SPECIAL ARTICLE
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Mass gatherings in Italy: a study from the 2015 Milan Expo

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Abstract

Introduction. A mass gathering (MG) is when a large number of people come together in a particular location for a specific purpose. Expo 2015 was an universal exposition hosted by Milan, Italy. The Pre-Hospital Emergency Company (AREU) of Lombardy Region (Milan-Italy) was involved in planning and managing the emergency rescue response inside the Expo 2015 area in Milan. In this paper, we review the AREU medical and public health response for the 2015 Milan Expo.
Methods. Existing risk-assessment processes for MGs were used (the Arbon Predictive Score and Maurer Score) to define the expected resources and the impact on the health systems. The objective of the plan was to reduce the impact of the event by adopting the model of First Aid Points (advanced medical posts) deployed in the event site acting as 'first health filters' for the hospital network in Milan.
Results. Our data indicate that 13,579 visitors were rescued in the 'Red Area' from 1 May to 31 October (with an average of 73 cases per day); 9,501 of them needed initial treatment or observation time at the First Aid Points, 1,289 of them were hospitalised (1% Red code, 29% Yellow code, 70% Green code); 65% of patients (57% female, with a mean age of 37 years old) had medical problems. Fatigue, light- headedness, dizziness, syncope, loss of consciousness and headache were the prevalent medical diagnoses.
Conclusions. Our study confirms that environmental factors, such as the weather, can contribute to large numbers of ill people at MGs. Overall, the AREU of Lombardy Region demonstrated excellent preparation for the Expo 2015 MG. Flexibility, integration and strong cooperation between the pre-hospital settings and hospitals were incorporated into the application of the plan. The final data showed the effectiveness of the adopted model and the reduced impact on the hospital network.

KEY WORDS: public health; mass gatherings; 2015 World Exposition; disaster planning; health care systems.

Riassunto

Introduzione. Un evento di massa può essere definito come l'incontro di un grande numero di persone in un luogo e per uno scopo specifico. Expo 2015 è stata un'esposizione universale che si è tenuta a Milano. L'azienda di Emergenza Pre-ospedaliera della Regione Lombardia (AREU Milano-Italia) è stata coinvolta nella pianificazione e nella gestione del servizio di primo soccorso all'interno dell'area espositiva di Expo Milano 2015. Con questo studio abbiamo esaminato le attività di AREU Milano-Italia nel corso di Expo Milano 2015.
Metodi. Per valutare le risorse necessarie e l'impatto sul servizio sanitario sono stati utilizzati i modelli di valutazione del rischio esistenti per gli eventi di massa (il modello di Arbon per la previsione del rischio atteso e l'algoritmo di Maurer per il fabbisogno delle risorse sanitarie). L'obiettivo della pianificazione è stato quello di ridurre l'impatto dell'evento attraverso il modello dei Punti di Primo Intervento (postazioni mediche avanzate) dislocati sul sito dell'evento come filtri di primo soccorso per la rete ospedaliera di Milano.
Risultati. Durante i sei mesi di Expo Milano 2015 abbiamo ricevuto nell' "Area Rossa" 13.579 visitatori (media di 73 visite al giorno); di essi 9.501 hanno ricevuto un trattamento iniziale o sono stati tenuti sotto osservazione nei Punti di Primo Intervento, mentre 1.289 sono stati ospedalizzati (1% codici rossi, 29% codici gialli, 70% codici verdi); il 57% dei pazienti era di sesso femminile (età media pari a 37 anni); il 65% dei pazienti ha presentato problematiche di natura medica. Malessere, affaticamento, stordimento, capogiro, sincope, lipotimia e cefalea sono state le diagnosi mediche effettuate con maggiore frequenza.
Conclusioni. Il nostro studio ha confermato che i fattori ambientali di natura atmosferica possono contribuire in maniera significativa a determinare i più frequenti problemi di salute durante gli eventi di massa. Nel complesso, l'AREU della Regione Lombardia ha dimostrato un eccellente preparazione per far fronte all'evento Expo 2015. Sono state messe in campo in fase di pianificazione flessibilità, integrazione ed una forte cooperazione con e tra i presidi ospedalieri. I dati finali dimostrano l'efficacia del modello adottato ed il contenimento dell'impatto dell'evento di massa sulla rete ospedaliera di Milano.

TAKE-HOME MESSAGE

Mass gatherings (MGs) of any nature present specific challenges for authorities in terms of maintaining public health. The Pre-Hospital Emergency Company (AREU) of Lombardy Region (Milan-Italy) was involved in planning and managing the emergency rescue response inside the Expo 2015 area in Milan. Overall, the AREU of Lombardy Region demonstrated excellent preparation for the Expo 2015 MG.

Competing interests - none declared.

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INTRODUCTION

A mass gathering (MG) is when a large number of people come together in a particular location for a specific purpose. Examples of MGs can include rock concerts, political rallies, fairs and festivals, religious gatherings, conventions and conferences [1]. The definition of an MG itself is not without debate [2]. According to the WHO's definition, it is 'an organised or unplanned event where the number of people attending is sufficient to strain the planning and response resources of the community, state or nation hosting the event' [3]. An MG is usually defined as more than a specified number of persons at a specific location for a specific purpose for a defined period of time. Different events may qualify as MGs depending on the local capacity to respond to the event. A homecoming parade with 1,000 spectators may be considered an MG in a small town but not in a major metropolitan area [4]. Some people define an MG as having more than 5,000 attendees. According to the WHO, the number of persons may be as few as 1,000, although much of the available literature refers to gatherings exceeding 25,000 persons [5]. MGs are highly visible events with the potential for serious health and political consequences if not managed carefully and effectively [6–10]. MGs of any nature present specific challenges for authorities in terms of maintaining public health. The influx of a large number of people together with changes in local infrastructure place a severe strain on national health and support services, compromising the authorities' ability to detect and respond to a problem [5]. Expo 2015 was a universal exposition hosted by Milan, Italy. The opening took place on 1 May 2015 and the Expo closed on 31 October 2015 (six months in duration). It was the second time that Milan had hosted the exposition. The first event was the Milan International Exhibition of 1906. The Expo 2015 participants comprised of 145 countries along with 17 organisations and 21 companies. The size of the venue site was 2 Km^2 (200 hectares) or 0.7 square miles (49 acres) and accommodated an average of 60,000 visitors per day, with 250,000 attending during the weekends. More than 22 million people in total attended Expo 2015 [11]. The long duration and the large number of visitors, together with the fear of possible terrorist attacks, contributed to concerns that the event could impose great challenges on Milan's public health security. Generally, the major anticipated health risks during MGs include heat- or cold-related illnesses, foodborne and waterborne illnesses, communicable diseases, drug- or alcohol-related problems, accidents and injuries, illness, injuries and panic related to intentional explosive, biological, or chemical attacks, and natural events (electrical storms, earthquakes, floods, hurricanes) [4, 10, 12]. The Pre-Hospital Emergency Company (AREU) of Lombardy Region (Milan-Italy) was involved in planning and managing the emergency rescue response inside the Expo 2015 area in Milan. In this paper, we review AREU's medical and public health responses for the Milan Expo of 2015.

METHODS

Existing risk-assessment processes for MGs were used (the Arbon Predictive Score and Maurer Score) to define the expected resources and the impact on the health systems. The Arbon Model was used to define impacts on pre-hospital services. Maurer's formula was used to define the quality and number of resources to be deployed [13]. These conceptual models are based on the idea that MG health can be understood as an inter-relationship between three domains: 1) the biomedical, 2) the environmental, and 3) the psychosocial. Key features influence the rate of injury and illness and characterise each domain. These key features are more or less well understood and combine to produce an effect (the patient presentation rate) and a response (the health plan) [14].

Our risk analysis assessment identified a few main risks, but other threats and hazards to safety and security also needed to be faced (domestic extremism, organised crime, cyber threats, attacks on transportation and on crowded places, non-conventional attacks). The objective of the plan was to reduce the

impact of the event by adopting the model of First Aid Points (advanced medical posts) deployed in the event site acting as 'first health filters' for the hospital network in Milan. All of the hospitals also reviewed their own emergency plans. Two main areas were identified: the 'Red Area' (the site of the event), with a few First Aid Points and rescue teams, and the 'Yellow Area' (the town area). Special attention was paid to crowd areas, the transport system and to the touristic and religious sites of the town. An Expo Command and Control Centre (Expo CCC) was displaced out of the 'Red Area' and into a dedicated and protected area, strictly according to safety and security management guidelines, and coordinated by the police and army.

Expo 2015 required a robust and flexible command and control structure with a clear allocation of roles and responsibilities, decision-making protocols and predefined communication strategies. The scores adopted allowed the strategists to define the human and technical resource needs and the expected impacts on the medical health services that would be deployed. Previous similar event plans (Expo 2008 in Saragozza, the 2004 Olympic Games in Athens) were analysed in the planning phase and regular drills were organised in advance [15]. All of the data were recorded on a daily basis using specific software; the International Statistical Classification of Diseases and Related Health Problems (ICD-9 code) for disease classification was used. The available rescue and transport resources comprised of ambulances with rescue teams, walking rescue teams, fast cars with emergency medical teams and equipped golf cars and bicycles with rescue teams. First Aid Points were deployed with hospital personnel and medical healthcare support. The main focus was on the elderly, paediatric care and the disabled. The numbers and daily distribution of the teams were defined according to the expected flows in the planning phase (60,000 daily visitors Monday–Thursday, 250,000 during the weekends). The emergency response needed to be flexible depending on any relevant security information.

RESULTS

The peak flow was on 11 October (272,000). More than 21 million people in total attended Expo 2015. Our data indicate that 13,579 visitors were rescued in the 'Red Area' from 1 May to 31 October (with an average of 73 cases per day); 9,501 of them needed an initial treatment or observation time at the First Aid Points, 1,289 of them were hospitalised (1% Red code, 29% Yellow code, 70% Green code); 65% of patients (57% female, with a mean age of 37 years old) had medical problems. The percentage of all of the hospitalisations in the hospital network in Milan was nearly 13%.

Over the course of Expo 2015, 81% of the patients rescued in the 'Red Area' were adults (with an average age of 37 years old) and 19% of them were people under 18 years of age (with an average age of 12 years old). Overall, 1,629 (12%) were classified as foreigners and 88% were Italians.

Preliminarily, the primary chief complaint or diagnosis fell into the following two major categories: trauma (35%) and medical (65%). These two types of cases require a retrospective review in order to determine if the secondary causes can be identified.

As table 1 shows, fatigue, light-headedness, dizziness, syncope, loss of consciousness and headache were the prevalent medical diagnoses.

DISCUSSION

MGs represent significant challenges for the public health system and the healthcare system. The characteristics of MGs that impact public health services include high rates of attendance, the duration of the event and security concerns. The incidence of illness and injury at MGs is believed to be higher than would occur naturally in a population of comparable size. The major anticipated health risks may include heat- or cold-related illnesses, foodborne and waterborne illnesses, communicable diseases and accidents and other types of injuries. In general, the most common types of medical problems associated with MGs include dermal and musco-skeletal

Table 1. Prevalence of the most frequent medical and trauma diagnoses

Diagnosis	**Frequency (Total *n* = 2,500)**
Physical discomfort and/or weariness	*n* = 362, 14.4%
Light heatstroke	*n* = 261, 10.4%
Syncope and/or dizziness	*n* = 219, 8.7%
Headache	*n* = 196, 7.8%
Superficial hand injuries	*n* = 170, 6.8%
Nausea and vomiting	*n* = 159, 6.3%
Sprained ankle	*n* = 159, 6.3%
Low back pain	*n* = 113, 4.5%
Superficial face or head injuries	*n* = 105, 4.2%
Skin rash	*n* = 104, 4.1%
Head trauma without loss of consciousness	*n* = 102, 4%
Fever	*n* = 87, 3.4%
Skin infection	*n* = 84, 3.3%
Acute cystitis	*n* = 79, 3.1%
Itch without specification	*n* = 78, 3.1%
Anxiety disorder	*n* = 77, 3%
Dermatitis	*n* = 74, 2.9%
Blunt trauma to the lower leg	*n* = 71, 2.8%

injuries (such as cuts, lacerations, abrasions, bruises, sprains and fractures), gastrointestinal issues (such as nausea, vomiting, diarrhoea, stomach cramps and abdominal pain) and possible heart problems (such as chest pain, light- headedness, syncope, dizziness and loss of consciousness). Alcohol is believed to increase the casualty rate. Heat-related illness is common during long-term outdoor events held in hot weather. On rare occasions, MGs result in a high number of injuries and deaths [16]. At the 2006 Hajj in Mecca, Saudi Arabia, a crowd stampede caused 346 deaths and at least 289 injuries. An explosion at the 1996 Summer Olympic Games in Atlanta killed 1 person and injured 111 people. Overall, the AREU of Lombardy Region demonstrated excellent preparation for the Expo 2015 MG. The emphasis on safety and security in an MG environment was noticeable. Fortunately, there were no significant events or impacts on the surge capacity. Our study confirms that environmental factors, such as the weather, can contribute to large numbers of ill people at MGs. In fact, our findings show the most medical diagnoses concerned both dermal and musco-skeletal trauma and heat-related illnesses such as fatigue (*n* = 362), light heatstroke and dizziness (*n* = 261), syncope and loss of consciousness (*n* = 219). Gene-

rally, human bodies can adjust to changes in environmental temperatures. However, with extended exposure to sunlight or heat-wave conditions, and especially with high humidity, the body may not be able to maintain its temperature at normal levels, resulting in elevated body temperatures. The individuals who are more likely to have ill health effects from high temperatures and heat-waves are infants and children, elderly people, overweight persons, people taking medications and people exposed to sunlight for a long period of time. However, a plan of preventive activities addressed this issue in a timely manner. In a paper review on the weather and environmental hazards at MGs, Soomaroo et al. have identified a total of five MG events where heat-related illnesses and dehydration were amongst the commonest causes for patient presentations [17]. Emergency planners at the 1996 Atlantic Olympic Games were quick to increase public awareness of the dangers of dehydration by encouraging spectators to drink plenty of fluids, seek shade and to recognise the symptoms of dehydration, which resulted in a reduction in heat-related illnesses presenting at medical centres, further highlighting for emergency planners that heat has a direct bearing on health provision at MGs [18]. Moreover, our findings show a low percentage of both high-risk infectious diseases such as traveller's diarrhoea, foodborne and waterborne diseases, airborne diseases and high-risk illnesses with non-infectious causes such as motor vehicle accidents. However, both nausea and vomiting were reported by 6.3 percent of visitors.

Implications for the future: the role of the risk assessment

Emergency preparedness for MGs relies on effective planning to prevent and reduce morbidity and vulnerability, especially in emergency situations. Therefore, MG analysis is considered an important way to improve understanding of the elements of the event and the impact the event may have on participant safety and health outcomes. Circumstances surrounding MGs, such as the weather conditions, the duration of the event, crowd size or the emotional/psychological states of the participants have been shown to make the events more hazardous and increase the vulnerability of organisers [15, 16]. MG risk-assessment processes include a strategic risk assessment and an event-based risk assessment. The strategic risk assessment includes the identification of hazards that could pose a risk to the MG, an assessment of their likelihood of occurring and an assessment of their potential impact. Event-based risk assessment is a process that should include 'enhanced surveillance' to quickly detect and communicate information related to diseases and health events amongst participants and an 'outbreak alert and response mechanism' to respond to and implement timely infection-control activities [19]. MGs are pre-planned public events held at a specific location for a defined period of time that strain planning and response resources. The goal for public health during MGs is to prevent or minimise the risk of injury or ill health and maximise safety for participants, spectators, event staff and residents. It is possible to achieve this through careful advance planning, including carrying out a risk assessment in order to identify potential public health risks and guide further planning efforts, surveillance to detect public health incidents quickly, and response mechanisms to implement control measures if an adverse health incident happens so as to minimise its effects.

CONCLUSION

In the Milan Expo 2015, flexibility, integration and strong cooperation between pre-hospital settings and hospitals were incorporated into the application of the plan. The final data showed the effectiveness of the adopted model and the reduced impact on the hospital network. Our health services fulfilled the requirements of the organisation, thus contributing to the success of Expo 2015. The experience gained from the Milan Expo of 2015 in terms of capacity-building and organisational development provided a source of valuable expertise for dealing with different mass casualty situations in Italy and with fu-

ture world expositions.

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