

Measuring emergency services workloads at mass gathering events

Zeitz et al maintain better information management can improve emergency workload planning at large public events

Abstract

This research measures and compares emergency services workloads and identifies factors that contribute to workload in serving the general public at mass gathering events. It derives from a collaborative project involving all emergency services that assisted at major events held in South Australia during 2003/2004. In collating workload measures for different emergency services, this research sought to ascertain if variables such as weather, crowd type and nature of an event assist in predicting the workload, across the service providers.

Over 5.7 million patrons attended major events in this period. Weather arises as a primary determinant of South Australian police workload. For SA Ambulance Service and St John First Aid Service there is a broader range of determinants. There are also examples of event specific determinants. The workloads for ambulance and police correlate but there is no correlation between St John workload and the other two emergency services. The level of staffing by both ambulance and police correlated closely with the workload of each group, while for St John, no such relationship was observed. The main recommendation from this research is the need for higher quality information management across emergency services.

Introduction

Contemporary Australian lifestyle is reflected in the large number of public community events that are held across the continent. Emergency service providers play a pivotal role in ensuring public safety in these unique temporary communities. Resource allocation to mass gathering events is generally based on experience and historical knowledge of events retained by individuals.

There is a need to make resource allocation at mass gathering events more closely mirror actual (predicted) needs [Arbon 2002], and further studies are required to inform the decision making process.

There are a number of differing views regarding the definition of mass gatherings [Arbon 2002:60]. Mass gatherings are events that are planned [Gaffney 2005] and organised [Milsten et al 2002]. Various authors have defined mass gatherings as events with attendances exceeding 1000 persons [De Lorenzo 1997, Parillo 2004] through to 25,000 [Milsten et al 2002]. An alternate definition proposed by Arbon [2004:210] states "a mass gathering is a situation or event during which crowds gather and where there is the potential for a delayed response to emergencies because of limited access or other features of the environment or location". In addition there is an increased risk that these gatherings may result in emergencies of their own accord. Mass gatherings in this study were defined as events that were planned in advance with a crowd size of at least 25,000.

The body of knowledge regarding mass gathering medicine has a focus on reviews of singular events [Arbon, 2004] with minimal analysis [De Lorenzo 1997]. Workload at mass gatherings has traditionally been measured in terms of usage rate, based on the number of people treated and the number of people present [Zeitz et al 2002, Arbon 2002, Milsten et al 2003]. There is a broad range of patient presentation rates (PPR) for mass gatherings, due to the diverse nature and location of events with PPR ranging from 0.14-90/1000 [Milsten et al 2002]. Despite a growing body of knowledge about medical service provision for mass gatherings [Zeitz et al 2005], and emerging tools to predict workload, there is very little data "available from which to plan the emergency medical needs for public events" [Parillo 2004].

In the non-medical literature the goal of event organizers and service providers has been described as "a safe and trouble-free celebration" [Bennett 1998:24]. The role of police at events has been described as policing of the law and regulations, communication with other agencies and the co-ordination of an emergency response in the



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St John ambulance tending to a jogger at a sport event.

event of a serious incident [Speed 1993]. Concerns have been raised due to the limited involvement of police in event planning. Speed [1993] argues that large public events cannot be managed by a single agency but need to have a multi agency planning team. It has been suggested that police should not be the lead authority, as they have a more response-based focus, whereas emergency management planning needs to focus on prevention and preparedness [Davies 1998].

Whilst the literature contains information on medical workload this does not extend to other emergency service requirements. What is missing from the literature is evidence supporting the guidelines presented in the variety of 'how to' manuals [EMA 1999, Health and Safety Executive 1999] that address medical care and other emergency service provision at mass gathering events. "Data collection from mass gathering events must now also be given priority. There is urgent need for an easily accessible database that will allow event planners to look back at the history of events that have taken place" [Hines 2000:150].

The identification of variables that impact on workload across Emergency Services is important in determining resource allocations that adequately meet the day-to-day activities of the emergency services. Greater understanding of emergency service capabilities allows for more definitive planning for resource allocation and in turn ensures effective and efficient use of these resources.

The purpose of this research was to measure and compare workloads of various emergency services at mass gathering events and to identify factors that impact on workload.

Method

This prospective, descriptive statistical review of the workloads of emergency services at mass gathering events was a collaborative project supported by all emergency services in the State of South Australia (as represented by the authors' affiliations). Representatives from each emergency service participated in the project forming research team (the authors). The group determined the events to be captured, the information required for profiling the event, and the data collected to measure workload for each of the emergency service. Table 1 summarises the data collection framework. Some less obvious determinants of work that have been described by Arbon [2002] included if an event was bounded in that it was fenced or contained in a defined area versus events such as pageants that covered a large area and multiple entry points, and the mobility of the crowd defined by events with limited seating or crowds were predominately standing. Age of the crowd was measured by age brackets 0-15, 16-35, 36-65 and 66 years or older. The calendar years 2003 and 2004 were selected so prospective information could be collected and to provide a greater depth of data than a single year analysis.

In South Australia there is a state-wide Emergency Services Major Event Coordinating Committee (ESMECC) and it was decided to include all events that are coordinated through this committee. Profiling data was collected from event organisers, event websites, emergency service operational plans, emergency services operational personnel and expert knowledge of the research group.

Table 1: The Data Collection Framework		
Events Captured	Event Profile Information	Workload Measures
All events coordinated through the Emergency Services Major Events Coordinating Committee (ESMECC) for 2003 and 2004.	Weather – daily maximum temperature and humidity.	South Australia Police – Arrests and reports and personnel hours.
All Australian Football League Competition Matches held at the AAMI Stadium due to the large crowd sizes (range 20,000 – 55,000).	Crowd size and profile – based on police estimates, gate turnover and/or ticket sales with subjective crowd descriptors determined by the research team i.e. age distribution and behaviour.	State Emergency Service – Incidents and duty hours.
	Profile of the event – including if it is bounded or extended, indoors or outdoors, seated or mobile crowd [Arbon, 2001] and type of concerts i.e. heavy metal, classical.	St John Ambulance – Casualties treated and duty hours SA Ambulance Service – Patients evacuated to hospital and personnel hours dedicated to the event.
	Nature and duration of the event – for example presence of alcohol and/or drugs, sporting event and length of event i.e. number of hours - number of days.	Metropolitan Fire Service – Incidents and personnel hours Country Fire Service – Incident information and volunteer standby hours.

Emergency services were asked to provide information describing their measures of work. Each organisation collated and supplied raw data on organisational workload. Data collation and entry was by a single operator. Workload for SAAS comprised tasking, i.e. dispatch of an ambulance to the event, irrespective of whether or not there was subsequent transport of a casualty to hospital. For St John, workload was defined simply as the number of patients presenting for treatment, whereas for police, workload included the composite of arrests, evictions from the event and reports. The State Emergency Service and both the metropolitan and country fire services incidents recorded and personnel hours tallied were the designated workload measures.

Statistical analysis involved analysis of all data, seeking determinants of workload, both for individual services and combined workload of all emergency services. Continuous data were analysed using linear regression with normalisation of non-Gaussian data as appropriate. Categorical variables were analysed by single factor analysis of variance. Significance was determined by a p value of < 0.05.

Results

In the data collection period, there were 19 different event types and 35 events in total. There were 156 event days referring to the number of days events occurred. For example the Royal Adelaide Show is a single event type but accounts for 9 event days per year. Overall the total crowd size in attendance for events over the 2-year period was estimated at 5,797,086 patrons. The average crowd size (where known) per day of event

was 40,824 with the median size 33,600 (range 2275 - 325,000). The average temperature at the start of the event captured was 17.5o Celsius (range 9 - 32) and 17oC (range 7 - 32) at the finish of events. Average daily maximum temperature for event days was 21oC and minimum was 13oC. Average humidity was of 59% (range 13 - 94). Crowd mood was described as passive, active or energetic with the project group determined the mood of the crowd for each event type. Of the 19 event types, 4 crowds were considered passive, 7 crowds were active and 8 energetic.

There were two distinct groups of emergency service providers. First were the services that were only required for specialised support at specific events. The State Emergency Service (SES) and both the metropolitan and country fire services attended only a few major events. Table 2 shows the service and number of days for which these organisations provided support. The Country Fire Service (CFS) provided an average total of 448 hours per year (320 in 2003 and 576 in 2004) with no specific incidents recorded. The Metropolitan Fire Service (MFS) attended very few incidents over the 36 event days. They supplied 1394 personnel hours both operationally and in operations command. For the four major events SES attended annually there were no specific incidents recorded with 4474 personnel hours registered. Due to the minimal number of incidents recorded by these three services they were not incorporated in the subsequent workload analysis.

The second group were the core services in attendance at the majority of events. There was a comparatively higher workload for St John First Aid Service, SA

Table 2: Events and number of event days attended by the CFS, MFS and SES

Service	Event Days
Country Fire Service	21 days
Metropolitan Fire Service	36 days
State Emergency Service	20 days

Table 3: Number of event types and days attended by SAAA, SAPOL and St John

Service	Event Types	Event Days
SAAS	17	114 days
SAPOL	19	135 days
St John	13	109 days
Total	19	156 days
Data for all 3 services	13	106 days

Ambulance Service (SAAS) and South Australia Police (SAPOL). Table 3 summarises the event numbers data were collected from. Of the 156 event days, there were 106 days attended by SAAS, St John and SAPOL for which detailed workload data was available.

Determinants of Workload

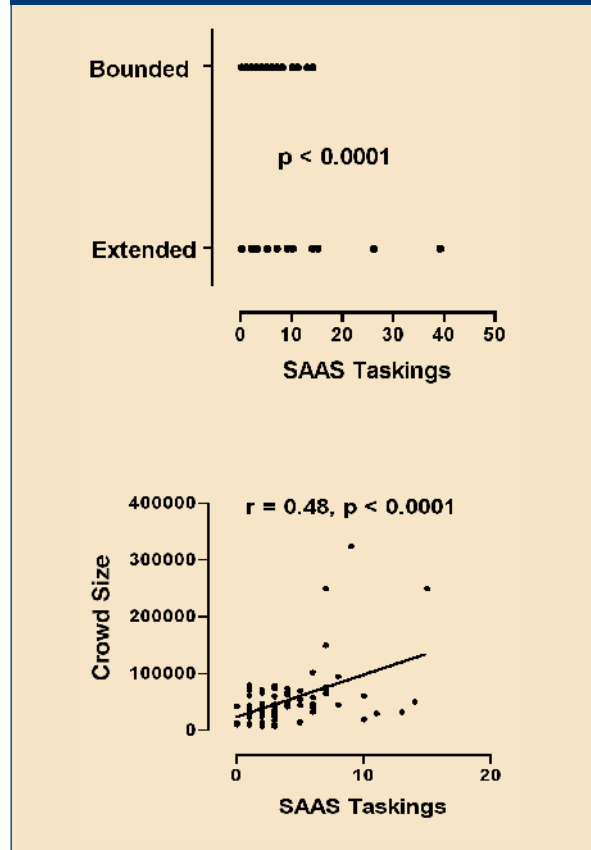
Following collection and definition of all workload data and collation of all crowd and event profile data for each event day, the determinants of workload for each service were analyzed.

For SAAS (see Graph 1), (event days = 114) the determinants of work, in order of importance were:

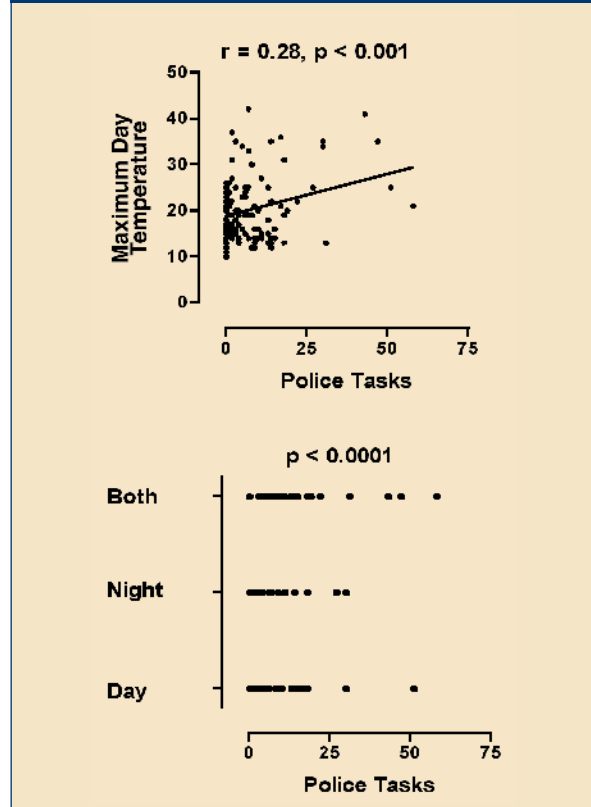
- If an event was bounded
- Crowd size
- Crowd mood
- The type of event (sporting, entertainment or community event)
- Younger age brackets of the crowd
- Availability of alcohol
- Weather – Minimum temperature & humidity
- Smoking at event

SAPOL workload was influenced by two determinants of workload. In order of importance for 135 event days these were weather (maximum temperature and humidity) and time of day the event was held. Graph 2 presents the respective plots of this for police.

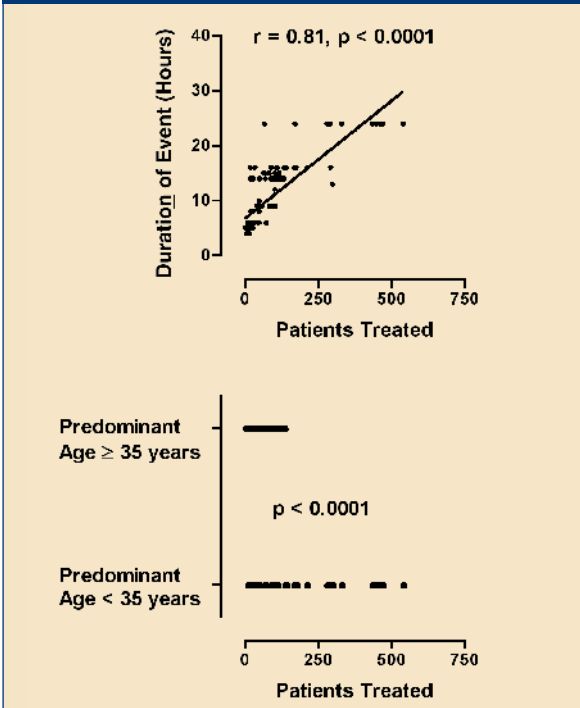
Graph 1 The relationship between boundary of event and crowd size for SAAS taskings.



Graph 2 The relationship between temperature and time of day for SAPOL tasking



Graph 3 The relationship between duration of event and age of crowd with patients for St John tasking.



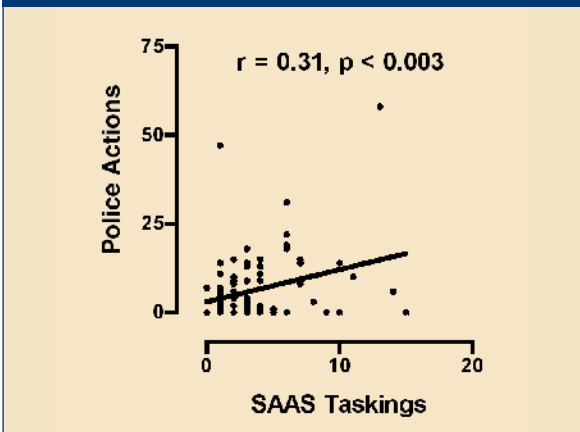
The determinants of workload for St John (Graph 3) for 109 event days, in order of importance were:

- Duration of the event
- Younger age brackets of the crowd
- Event type (sporting, community, entertainment)
- Availability of alcohol
- Mobility of crowd
- Time of day
- Smoking at event
- Day of the event
- Minimum temperature

Combined Events

There were 100 event days for which data on workload for St John, SAAS and SAPOL were complete. The workload for SAPOL and SAAS were correlated ($r = 0.55$, $p < 0.0001$) suggesting similar determinants of workload. While activity from events on New Year's Eve substantially strengthened the association, a modest positive correlation persisted even when these event days were excluded (Graph 4). However, neither service's workload was correlated with the activities of St John.

Graph 4: The relationship between event workload for SAAS and SAPOL.



Comparison of Emergency Services Workload

In order to assess the impact of various measured parameters on the overall combined workload of emergency services, a means of combining data was required. This was achieved by ranking the workload of each service (from 1 to 106) for each of the events i.e. the event day resulting in the lowest workload for SAPOL was ranked at 1 while the event day resulting in the highest workload was ranked as 106. The ranking for each service; SAPOL, SAAS and St John, was then added to produce an overall measure of combined workload for emergency services. The significant determinants of workload in order of importance were:

- A mobile crowd
- Events with a component inside
- Time of day for the event (increased work at night)
- The longer events
- Smoking at the event
- Events held on a weekend
- Event type (community events have highest workload)
- Larger the crowd size
- Predominantly young crowd less than 35

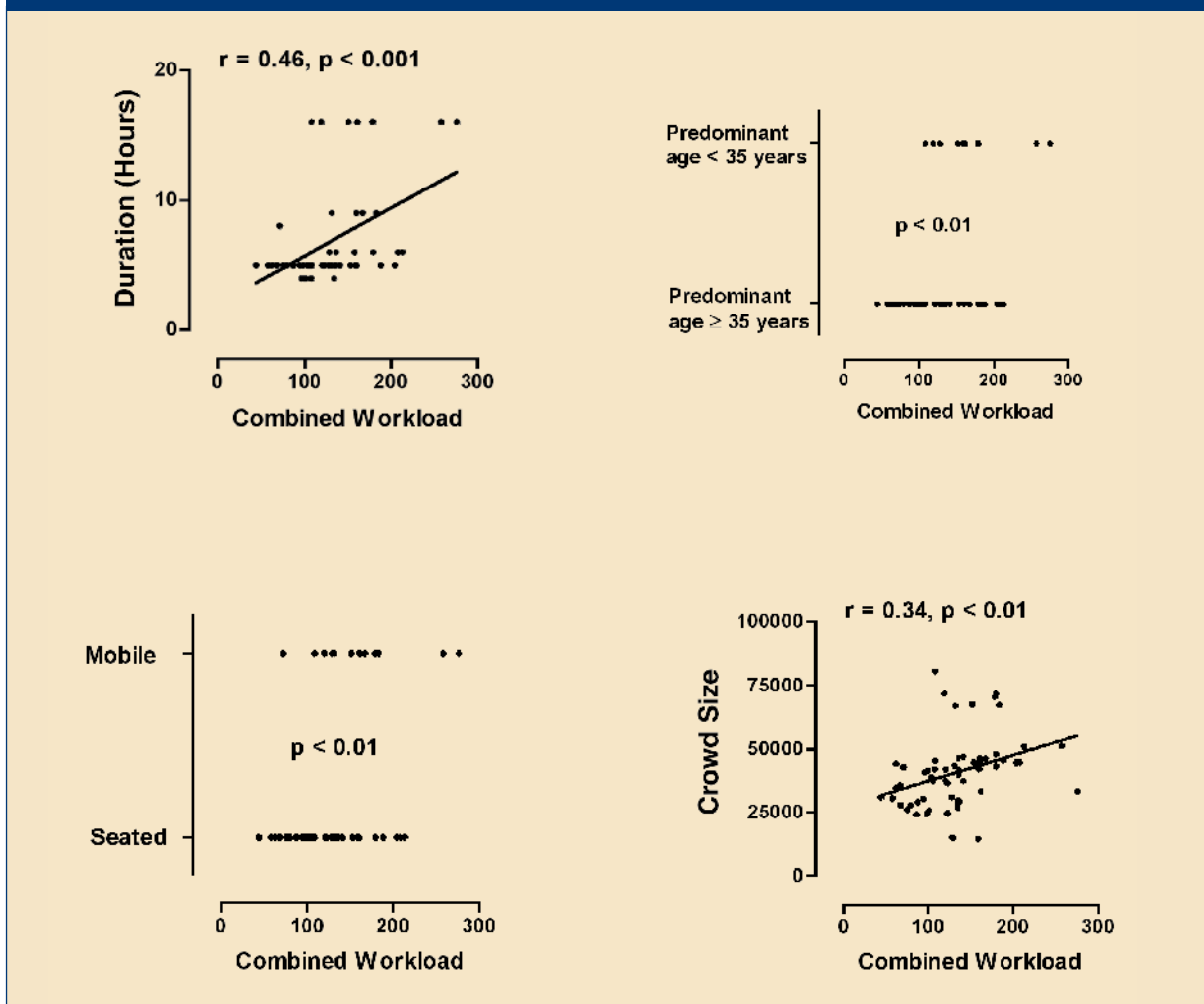
The more important factors are demonstrated graphically in Graph 5.

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Staffing levels are an important consideration at mass gathering events.

Graph 5: The relationships between various event factors and combined emergency services workload.



Personnel Hours

For each of the main emergency services, the number of personnel present during the event was determined by taking the total number of duty hours worked for the event, and dividing this by the duration, in hours, of the event, providing an average number of personnel available for each hour of the event. This figure was then compared with a number of variables that might be expected to have an impact, the data being displayed in Table 4. Only the type of event (sporting, community or entertainment) was a common factor for determining staffing levels for all services.

Crowd size and bounded events were important determinants of staffing levels for SAAS and SAPOL, but not for St John. A young mobile crowd influenced staffing by SAPOL and St John but not SAAS. The level of control of alcohol was not a significant factor in influencing staffing levels. Of interest, the level of staffing by both SAAS and SAPOL correlated closely with the workload of each group while for St John, no such relationship was observed.

Discussion

This project has established a comprehensive and substantive database of information relating to mass gatherings held in South Australia in 2003/2004. The key finding of this study is that, despite differing roles at mass gatherings, core emergency services (SAPOL, SAAS and St John) have very similar determinants of workload. CFS, MFS and SES supported events in a number of different roles and had less definitive workload measures and a significantly reduced measurable workload captured as incidents. For these services, the major role relates to either a preventive role or being on standby in case an incident occurs. It is particularly the case for fire services that, while the risk of an adverse event is obviously low, the ability to respond rapidly at a large mass gathering is an overriding consideration. While traditional determinants of workload proved predictive in the present study, such as crowd size and weather, it nevertheless remains possible that there are factors important to the determination of workload that were not measured or collected during this project.

Table 4: Personnel hours and variables influencing workload

	SAAS	SAPOL	St John
Crowd Size	r = 0.60 p < 0.0001	r = 0.56 p < 0.0001	NS
Event Type	p < 0.05	p < 0.0001	p < 0.01
Alcohol Present	p < 0.05	NS	NS
Young Crowd	NS	p < 0.0003	p < 0.01
Mobile Crowd	NS	p < 0.0001	p < 0.01
Bounded Event	p < 0.0001	p < 0.0001	NS
Workload	r = 0.65 p < 0.0001	r = 0.47 p < 0.0001	NS

NS = No significant correlation observed

The time of day the event was held (day, night, or day/night) was the only determinant of workload for SAPOL, indicating the onset of night as being a particular factor for police. The nature of the event was an important determinant of workload as was a younger crowd demographic for police ambulance and St John. This is consistent with the experience of these services that younger crowds and patrons are more likely to access medical services at events. While this may reflect the nature of medical incidents at events, it remains possible that older patrons make a choice to leave the event if they are unwell and seek attention away from the event. The availability of alcohol was a significant factor in determining medical workload but, interestingly, did not impact on the workload of SAPOL. While the smoking status of events appeared to impact on medical workload, it is likely that this is simply a confounder for some other aspect of the event determining workload.

Mobile crowds generated more work for emergency services than seated crowds and this probably reflects a longer duration of events for mobile crowds. Longer events and events held on weekends produced a greater workload for services but crowd mood did not. While it is likely that overall crowd behaviour is different during the week compared to weekends, it is apparent that a simple measure of crowd mood does not detect this difference, the difference only being apparent based on day of the week. Crowd size and duration of the event were consistent determinants of workload, consistent with the published literature in this area.

The workloads of SAAS and SAPOL correlated with each other but not with St John. This is the first report to show that diverse emergency services have similar determinants of workload. The majority of previous literature relates to medical workload but we have now observed that the factors determining medical workload are indeed similar to those determining the workload of SAPOL. Correlation between staffing and workload occurred based on event days. The level of staffing by

both SAAS and SAPOL correlated closely with the workload of each group while for St John, no such relationship was observed. This is an important observation as both SAAS and SAPOL have paid employees whilst St John members are volunteers. This suggests that over time SAAS and SAPOL, constrained by fiscal considerations, have become adept at determining the level of presence most appropriate for different major events. Furthermore, both SAAS and SAPOL have other resources that can be readily be mobilized in the case of an extraordinary event.

While St John has the largest measurable workload, staffing levels do not match workload. This appeared largely due to excess staffing at some events rather than inadequate staffing levels. This likely reflects the voluntary nature of St John activity but nevertheless has implications, as even volunteer resources are limited in supply. The exploration of the utilisation of volunteers for St John at major events is warranted.

This research has measured and compared the workloads of emergency services at mass gatherings in South Australia over a 2 year period. It demonstrates similar workload determinants for core emergency services. Priorities for the future include: the development of information systems to monitor emergency services workload at mass gatherings to inform decision making about the level of emergency services that should be provided; more comprehensive longitudinal studies of workload determinants for emergency service providers to support the development of predictive models; the development of mass gathering key performance indicators and benchmarks locally, nationally and internationally; the development of a greater understanding of the relationship between emergency services staffing and safe mass gatherings; opportunities to research law and order work at mass gatherings and best practice utilisation of volunteers to manage workload at mass gathering events.

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About the authors

Kathryn Zeitz is a volunteer with St John for over 25 years whose most recent appointment is as Chief Superintendent and is currently involved in mass gathering and clinical first aid research. She has a PhD relating to clinical nursing practice and works at the Royal Adelaide Hospital in healthcare redesign.

Shane Bolton is currently employed as an Intensive Care / Aeromedical Retrieval Nurse at Flinders Medical Centre in South Australia. A St John volunteer for more than 19 years and recently appointed as State Emergency Management / Disaster Coordinator. He also has a keen interest in Major Event Management and the role of Healthcare Professionals within St John.

Senior Sergeant Russell Dippy has 17 years police experience, and is currently the Emergency Management Coordinator for the South Australia Police. He has had extensive involvement in the recent changes to South Australia's Emergency management arrangements and has written many of the States whole of government and Police emergency management plans.

Yvette Dowling is the CFS State Operations Planning Officer Analyst. Yvette has 10 years service as a volunteer at the Happy Valley Country Fire Service Brigade. She also has 6 years service as a staff member undertaking various roles within the Country Fire Service organisation.

Lee Francis is the General Manager of Emergency & Major Events with the SA Ambulance Service. Lee has a 30 year career paramedic with experience in areas including road operations, rescue, communications and education. In addition to his clinical qualifications, he holds an MBA and is a Captain in the Australian Army Reserve, posted to 3rd Health Support Battalion.

John Thorne, is the Regional Commander Central Region State Emergency Service. He has worked for 21 years with SA Police, and 21 years with the State Emergency Service. Extensive experience in emergency management and planning. Awarded the Emergency Services Medal in the Queens Birthday Honours and Certificate of Disaster Services Administration Certificate at the Australian Emergency Management Institute.

Terry Butler was a member of the MFS from 1972, he was promoted to officer in 1985 serving at Adelaide Station and later at Salisbury station, Terry joined the operations support section in 2003, where he was the major events officer until December 2005.

Chris Zeitz is the State Professional Officer for the St John Operations Branch in SA with over 25 years service. He is a Cardiologist and a senior lecturer with University of Adelaide.

Contact:

Kathryn Zeitz

Email: kmzeitz@onaustralia.com.au