, Verbeek PR, MacDonald RD, Burgess RJ, Schwartz B. Half-a-million strong: The emergency medical services response to a single day, mass gathering event. *Prehosp Disater Med.* 2004;19(4)287-296.

11. Zeitz KM, Zeitz CJ, Arbon P. Forecasting medical work at mass-gathering events: Predictive model versus retrospective review. *Prehosp Disater Med.* 2005;20(3):164-168.

12. Hnatow DA, Gordon DJ. Medical planning for mass gathering: A retrospective review of the San Antonio Papal Mass. *Prehosp Disater Med.* 1991;6(4):443-450.

13. Hiltunen T, Kuisma M, Maataa T, Tennila A, Hari T, Backman R, Vayrynen T. *Prehosp Disat Med.* 2007;22(4):304-311.

14. Nguyen RB, Milsten AM, Cushman JT. Injury patterns and levels of care at a marathon. *Prehosp Disater Med.* 2008;23(6):519-525.

15. Australian Institute of Health and Welfare (AIHW). Injury surveillance national minimum data set: national health data dictionary, Version 12. National health data dictionary. (Cat. no. HWI 57). Canberra: AIHW. 2003.

16. St John Ambulance Australia (SJAA). Event and emergency first aid minimum data set proposal. Canberra: Australia 2005.

17. Zeitz KM, Schneider DPA, Jarrett D, Zeitz CJ. Mass gathering events: retrospective analysis of patient presentations over seven years at an agricultural and horticultural show. *Prehosp Disater Med.* 2002;17(3):147-150.

18. Arbon P, Bridgewater FHG, Smith C. Mass gathering medicine: A predictive model for patient presentation rates. *Prehosp Disater Med.* 2001;16(3):109-116

FIGURES

No	Age	Gende	Date	Time	Rx Dur	Type	Injury	Inj Loc	Injury	Inj Loc	Injury	Inj Loc	Illnes	Enviro	MH	Out
1	41	1	20/10/2004	1010	8	1	11	19								0
2	32	1	20/10/2004	1055	10	1	25	14								0
3	25	1	20/10/2004	1040	5	1	14	14								0
4	36	1	20/10/2004	1210	14	1	25	17								1
5	46	1	20/10/2004	1210	5	1	25	12								0
6	39	1	20/10/2004	1215	5	1	25	14								0
7	36	1	20/10/2004	1318	40	1	11	13								0
8	32	1	20/10/2004	1345	11	1	16	16								0
9	30	1	20/10/2004	1410	15	1	13	20								0
10	28	1	20/10/2004	1432	11	1	28	20	13	11	13	17				0
11	31	0	20/10/2004	1435	52	1	13	16								1
12	34	1	20/10/2004	1435	15	1	13	20								0
13	23	0	20/10/2004	1455	75	1	28	20	14	14	19	2				1
14	32	1	20/10/2004	1505	6	1	11	13								0
15	33	1	20/10/2004	1530	10	1	12	19								0
16	30	1	20/10/2004	1545	18	0							5			0
17	44	1	20/10/2004	1620	5	1	13	17								0
18	23	1	20/10/2004	1625	15	1	28	20	13	10	13	15				0
19	24	0	20/10/2004	1630	20	1	28	20	13	15	15	12				0
20	42	1	20/10/2004	1634	6	0							12			0
21	28	0	20/10/2004	1654	11	1	28	20	13	12	14	17				1
22	45	0	20/10/2004	1717	106	1	28	20	13	12	14	16				0

Figure 1: Example data collection tool using Microsoft Excel

TABLES

Table 1: Patient Data Set and Entry Codes

DEMOGRAPHICS			
Individual	Age		Years
	Gender	1	Male
		2	Female
	Reason at Event	1	Participant
		2	Spectator
		3	Official
		4	Other
Presentation	Date		dd/mm/yy
	Time		24 hour clock
	Duration of Treatment		In minutes

PRESENTATION TYPE		
	1	Injury
	2	Illness
	3	Environmental
	4	Mental health

INJURY		
Major injury	1	Fracture
	2	Dislocation
	3	Crushing injury
	4	Traumatic amputation
	5	Intracranial injury (incl. concussion)
	6	Injury to internal organ
	7	Drowning, immersion
	8	Asphyxia or other threat to breathing
	9	Burn or corrosion
	10	Electrical injury
Soft tissue	11	Sprain or strain
Wound	12	Blister
	13	Abrasion
	14	Superficial laceration
	15	Open wound
	16	Other minor wound
Face specific	17	Eye injury
	18	Dental injury
Foreign body	19	Foreign body in external eye
	20	Foreign body in ear canal
	21	Foreign body in nose
	22	Foreign body in respiratory tract
	23	Foreign body in alimentary tract
	24	Foreign body in genitourinary tract
	25	Foreign body in soft tissue
	26	Foreign body, other/unspecified
Review	27	Review of injury
Multiple injuries	28	Injuries of more than one ‘nature’

INJURY LOCATION		
Location	1	Head
	2	Face
	3	Neck
	4	Spine
	5	Back
	6	Thorax
	7	Abdomen

		8	Pelvis
	Limb	9	Shoulder
		10	Upper arm
		11	Elbow
		12	Forearm
		13	Wrist
		14	Hand
		15	Thigh
		16	Knee
		17	Lower leg
		18	Ankle
		19	Foot
		20	Multiple locations

ILLNESS			
Major	Cardiac	1	Cardiac arrest
		2	Chest pain
		3	Other
	Respiratory	4	Respiratory arrest
		5	Asthma
		6	Other
	Neurological	7	Seizure
		8	Collapse, unspecified
	Gastrointestinal	9	Nausea/vomiting
		10	Diarrhoea
		11	Diabetes related
Minor		12	Headache
		13	Skin/rash
		14	Fever
		15	Pain
		16	Eye
		17	Ear
		18	Faint
		19	Other

ENVIRONMENTAL		
Heat related	1	Sunburn
	2	Exhaustion
	3	Stroke
Cold related	4	Hypothermia
	5	Frostbite
Bites and stings	6	Bite or Sting
	7	Envenomation
Drug related	8	Alcohol related
	9	Substance related
	10	Both substance and alcohol related

MENTAL HEALTH		
	1	Anxiety
	2	Psychiatric disorder

OUTCOME		
Referred to further health treatment	1	Hospital by ambulance
	2	Hospital by own arrangements
	3	Referred to doctor
Not referred	4	Nil
	5	Refused treatment

Table 2: Data dictionary to supplement data minimum data set and entry codes

DEMOGRAPHICS	
Age	Age in years at time of treatment
Gender	Male or Female
Date	The date of presentation
Presentation time	The time of presentation (using the 24 hour clock)
Duration of treatment	In minutes (time in versus time out)
Participant	Someone who is participating in the race when the injury / illness occurred
Spectator	Someone who is watching the event when the injury / illness occurred
Official	An official of the event
Other	Anyone else not included in the above

PRESENTATION TYPE	
Injury	As defined below
Illness	As defined below
Environmental	As defined below
Mental Health	As defined below

INJURY	
Select the item which best characterises the nature of the injury chiefly responsible for the presentation, on the information available at the time it is recorded.	
Fracture	Excludes tooth
Dislocation	Includes ruptured disc, cartilage, ligament
Crushing injury	
Traumatic amputation	Includes partial amputation
Intracranial injury	Includes concussion
Injury to internal organ	
Drowning, immersion	
Asphyxia or other threat to breathing	Excludes drowning
Burn or corrosion	Excludes eyes
Electrical injury	
Sprain or strain	
Blister	Simple friction wound
Abrasion	
Superficial laceration	
Open wound	Not superficial
Other minor wound	
Eye injury	Excludes foreign body in external eye, includes burns
Dental injury	Includes fractured tooth
Foreign body in external eye	
Foreign body in ear canal	
Foreign body in nose	
Foreign body in respiratory tract	Excludes foreign body in nose
Foreign body in alimentary tract	
Foreign body in genitourinary tract	
Foreign body in soft tissue	
Foreign body, other/unspecified	
Review of injury	A representation for the review of an injury or wound
Multiple Injuries of more than one ‘nature’	Indicate ‘multiple injuries’ as the primary presentation, and include the specific injuries as secondary, tertiary and so on.

INJURY LOCATION	
Head	Excludes face
Face	Excludes eyes
Neck	

Spine	
Back	
Thorax	
Abdomen	
Pelvis	Includes perineum, genital area and buttocks
Shoulder	
Upper arm	
Elbow	
Forearm	
Wrist	
Hand	Includes fingers
Thigh	
Knee	
Lower leg	
Ankle	
Foot	Includes toes
Multiple locations	Involving more than one bodily location

ILLNESS	
Cardiac arrest	No pulse present at some time related to presentation
Chest pain	Chest pain likely to be cardiac in origin
Cardiac other	Any other cardiovascular presentation
Respiratory arrest	
Asthma	Shortness of breath with history of asthma
Other	Other respiratory problems, such as hyperventilation
Seizure	
Collapse	Patient presenting having collapsed with sustained alterations to vital signs
Nausea/vomiting	Patient presenting vomiting, having vomited or feeling like vomiting
Diarrhoea	Suspected gastrointestinal cause
Diabetes related	Presentation relating to diabetic management
Headache	Simple headache with no neurological changes
Skin/rash	Any skin reaction
Fever	Any presentation for management of a fever
Pain	Presentations for management of pain that is not resultant from a recent injury
Eye	Presentation for eye irritations, foreign bodies in eye, and sore eyes
Ear	Presentations for foreign bodies in ear and ear ache
Faint	A patient having collapsed who fully recovers to normal
Other	Any other presentation for a significant medical reason, for example anaphylaxis

ENVIRONMENTAL	
Sunburn	Redness and tenderness of skin resulting from sun exposure
Exhaustion	Heat injury due to extreme heat and excessive sweating
Stroke	Exposure to intense heat, associated with high fever and collapse
Hypothermia	Extreme exposure to the cold
Frostbite	Frostbite related to extreme exposure to the cold
Bite or sting	Insect bites or stings. Animal bites, such as dog bite, are considered wounds
Envenomation	Snake, spider or sea creature envenomation
Alcohol related	Presentations that primarily related to the consumption of alcohol
Substance related	Presentations that primarily related to the consumption of prescription or non prescription substances e.g. overdose
Both substance and alcohol related	Presentations that primarily related to the consumption of a combination of alcohol and prescription or non prescription substances

MENTAL HEALTH	
Anxiety	Presentation related to anxiety or panic attack, not necessarily psychiatric in nature or substance related
Psychiatric disorder	Psychiatric or mental health related presentations

OUTCOME	
Hospital by ambulance	Immediate ongoing medical assistance required - ambulance transport to hospital

Hospital by own arrangements	Medical assistance or intervention at a hospital required – ambulance transport not required
Referred to doctor	Referred to own general practitioner for non-urgent follow-up
Nil	Person discharged, not required to seek medical assistance
Refused treatment	Patient does not want treatment