

Mass Gathering Events: Retrospective Analysis of Patient Presentations over Seven Years

Kathryn M. Zeitz, MN;¹ David P.A. Schneider, BN;² Dannielle Jarrett, BN;³
Christopher J. Zeitz, PhD⁴

1. St. John Ambulance Australia
2. University of Adelaide, Adelaide Australia

Correspondence:
Kathryn M. Zeitz, MN
State Nursing Officer
St John Ambulance Australia
C/o 18A Farrell Street
GLENELG SOUTH
South Australia 5045
Zeitz@onaustralia.com.au

Keywords: casualty presentations; crowds, first-aid; mass gathering medicine; patient presentations; public event; transport

Abbreviations:

CP = Casualty Presentations
PPR = patient presentation rates
RAS = Royal Adelaide Show
SD = standard deviation
TTHR = Transportation to Hospital Rates

Received: 16 June 2002

Accepted: 10 August 2002

Web Publication: 22 January 2003

Abstract

Introduction: St John Ambulance Operations Branch Volunteers have been providing first-aid services at the Royal Adelaide Show for 90 years. The project arose from a need to more accurately predict the workload for first-aid providers at mass gathering events. A formal analysis of workload patterns and the determinants of workload had not been performed.

Hypothesis: Casualty presentation workload would be predicted by factors including day of the week, weather, and crowd size.

Method: Collated and analyzed casualty reports over a seven-year period representing >7,000 patients who presented for first-aid assistance for that period (63 show days) were reviewed retrospectively.

Results: Casualty presentations correlated significantly with crowd size, maximum daily temperature, humidity, and day of the week. Patient presentation rate had heterogeneous determinants. The most frequent presentation was minor medical problems with Wednesdays attracting higher casualty presentations and more major medical categories.

Conclusion: Individual event analysis is a useful mechanism to assist in determining resource allocation at mass gathering events providing an evidence base upon which to make decisions about future needs. Subsequent analysis of other events will assist in supporting accurate predictor models.

Zeitz KM, Schneider D, Jarrett, D, Zeitz CJ: Mass gathering events: Retrospective analysis of patient presentations over seven years. *Prehosp Disast Med* 2002;17(3):147-150.

Introduction

The provision of emergency health services at public events provides unique challenges in the health-care planning context. Health care at mass gathering events has three aims: (1) primary care; (2) emergency care; and (3) major incident response.¹ There are 2,700 trained St. John Volunteers in South Australia providing on average 145,000 hours of first-aid service to the community annually. The Royal Agricultural and Horticultural Society of South Australia, Inc. have been hosting the Royal Adelaide Show (RAS) from its current location at Wayville in metropolitan Adelaide since 1925. St. John Ambulance Australia volunteers have been providing first-aid coverage to the RAS

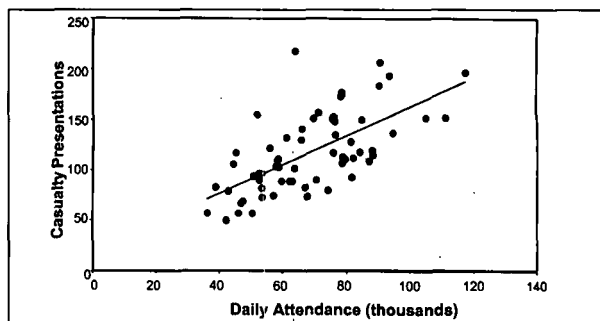
since 1911. On average, over the past seven years, 616,00 patrons have attended this nine-day event, annually. St. John volunteers treat >7,000 casualties during this event.

Planning for appropriate services at large events traditionally has been based on local experience and anecdotal knowledge and not on vigorous research or needs analysis. Although a previous model has been proposed for determining expected workload at mass gathering events, the applicability of this model to a single, recurrent event was uncertain.² Therefore, the current project was developed to analyze historical event data to assist with identifying factors that impact on workload, and to assist with

Year	Attendance	Patients Treated	Ambulance Transfers
1995	637,996	1,021	Not Available
1996	651,733	1,272	14
1997	608,456	1,030	16
1998	631,947	1,021	29
1999	623,372	1,192	28
2000	577,341	867	23
2001	585,559	1,014	17

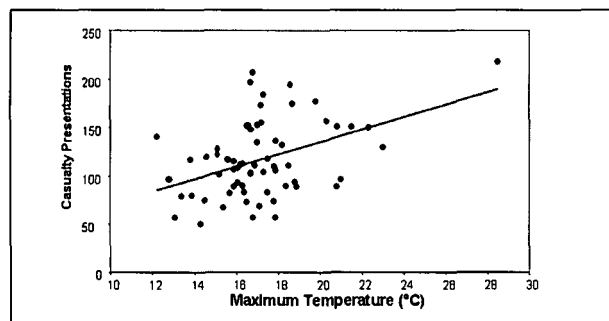
Prehospital and Disaster Medicine © 2002 Zeitz

Table 1—Summary of the data collected for the past seven years



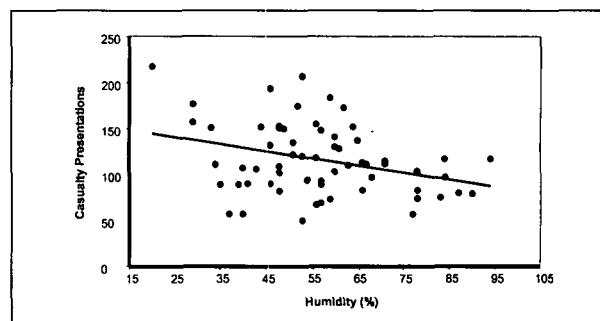
Prehospital and Disaster Medicine © 2002 Zeitz

Figure 1—Number of patient presentations compared with daily crowd attendance



Prehospital and Disaster Medicine © 2002 Zeitz

Figure 2—The influence of maximum daily temperature on patient presentations



Prehospital and Disaster Medicine © 2002 Zeitz

Figure 3—The influence of maximum daily humidity on the number of patient presentations

resource allocation at future events. This paper analyses data generated on patient presentations from a single major public event over a seven-year period. The aim was the identification of factors that contribute to the number of patients that present, to assist with planning for the provision of first-aid services, based on evidence including type and pattern of patient presentation. This will enable more appropriate resource allocation in the coming years.

Method

A number of factors relevant to the expected casualty presentation rate have been described previously.²⁻⁴ Data were collected on crowd size, maximum daily temperature, humidity, and day of the week. Patient presentation data were generated from the documented casualty reports completed for every person treated by a St. John member, including day of presentation, type of injury/illness, and if conveyance to hospital via an ambulance was required. These data have been collected since 1995. Retrospective weather information was obtained from the Bureau of Meteorology; Adelaide and crowd attendance data were obtained from the Royal Agricultural and Horticultural Society of South Australia, Inc. Descriptive statistical analysis was undertaken using Statistica '99. All measures are reported as mean ±one standard deviation (SD), and statistical significance was accepted at a *p*-value of <0.05.

Results

Over the last seven years of the RAS, the average daily attendance has been 68,500 (range 39,010 to 117,539), with a total average attendance for the nine days of the event of 616,629 (Table 1). The number of patients treated on any

given day varied widely from 57 to 218, with Patient Presentation Rates (PPR) (casualties and patients presenting per 1,000 patrons) of 1.7, and Transportation-to-Hospital Rates (TTHR) (the number of patient transported to hospital per 1,000 patrons in attendance) of 0.034. These indicators are well-described measures of workload.²

Crowd Size

The daily crowd size averaged 68,514 ±17,812. There was a strong correlation between crowd size and patient presentation rates (*r* = 0.65, *p* <0.0001; Figure 1). However, there was no correlation between crowd size and the patient presentation rate, i.e., by nature of there being a larger crowd, there were more patients, but other factors appeared to be responsible for the patient presentation rate.

Weather

The average maximum daily temperature during the seven years of the RAS was 17 ±2.6°C (range = 12.2 to 28.5°C) (63°F; range = 54-83°F) The humidity readings ranged from 20 to 94% with an average of 56 ±16%. The relationship between patient presentation and temperature and humidity are shown in Figures 2 and 3. There was a significant correlation between maximum daily temperature and the number of patient presentations (*r* = 0.44, *p* <0.0003), but there was no correlation with the PPR (Figure 2). There was a weak correlation (*r* = -0.28, *p* <0.05) with the number of patient presentations, but not with the PP rate (Figure 3). There was no association between crowd size and weather.

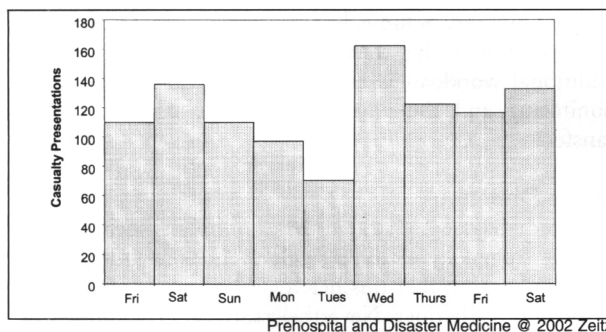


Figure 4—Casualty presentation by day of week.

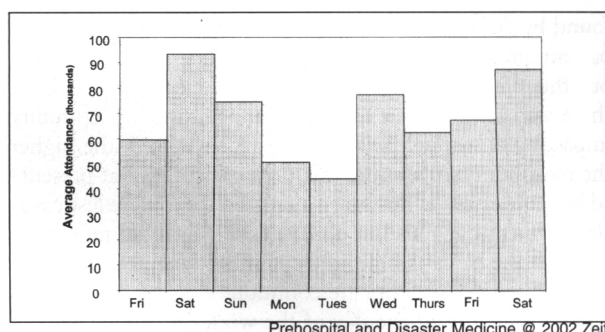


Figure 5—Daily crowd attendance by day of the week

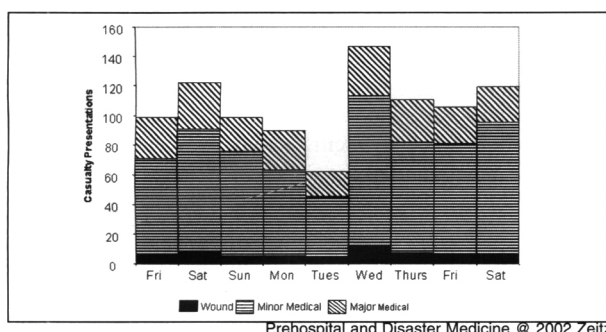


Figure 6—Type of patients by on day of the week

Day of the Week

Wednesdays (Half-price admission) on average, produced the highest number of casualties (Figure 4), but did not have the highest crowd size (Figure 5). Highest levels of attendance occurred on Saturdays, producing the second highest workload. Mondays and Tuesdays reflected the lowest level of attendance and the lowest number of patient presentations. There was variation between the different days of the week with weekend days having higher levels of attendance, but producing lower PP rates than weekdays for which the converse was true ($p < 0.0002$ for PPR weekend vs weekdays). Therefore, for this event, PPR are not the sole predictor of global workload.

Category of Illness/Injury

St. John first responders, as part of the documentation process, categorise patient presentations according to established criteria. The most frequent categories of presentation during the RAS were minor medical complaints including headaches, nausea, and/or vomiting (PPR = 1.0), wounds ranging from lacerations to blisters (PPR = 0.39), injuries such as fractures and sprains (PPR = 0.12), and major medical inclusive of asthma to cardiac chest pains (PPR = 0.09) (Figure 6). Wednesday not only attracted a higher number of patient presentations, but also manifested with more major medical casualties.

Discussion

Traditionally, planning for mass gathering events has been ad hoc, based mostly on individual experience rather than vigorous research or analysis. Internationally, individual

events have been analyzed, including sporting events, rock concerts³ and agricultural shows.⁴ Data from Australia are scarce. While Arbon *et al*² found the data generated from specific event analysis has limited applicability across a variety of events or venues, the value of such information is in improving planning and resource allocation at the specific event under investigation. The literature describes factors influencing the PPR and TTHR including weather, crowd size, crowd profile, event type and “data collection and reporting forms”,² with gender and age profiles also being analyzed.³

The RAS compares well to other mass gathering events reported in the literature. Published experience describes PP rates ranging from 0.14–90.05 with Arbon *et al*² stating that the most frequently reported rates range between 0.5 to 2.0. The Royal Adelaide Show PPR of 1.7 over the seven years fits well within this range. However, while crowd size correlated well with the number of patient presentations, it did not correlate with the PPR. This is supported by Arbon *et al*² who also described increasing crowd sizes having a positive relationship with casualties presenting for treatment, and Milsten who found a weak correlation between attendance and medical usage rates.³ The TTHR over the same period was 0.034, mid-range within the literature-described range of 0.01 to 0.55.

A Predictive Model for patient presentation rates and transport to hospital rates was developed by Arbon *et al*² after reviewing Australian mass patient events over a 12-month period. Reviewing events with a combined attendance of 12,046,436, the average PPR was 0.992 and the TTHR was 0.027. The type of event layout was found to differentiate PPR. An event, which was bounded and focused, had a PPR of 1.264, TTHR of 0.03, and unbounded extended events the PPR was 0.266 and the TTHR was 0.02. This compares favorably with the Royal Adelaide Show, which is a bounded focused event. A previous analysis on patient presentations at the RAS in 1991 that used a questionnaire survey of members to determine the appropriateness of a Medical Officer at the event found a PPR of 1.9 (1.6 for weekend days and 2.1 for week days).⁴

Temperature long has been regarded as a predictor of workload at mass gathering events. This study found a correlation between PPR and the maximum daily temperature as has been supported by others.⁴ Relative humidity was

found by Arbon *et al*² to be more consistent in influencing patient presentations, increased humidity increased PPR, but the effects of temperature were not clear. At the RAS, there was a correlation between temperature and humidity impacting on patient presentations. As expected, the higher the maximum temperature the more casualties that presented but conversely as humidity increased there were less casualties presenting. This last observation is likely to reflect the fact that the RAS is held in September when rain fall and records of high humidity are common.

The influence of the day of the week on patient presentations was first discussed by Flabouris and Bridgewater,⁴ and a strong correlation again has been demonstrated. In the present study, the availability of half-price admission on Wednesdays resulted not only in larger crowd sizes, but also a high PPR with a correspondingly high rate of major medical patients. This suggests that the strategy of half-price admission mid-week produces significantly different crowd demographics. Indeed, this may be the case for all week days as compared to weekend days.

The reasons for patient to present to the to St. John first responders varied widely ranging from rabbit bites, to being crushed by cows, to injuries from the collapse of a show ride. In 2000, a ride known as the 'Spin Dragon' collapsed. In addition to the usual workload, there were 35 casualties with 27 transported to a hospital with injuries ranging from trauma to emotional distress. These 35 casualties were not captured in this data set as no formal documentation was completed on patients due to the torrential rains that were falling during this incident.

The ability to predict the number of patients that may require transportation to a hospital is useful as not only is it a predictor of workload, but it also enables adequate planning by ambulance services. The higher the number of patient presentations on Wednesdays increases the workload

not only by sheer volume, but also due to potentially sicker casualties requiring transfer to a hospital by ambulance. Additional workload is created due to the more intense monitoring and the work generated in coordinating a transfer.

Future Directions

This study has demonstrated that, not only is there significant heterogeneity within a single event as regards patient presentations, but that this heterogeneity extends to different types of gatherings. Nevertheless, there are a number of important consistencies that occur, such as workload on given days of the week. Future studies will focus on particular crowd demographics, such as age, that also may predict workload. Other recurrent events also will be studied to see if similar patterns of consistency from year to year can be detected. The information gathered from the current study will be utilized for planning future RAS patient activity including staffing arrangements on a daily basis. A comparison will be undertaken to determine predicted and observed workloads for the 2002 Royal Adelaide Show.

Conclusion

Increasing competition in the first-aid provision arena, increasing legal implications for practice, difficulties with the recruitment and retention of volunteers, and a drive for better human and material resource management has given mass gathering event planning and provision a stronger foundation than traditionally has been the case. This review of patient presentation patterns has supported current findings on factors influencing workload. It supports the notion that statistical review and historical/experiential knowledge can contribute to service provision planning and provides a framework for more quantitative analysis of other mass gathering events.

References

1. Kerr GW, Jackson AP, Parke T: The dangers of taking "T in the Park". *Scottish Medical Journal* 1996;41(6):165-6.
2. Arbon P, Bridgewater HG, Smith C: Mass Gathering Medicine: A predictive model for patient presentation and transport rates. *Prehosp Disast Med* 2001;16(3):109-116.
3. Milsten AM, Seaman KG, Liu P, Bissel RA, Maguire BJ: Variables influencing medical use rates in mass gathering events. Research Forum abstracts; Poster presentations. *Ann Emerg Med* 2001;38(4):S108.
4. Flabouris A, Bridgewater HG: An analysis of demand for first-aid care at a major public event. *Prehosp Disast Med* 1996;11(1):48-54.
5. De Lorenzo RA: Mass gathering medicine: A review. *Prehosp Disast Med* 1997;12(1):68-72.