Supplementary Table 1: Review of previous studies reporting on mass gathering healthcare

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| **Primary Author/****Year**  | **Event type (country)** | **Purpose** | **Methodology** | **Patient demographics** | **Presenting complaint** | **PPR (/1000 attendees)** | **TTHR (/1000 attendees)** | **Other relevant findings** |
| Flabouris131996 | Various major public events (Australia) | To analyze the demand for primary medical care at a public event by identifying the patients and initial symptoms that may predict that demand | Retrospective analysis of 1276 questionnaires completed by St. John Operations Branch personnel after each patient consultation | 58% female, 42% maleMost frequently presenting age group 13-20 years | 43.7% CNS (95.2% headaches), skin (25.6%), musculoskeletal (8.1%), gastrointestinal (7.1%), eye (5%), respiratory (3.1%) and ENT (2.6%) |  1.9  | 0.021 | - 2.4% of patients referred to hospital - Strongest correlation with max daily temperature (r = 0.715, p <0.02) and show day (r = 0.615, p <0.05) - Poor correlation with daily attendance (r = -0.235, p >0.54) |
| Arbon12001 | Various major public events (Australia) | To develop data set and regression models that are predictive for mass gathering events (not specific venue or event-specific)and improve event planning for future mass gatherings | First aid commanders surveyed at 201 mass gatherings comprising 11956 patients treated over 12 months by St. John Ambulance Australia  | No data presented | 80% presentations minor injuries and illnesses. Laceration was the most common injury requiring prompt treatment.  | 0.992 | 0.027 | - PPR declined as crowd size increased - Weather (particularly relative humidity) related positively to an increase in PPR - Availability of alcoholic beverages was associated with increased number of patients- A predominantly seated audience was associated with a significantly lower PPR (p <0.01). - Mobile audiences (e.g. at shows and fairs) were associated with higher incidence of injury |
| Zeitz162002 | Agricultural show (Australia) | To predict workload for first aid providers at mass gathering events based on factors such as day of the week, weather, and crowd size. | Collated and retrospectively analysed casualty reports over a seven-year period for over 7,000 patients who presented for first-aid assistance (63 show days) | No data presented | Minor medical complaints (headaches, nausea, and/or vomiting most common followed by wounds, fractures and sprains and major medical inclusive of asthma to cardiac chest pains  | 1.7 | 0.034 | - Average daily attendance 68, 500- Crowd size correlated with PPR (r = 0.65,p <0.0001)- Max daily temperature correlated with number of presentation (r = 0.44, p <0.0003), but not PPR- Highest attendance occurred on Saturdays, highest workload on Wednesdays (half-price admission) despite not having largest crowd size- Weekends had higher levels of attendance, but produced lower PPRs than weekdays for which the converse was true (p <0.0002 for PPR weekend vs weekdays).  |
| Milsten14 2003 | Sporting and music events (USA) | To identify the variables associated with increased medical usage rates (MURs) and injury patterns to facilitate medical planning for these events | Retrospectively reviewed patient information collected over a three-year period from 216 events and analysed the data | Equal overall gender mixMedian age 26 (baseball), 33 (football), 18 (rock concert) | Most common presentations dermal and musculoskeletal 28%, medication request (18.0%), headache (7.6%) and heat illnesses (5.9%)  | 0.61 | None given | - MUR (Medical Usage Rate, patients/10,000 attendees) was higher when temperature >27ºC (p<0.0001)- 16% required advanced care- MUR higher at sporting events- Concerts had highest percentage of transports (due to presentation type and frequency - more head and neck injuries from crowd surfing or being in the mosh pit) |
| Morimura152004 | Sport (Japan) | To establish and evaluate guidelines for casualties at mass gatherings and improve medical planning and preparedness | Prospectively collated patient and event information (attendance, weather) and analysed 1,661 patient presentations at 32 football games in Japan and 1,305 patients at 23 games in Korea during 2002 Fifa World Cup.  | Mean age 30 ± 17, range 0-87 years36% male, 30% female, 34% data not collected | 23.2% trauma (including minor injuries e.g. blisters, scrapes, lacerations), 21.0% headache, 2.6% obstetric, 0.7% cardiovascular, 39.9% other, 12.6% no data. | 1.21 | 0.05 | - PPR of all patients increased by more difficult accessibility (p<0.0001, r2=0.650)- As spectator numbers increased, PPR decreased (p <0.0001, r2= 0.677)- Temperature and accessibility independently increased PPR of patients who were outside of venue (p<0.0001, r2=0.797)- 1,587 patients discharged back to event (95.5% of the total) |
| Feldman122004 | Music (concert, Canada) | To report emergency medical services response, outcomes and role of doctors at a large, single-day mass gathering event | Prospective collation and analysis of 1205 records at a one-day ticketed concert with 450 000+ attendees. Details included patient demographics, primary complaint, treatment and disposition. | Mean age 28 ± 11, range 4-62 years61% female, 39%% male | Major complaint groups were headache (27%), heat-related (12%), nausea/vomiting (7.6%), musculoskeletal (6.9), breathing-related (6.6%). | 4.2 | 0.05 | - 48% of patients transported via internal ambulance to field hospital or rehydration unit- 11.9% were treated at rehydration unit- 37.6% treated at onsite hospital- No analysis of factors affecting PPR |
| Grant3 2010 | Agricultural fair (USA) | To identify and evaluate the range and nature of illness/injury at an annual New-York multi-day, mass gathering over 5 years | Retrospective analysis of patient data for 2,075 patients at the New York State Fair between 2004-2008.  | Mean age 24.4 ± 21.6 years58% female, 42% female | Major presentation reasons were dehydration/heat related (11.4%), abrasion/laceration (10.6%), fall-related (10.2%) | 0.48 | 0.027 | - Two of the three major presentation groups (dehydration/heat-related and fall related) were disproportionately female.- Direct relationship between age and female gender (higher number of females>40 years) within the fall-related injury category (p <0.05)- Age not associated with dehydration/heat-related illness or the abrasion/lacerations |
| Bledsoe22012 | Arts festival (USA) | To report the planning and emergency medical services provided at Burning Man 2011 | Retrospective, descriptive review of 2,307 patients at Burning Man 2011, a 7 day arts festival with 53,735 attendees. | 51% male, 49% female8 children (0.3%) | Major presentation groups were soft tissue injury (12.2%), heat-related (9.3%), eye-related (8.3%), urinary tract infection (7.8%), orthopaedic (7.2%) and other trauma (7.1%)  | 43 | 8.61 | - How patients presented: 79% walked in, 21% arrived by ambulance or QRV (quick response vehicles)- Triage: 1% as “red” (immediate) category, 17% as “yellow” (delayed) and 82% as “green” (minor)- Average length of time in onsite hospital was 44 minutes- Average patient length of treatment in field hospital was 44 mins (range 1-97 mins) - High PPR and TTHR may be due to length of event, location, awareness of medical services and higher risk nature of event. |
| Bortolin112013 | Religious exhibition (Italy) | To improve understanding of the nature of presentations to on-site medical services during relatively long-term religious events | Retrospective analysis of 538 presentations to medical services at the 40-day 2010 Holy Shroud Exhibition, with 2,113,128 attendees | 62% female, 38% maleMean age 47.8, range 2-110 years19.37% patients paediatric | Major presentations were cardiological, including fainting (30.2%), trauma (19.7%), respiratory (3.3%), neurological (7.9%) and psychiatric (1.9%). | 0.27 | 0.039 | - Paediatric patients had a lower rate of evacuation to hospital of 5.4% compared to older age groups (p=0.0009).- Trauma patients more likely to need transport to hospital (OR 2.20)- Respiratory patients had a high transport to hospital rate of 30.4%- Significant variation of PPR over different weeks of the event occurred, between 0.17 and 0.34 (p<0.0001) |
| Pakravan72013 | Agricultural  show (UK) | Improve understanding of the nature and demographics of patient presentations, andcompare the level of medical coverage of the 2011 Suffolk Show with the recommendations in the Event Safety Guide published by the Health and Safety Executive  | Retrospective analysis of 180 patient medical records over the 2 days of the 2011 Suffolk show with 90,000 attendees | 66% female, 34% male of 112 cases 35.5% of all cases paediatric (<18)16% staff presentations | Most common cases were abrasions and other minor wounds (23.2%), blisters (17.8%), headache (12.5%), faint/collapse (8%), allergies (7.1%) | 2 | 0.1 | - 78 patients on day 1 and 102 on day 2- Average treatment length 9.2 mins- Pre-existing issues where patient reported feeling unwell prior to event comprised 10.2% of cases- 31% patients on one or more medications at time of presentation- More than 95% of patients walked in to seek help |
| Zeitz172013 | Sport (Australia) | To explore the psychosocial aspects of crowd behaviour as a driver of demand for acute medical care | Retrospective and descriptive statistical review of the healthcare workload over 2 years of AFL matches (317 games) | No data presented | No data presented | Not supplied | Not supplied | - Positive correlation between crowd size and PPR (r=0.124, n=317, p=0.028)- Negative correlation between crowd density and PPR (r = –0.206, n = 317, P < 0.0005)- Supporters of different football teams generated statistically significant different PPRs (p=0.014) |
| Stagelund232014 | Music (Denmark) | To increase knowledge on medical issues and healthcare organisation at major music festivals | Prospectively recorded and analysed 10,630 patient presentations over 10 days at the 2012 Roskilde Music Festival with more than 130,000 attendees | No data presented | 6919 minor presentations including wounds and sprains, 3473 recorded illnesses/injury such as infection (20.1%), pain (19.4%), wounds (12.0%) | 72 | 1.8 | - 268 patients referred to a local hospital, general practitioner or dentist- 2115 of 3473 recorded illnesses/injuries involved doctor in treatment- 6919 minor presentations treated by first aid volunteers- High PPR may be due to bounded event perimeter, awareness of medical services and presence of existing conditions and injuries prior to event |
| Nable42014 | Racing/Sports | To determine the accuracy of the Arbon model (regression model-derived equations) and Hartman model (categorizes events into only three discreet severity types) in predicting the number of patient encounters and transportations from the Baltimore Grand Prix | Retrospective observational study of 216 patient presentations at the 3-day Baltimore Grand Prix over two years, 2011-2012 | No data presented | No data presented | 0.985 (2011)0.672 (2012) | 0.115 (2011)0.137 (2012) | - Hartman predictive model overpredicted number of patient encounters, whilst Arbon model overpredicted encounters for all but one day.- Arbon model underpredicted transports, Hartman model both over and underpredicted. |
| Lund222015 | Music (Canada) | To improve understanding of the impact of music festivals (specifically EDMs) on local emergency departments | Prospective comparison of PPR and ambulance transfer rate between a first aid only and a higher level of care model. 83 presentations were recorded over two days at an electronic dance music event. | Mean age 19.1, range 15-34 years69% female requiring higher level care46% of patients needing higher level care under 19 | 79% cases drug and alcohol related | 4.09 | 0.54 | - Average length of stay in the main medical area was 70.8 minutes- Presence of higher-level care teams resulted in 72.5% reduction in transport rate. |

Abbreviations included:

PPR – Patient presentation rate, number of patients presentations per 1,000 attendees

TTHR – Transport to hospital rate, number of patient transports to hospital per 1,000 attendees

EMS – Emergency medical service

EDM – Electronic dance music