



Review Paper

# The Olympic and Paralympic Games 2012: Literature review of the logistical planning and operational challenges for public health

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Received 17 January 2007; received in revised form 23 April 2008; accepted 23 April 2008

**KEYWORDS**

Olympics;  
Paralympics;  
Mass gatherings;  
Mass gathering  
medicine;  
Sporting events

**Summary Objective:** To undertake a review of the literature relating to public health planning and interventions at previous summer Olympic and Paralympic Games and other relevant major summer sporting events or mass gatherings, with a focus on official publications and peer-reviewed articles.

**Study design:** Literature review.

**Methods:** A literature review was undertaken using all biomedical databases and a freetext search using Google to widen the search beyond peer-reviewed publications. Search terms used were: Olympics; Paralympics; mass gatherings; mass gathering medicine; sporting events; weather; planning; and organisation. Citations within articles were searched to identify additional references that would inform this review. This literature review concentrates on the public health aspects of population care at mass gatherings, particularly the Olympic and Paralympic Games which are set over several weeks, focusing on surveillance, prevention and health service quality.

**Results:** The literature identified 10 areas of public health planning: public health command centre and communication; surveillance, assessment and control; environmental health and safety; infectious disease outbreaks; implications of weather conditions; health promotion; travel information; economic assessments; public transport and reduction of asthma events; and preparing athletes for potential allergies. The following themes emerged as crucial factors for the success of any public health interventions at Olympic and Paralympic Games: detailed planning of deliverables; pre-identification of critical success factors; management of risk; detailed contingency planning; and full testing of all plans prior to the event.

**Conclusions:** The 2012 Olympic Games will provide an exciting challenge for public health providers and systems. Preparation requires early detailed planning of policies, procedures and on-site health promotion events, in addition to helping to

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set up the surveillance and monitoring systems that will capture public health activity alongside medical activity. Learning from the literature review will support the identification of critical success factors and help to formulate recommendations that will allow optimal utilization of public health initiatives. All plans require full costings in advance which are supported by internal and external health-related agencies, voluntary organizations and sponsors. A risk assessment should be undertaken as part of the planning process leading to risk management plans for mitigating identified potential risks. All surveillance and monitoring systems, communication, policies and procedures will require full testing prior to commencement of the Games.

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## Introduction

The London 2012 Games will be held between 27 July and 12 August (Olympic Games) and 29 August and 9 September (Paralympic Games) 2012. Although the majority of events will be held in London, some events will take place in various stadia across the UK. All events of this size require the provision of temporary medical and public health services in places that are different from usual, serving populations significantly larger than that of the local population.

All mass gatherings vary in their complexity and pose unique challenges for maintaining the public's health, as well as providing medical and personal safety needs for the competitors, officials and spectators to the Games and related entertainments, as well as the indigenous population surrounding the venue sites. The duration, size and locations of the gatherings, the possibility of terrorism, and the effects of hot or cold weather need to be taken into account when planning and running the Games.

Thousands of mass gathering events are held each year, at national, regional and local levels. Spectator sports, ceremonies, rallies and fairs are just some of the events held across the UK. The definition of a 'mass gathering' in published literature has been accepted as over 1000 people<sup>1</sup>; however, most of the published literature reflects much larger events, generally >25,000 spectators.

This literature review covers the public health planning identified in previous temporary events focusing on generic surveillance issues, prevention and health service quality. It does not cover surveillance monitoring systems, data collected and collection points, health protection from terrorism, mass casualty care, physical layout of venues with regard to emergency access to stadia etc. as these will be dealt with by other stakeholders, nor does it cover the logistical provision of

emergency medical services, as these are outlined elsewhere.<sup>2</sup>

## Search strategy and overview

A literature search was carried out using Medline from 1959, Cinhal, Cochrane, Bandolier and King's Fund, and reports from the Sydney Olympics and International Olympic Committee (IOC). Keywords used were: Olympics; Paralympics; mass gatherings; mass gathering medicine; sporting events; weather; planning; and organisation. Freetext searches were undertaken to widen the search further to identify literature that may not have been published in medical or biomedical databases. References from papers were scrutinized to ensure that the most relevant literature to this review was located, accessed and reviewed.

In total, 90 papers, dating back to 1986, were identified through the literature search. Whilst some of these papers provided valuable information for the period, they were not all germane to this review. The age of some of the papers meant that they were of little value as the issues today, and in 2012, will be different due to the increased numbers of attendees, different behaviours and modern media opportunities such as widescreens outside Olympic venues.

Although the body of literature has grown over the years, most of the published articles found were descriptive rather than analytical, but it can be seen that trends in practice have developed into acceptable standards, enabling identification of key public health issues.

## Planning and organization

Managing and operating mass gatherings requires a great deal of planning and forethought, starting

many years in advance, particularly for events as large, prolonged and complex as the 2012 Games.

For the Sydney Games, it has been estimated that a minimum of 127,000 people converged on Sydney, including athletic teams, volunteers, media and 100,000 visitors.<sup>3,4</sup> An estimated 1.5 million people congregated around Sydney Harbour for the closing night celebrations.

There were an estimated 2 million visitors to the Atlanta Games<sup>5</sup> in addition to about 30,000 athletes, officials, media and volunteers; this number is more likely to reflect those visiting the UK where air, sea and land transport are relatively inexpensive.

Public health planning for the 2012 Games requires the co-ordination of local, regional and national health-related agencies as well as lateral co-ordination with private sponsors and voluntary organizations. Planning takes a minimum of 3 years to ensure that stakeholders are identified and roles delineated.<sup>6</sup> Planning for the Games is quite different from planning for most mass gatherings, as the facilities and medical services to be provided are clearly defined by the IOC<sup>2</sup>; in addition, most Olympic and Paralympic teams will bring some of their own medical care providers.

Many volunteers are required to support the Games, and this review highlights the need to identify these people at an early stage (at least 2 years before the event for prehospital providers<sup>7</sup>) and give them the opportunity to work at test events.<sup>8,9</sup>

## Public health and the 2012 games

Managing the risk and impact of public health issues presents significant challenges when planning for the Games. Experience at previous Games has shown that major anticipated medical problems that require medical services and activity include heat-related illnesses,<sup>5,10</sup> foodborne and waterborne illnesses,<sup>5,11</sup> sexually transmitted diseases (STDs)<sup>12</sup> and communicable diseases.<sup>4</sup> Most patient encounters are likely to be minor complaints such as headache, fatigue, minor abrasions, lacerations, sunburn and bee stings.<sup>13</sup> The evidence shows that events held during hot weather increase the patient visit rate significantly,<sup>14</sup> and also increase the need to place healthcare facilities close to drinking water and sanitation facilities.<sup>13</sup>

The nature of the particular event is significant because visitors that are allowed to move about more freely have more opportunities for minor trauma and exposure-related or exertion-related illnesses than events where spectators are

primarily seated.<sup>14</sup> Heat exhaustion, muscle injuries and trauma are more common with outdoor sporting events. Alcohol abuse, illicit drug usage and attendant dehydration can be expected at major spectator events,<sup>13</sup> although morbidity is more likely at rock concerts<sup>15,16</sup> than at sporting events.<sup>17</sup>

In addition, surveillance systems are required to detect the emergence of infectious disease outbreaks and any unusual disease and injury patterns in spectators, participants and the local population, as well as to measure health services use.<sup>12</sup>

Hnatow and Gordan<sup>18</sup> identified nine major elements of planning for an entire event. Using parts of this model that relate to public health, plus other public health elements identified through the literature review, the following areas should be prioritized for planning.

## Public health command centre and communication

Public health requires a central command area to co-ordinate and manage key public health issues and initiatives, with clear delineation of responsibilities and authority.<sup>5,19</sup> The command centre staff should be capable of identifying public health threats and, through action and communication, minimize harm. The primary function of the command centre is to detect issues threatening public health and to co-ordinate responses to them, including media, terrorism and bioterrorism, disease outbreaks, food safety and prevention services.<sup>5,12</sup>

The location of the command post should be clearly marked, and its telephone numbers and radio identifiers should be known by all event personnel. The command centre should be staffed throughout the Games and should ideally be in the vicinity of event administration and security.<sup>19</sup> Each Olympic venue requires public health response teams that are available on-call 24 h/day.<sup>5</sup>

Developing and implementing well-organized communication is the key to delivery of an efficient public health system at the 2012 Olympic Games.<sup>20</sup> Communication capacity<sup>21,22</sup> is important as part of the planning considerations for each venue and across different venues. This is particularly important for public health emergencies or for instigating changes in positioning of goods or services due to emerging public health risk areas. A back-up system should be established in the event that first-line radio communication fails.<sup>4,23</sup>

Implementation of continuous quality improvement and regular debriefings<sup>19</sup> across all sites

enables sharing of 'best practice' and improved public health interventions and services.

### Surveillance, assessment and control

Mass gatherings are usually a collection of well people, but they do produce a higher incidence of injury or illness than in the general population,<sup>24</sup> of which only a minority (around 5%) require emergency care.<sup>17</sup> Most of those seeking medical help are visitors.<sup>25</sup> Recent analysis of patient presentation rates (PPR) per 1000 spectators suggests that there is an average PPR of 0.992.<sup>26</sup> Events at which the audience is predominantly seated demonstrate a significantly lower presentation rate ( $P < 0.01$ ).

Public health surveillance, incorporated into the Games surveillance and monitoring system, is required to facilitate rapid detection of outbreaks and other health-related events, particularly illicit drug use or excessive alcohol use,<sup>3</sup> and enable public health teams to respond with timely control measures.<sup>3,4,27–30</sup> The surveillance system should be set up and tested prior to the start of the Games to ensure that it is capable of measuring every patient encounter at Olympic venues and first aid stations,<sup>4,31</sup> as well as identified public health issues.

Data collected should be able to: distinguish between presentations due to injury and those due to ill health;<sup>4</sup> capture general practitioner (GP) reporting of imported communicable diseases via the normal surveillance systems; provide environmental health monitoring as well as public health data on goods and leaflets distributed during the Games and at health promotion events. Keeping detailed records of all public health interventions is important, even for those issues that might be deemed less important such as those who request bottled water, 'heat-related' products (e.g. sun screen), bandages and condoms etc., in order to maximize the data collection<sup>32</sup> and ensure that economic assessments are as accurate as possible to inform future Games.

In Sydney, an enhanced and comprehensive surveillance system was developed using data from multiple sources, and transferring data back to the centre three times a day,<sup>4</sup> differing from earlier Olympic Games which reported three times a week.<sup>10</sup> Three-day moving averages were used to detect unusual infectious disease outbreaks to allow same-day medical and public health interventions.<sup>33</sup> To maximize the quality of data collected, three pilot studies, a full trial and a validation study were conducted prior to commencement. Data were not collected systematically for alcohol, but it was noted as a contributing cause in 13% of medical cases.<sup>31</sup>

At the Sydney Games, a surveillance report was produced each evening focusing on public health issues, particularly food-related illnesses, communicable diseases and injuries suffered by spectators at Olympic venues.

GPs are a major provider of primary care services, but for the Sydney Olympics, only one in 10 GPs reported that they were well prepared for the Games.<sup>34</sup> This may have a considerable negative impact on the adequate treatment of patients, the identification of unusual symptoms and the surveillance of communicable diseases. GP briefings are required before the 2012 Olympics; with telephone hotlines established that facilitate immediate disease reporting on a 24 h/day, 7 days/week basis, increased awareness can be achieved with GPs by publishing to the medical community 6 weeks prior to the start of the Games.<sup>10</sup>

During the Sydney Olympics,<sup>35</sup> four public health staff and eight public health trainees worked full time on collecting, collating and analysing surveillance data and preparing reports. Fifty surveillance officers were trained to collect emergency department data, and each emergency department was staffed by an officer for 18 h/day, 7 days/week. Ten additional senior staff participated in the daily review meetings. Emerging issues could be identified within 24 h.

### Environmental health and safety

Setting new policies and procedures to aid immediate resolution of environmental hazards will help to keep the public safe. In the 1996 Atlanta Games, six sets of environmental health regulations were either created or modified, and enforced aggressively,<sup>5</sup> in anticipation of the Olympics and the foreseeable problems:

- regulations were enhanced to allow for immediate supervisory suspension of a food service permit;
- potable water was required to be available at all venues. The number of water containers required at each venue was specified, based on projected attendance;
- acceptable accommodations were defined and special provisions were made for bed and breakfast establishments;
- water quality standards were specified for all swimming pools and recreational waters at Olympic venues and public pools; and
- provisions were made for the required number of portable toilets at events, based on

projected attendance, and the required maintenance and cleaning of the portable toilets.

One common area of concern for both environmental management and disease control involves illegal food operations, particularly those close to the venues. Prior to the Sydney Games, judicial and law enforcement policies were introduced that allowed unlicensed food operations to be closed immediately without the usual 2-week waiting period for a court order.<sup>10</sup>

In 1994, a training and certification programme for environmentalists who would work at the 1996 Atlanta Games was established.<sup>5</sup> In addition, numbers were supplemented with environmentalist staff from non-Olympic counties.

Throughout the Sydney Olympics, food safety teams (115 officers) conducted food site inspections, utilizing selective sampling and microbiological testing. At intervals, environmental health teams inspected water cooling systems, waste services, sanitation and general safety matters inside the venues. Daily reports were provided.<sup>4</sup>

In Atlanta, 150 food and drug inspectors, from Georgia and other parts of the USA, were employed to inspect and monitor food vendors.<sup>12</sup> In addition, local and regional public health officials were required to provide general environmental health services such as water testing, sanitation services and solid waste disposal.

### Infectious disease outbreaks

Infectious disease outbreaks at mass gatherings are uncommon,<sup>31</sup> although with several million meals to be served, this amplifies the potential for foodborne disease outbreaks. A review article<sup>36</sup> covering the 27 years between 1966 and 1993 only identified 38 reports of disease outbreaks or 'other instances of transmission' of disease associated with competitive sports. However, this may reflect inadequate surveillance of populations that later disperse or non-reporting of symptoms.

Unique considerations for the Sydney Games, regarding disease transmission, included cruise ships serving as floating hotels and imported communicable diseases (e.g. in 1996, tourists travelling in countries where yellow fever is endemic unknowingly imported the disease to the USA and Switzerland).<sup>28</sup> Provision of information packs to all GPs and accident and emergency departments about communicable diseases that are not prevalent in the UK is important.<sup>20,34</sup>

Adequate laboratory capacity is a key issue for all Games. Planning in Sydney included identifying the seasonal nature of different types of disease.<sup>31</sup>

Retrospective analysis identified the need for rapid influenza diagnostic kits to improve the specificity of presentations for 'influenza-like' illness.<sup>4</sup>

The use of vaccine supplies, including immunoglobulins, requires close monitoring to ensure availability in the instance that larger than normal quantities are required.<sup>10</sup>

### Implications of weather conditions

Exposure to excessive heat contributes to a range of heat-related illnesses.<sup>16,33,37,38</sup> Previous surveillance<sup>16,33</sup> has shown that heat-related condition measurements range from 0.4 to 11.5 cases per 1000 people at temperatures of 86 °F (30 °C) to 121 °F (49.4 °C), respectively. Standing in direct sunlight in stadia or walking around without adequate protection from the elements results in the highest numbers of observed cases.<sup>39</sup>

Heat-related illnesses represent a large proportion of patient visits,<sup>16,40</sup> accounting for 2% of emergency department visits, 10% of which required hospital admission.<sup>41</sup> Risk factors for heat-related mortality and morbidity include age, socio-economic status, urban living and not practising preventative behaviours.<sup>33</sup> Risks of heat-related illness, as a result of prolonged exposure to heat, can be reduced at crowded outdoor events by anticipating changing environmental conditions and recognizing how people might be at risk. Interventions can include extensive media public awareness campaigns, informing spectators of preventive measures for heat-related illness,<sup>42</sup> supplemented by pamphlets targeted at ticket purchasers in advance and on a daily basis when entering event fora.

In Atlanta, the surveillance system used two categories of heat-related illness: 'heat (skin/sunburn)' and 'heat (exhaustion/stroke)'. This information allowed public health officials to increase public awareness announcements at these venues, encouraging spectators to drink more fluids, seek shade and recognize the symptoms of heat-related illness.<sup>41</sup> The highest rates of heat-related illness in Atlanta were at the beach volleyball venue and the Horse Park,<sup>12</sup> and at the equestrian event in Los Angeles.<sup>10</sup>

In Atlanta, regulations required that drinking water was available to participants.<sup>5</sup> However, conflict arose about the provision of water at venues between sponsors, sellers and health professionals.

Resources can be combined from all agencies to provide shelter, water, wide-brimmed hats, fans, sunscreen and prevention information to pedestrians along Olympic venue corridors. In addition, the provision of water misters attached to high-

velocity evaporative fans in the most crowded sites, which help to cool spectators and pedestrians,<sup>12,42</sup> plus ample water fountains in key areas have the ability to reduce the risk of adverse events from heat exposure.<sup>10</sup> Air-conditioned buses can be used as cooling stations.<sup>33</sup>

Although recent settings for the Games have been in warm climates, if the weather is cold and wet, this can lead to cold-related illness (hypothermia, frost-bite) and more falls caused by wet grass.<sup>37</sup> Hypothermia is increased at events with water, rain or where participants abuse alcohol. It is important that venues have plenty of warm areas available, with heated patient treatment areas.<sup>21</sup>

## Health promotion

Respiratory illnesses, minor injuries (cuts, abrasions and strains), heat-related injuries and minor problems (headache, blisters, sunburn) comprise 75% of patient presentations,<sup>26</sup> many of which can be prevented through robust pre-Games information to attendees.<sup>41</sup>

Medical staff can support public health messages by providing information and advice on food, transport and safety issues as well as known hazards (e.g. environmental issues, banned drugs)<sup>43</sup> alongside medical care. In Atlanta, public health education materials were distributed, including a wellness brochure, with the tickets to all visitors.<sup>5</sup> In Sydney, health promotion messages and related warnings were prepared, and a 24 h health media centre was operated during the Games to distribute health messages to the general population.

Safe sex campaigns to limit the spread of STDs were initiated in Atlanta,<sup>12</sup> including distribution of posters, pamphlets and buttons in 17 languages; 50,000 condoms in Olympic colours were distributed at the on-site polyclinic.

The Sydney Olympic Committee was committed to achieving a non-smoking environment and introduced a non-smoking policy for all venues, including seating areas, enclosed bars and restaurants, bedrooms and living quarters in the villages, enclosed staff break areas, Olympic transport vehicles and hospitality suites.<sup>8</sup>

## Travel information

All cities have areas with significant crime, so the provision of information and advice about taking common sense precautions to those venturing out, particularly late at night, can increase personal safety.<sup>43</sup> A pamphlet outlining the issues for those travelling to the Games may prevent some

unnecessary incidents.<sup>44</sup> Most importantly, visitors should be attentive to road safety.

All competitors taking part in the Sydney Games were given advice on relevant vaccinations as well as other health promotion advice.<sup>43</sup> Information was provided about how athletes could prepare to minimize the effects of jet lag and its resultant impact on sleep patterns.

## Economic assessments

There are considerable logistical issues about delivering both routine and emergency health care during the Games but these are largely predictable. Sustaining momentum to ensure health planning for 2012 is a significant challenge, and will become increasingly resource intensive. Failing to match resources to the developing workload will be a risk.

In Atlanta, no systems were in place to gather the public health personnel costs associated with the Games planning and operations.<sup>5</sup> Retrospective costings were calculated, but these were unable to calculate all the costs correctly. Atlanta stated that the biggest single error in public health preparations at the state level was the failure to secure funding in advance for health promotion activities.

## Public transport and reduction of asthma events

Despite advances in asthma therapy, asthma remains a substantial public health problem for children, particularly in areas of high pollution due to road traffic.

Research undertaken during the Atlanta Games<sup>42</sup> identified that acute asthma care in children decreased during the Olympic Games, although the findings were not significant. Atlanta's strategy included the development and use of an integrated 24 h/day public transportation system, the addition of 1000 buses for park-and-ride services, local business use of alternative work hours and telecommuting, closure of the downtown sector to private automobile travel, altered downtown delivery schedules, and public warnings of potential traffic and air quality problems.<sup>45,46</sup>

## Preparing athletes for potential allergies

The performance of Olympic athletes can be jeopardized with seasonal allergic rhinoconjunctivitis if it coincides with the peak of the pollen season.<sup>47</sup> Pre-testing Olympic sites in the years prior to the event can assess likely pollen counts, so that management advice can be given to participants in advance.

## Recommendations

Whilst the literature was not able to fully document all public health planning for the Games, lessons from the past can be itemised.

### Public health command centre and communication

- a. Set up to co-ordinate and manage public health initiatives guided by a surveillance system fed by medical providers and integrated with the overall central command centre for the Games.
- b. Centre to be clearly visible and contact details known to all event personnel.
- c. Each Olympic venue to establish 24 h/day, 7 days/week response teams.
- d. Implement continuous quality improvement across all sites.
- e. Ensure that back-up systems are in place should first-line radio communications fail.
- f. Use command centre to communicate public health messages, oversee surveillance and re-site public health resources and staff when required.
- g. Essential for Department of Health, Health Protection Agency (HPA) and service public health to work together seamlessly with no mixed messages.
- h. Provide training for all public health staff alongside HPA to build capacity for emergency situations.

### Surveillance, assessment and control

- a. Develop a robust surveillance system that is fully tested in several different mass gathering situations.
- b. Transfer data three times per day from different collection points, and surveillance system to be analysed and reported daily in order to identify emerging issues.
- c. Systematically collect alcohol-related incident data.
- d. Appropriate education through GP information packs regarding unusual diseases and reporting structures in advance of the Games to ensure correct reporting of diseases.
- e. Keep full records of all goods given out by public health and medical staff, e.g. condoms, sun cream etc.

### Environmental health and safety

- a. Set and aggressively enforce new policies and procedures to aid immediate resolution of

environmental hazards, e.g. food vendors, as well as monitoring the provision of new accommodation for spectators.

- b. Develop a training and certification programme for environmentalists working at the Games.
- c. Conduct regular food site inspections, selective sampling and microbiological testing.
- d. Ensure adequate laboratory support to enable higher than normal levels of food testing.
- e. Inspect water cooling systems, waste services, sanitation and general safety matters inside all venues.
- f. Provide daily reports to the surveillance centre.
- g. Consider likelihood of sewage and drainage problems due to excessive rain or flooding.

### Infectious disease outbreaks

- a. Identify new living accommodation options and ensure that they meet statutory health requirements and have contact details of the public health command centre.
- b. Identify typical diseases prevalent in UK during period of Games.
- c. Develop GP information pack with regard to imported communicable diseases.
- d. Ensure that vaccine supplies are available, including immunoglobulins.
- e. Ensure that laboratory capacity is adequate to deal with a potentially higher than normal workload.
- f. Distribute condoms.

### Implications of weather conditions

- a. Surveillance to use two categories of heat-related illness: heat (skin/sunburn) and heat (exhaustion/stroke).
- b. Provide adequate shade at all venues, particularly external venues such as equestrian and beach volleyball events.
- c. Increase public health announcements and information about preventing heat- and cold-related illnesses and injuries.
- d. Provide safe, free drinking water and water fountains (having resolved potential conflict with sponsors), water misters, high velocity fans and air-conditioned buses.
- e. Using health promotion stands, give out sun screen, wide-brimmed hats and fans to pedestrians.
- f. Develop a wet weather plan to include problems of rain and flooding, additional patient presentations through slips and falls.
- g. Provide plastic rain covers for clothes or umbrellas.

- h. Provide warm areas for events when it is raining, cold or where alcohol is used by participants.

### Health promotion

- a. Identify key public health stakeholders and sponsors and bring on side early; ensure that there is no conflict with free handouts with major sponsors.
- b. Work with sponsors to develop and deliver healthy food options and healthy eating messages.
- c. Prepare preventative literature to be mailed to visitors with their tickets and to hand out at the events, to include heat- and cold-related issues, STDs, smoking cessation, alcohol etc.
- d. Set up and man a health media centre for 24 h/day, 7 days/week.
- e. Use radio and television to distribute health messages to the general population.
- f. Set up health promotion stands in venues for the distribution of information and other health-related goods, e.g. sun screen, plastic rain covers.
- g. Ensure that all the event sites, accommodation and hospitality venues used for the Games are smoke-free zones.

### Travel information

- a. Prepare a pamphlet for those travelling to the UK (visitors and teams) on:
  - personal and possessions safety;
  - road safety for drivers and pedestrians (awareness that the UK has right-hand-drive vehicles, which travel on the left side of the road);
  - immunizations; and
  - jet lag and sleep patterns and appropriate advice that will help to reduce the harm from jet lag.
- b. Use of health promotion stands to re-inforce travel messages at Games.

### Economic assessments

- a. Ensure adequate resources (money and people) for the developing workload.
- b. Put in place a full costing exercise and monitor spending prospectively.
- c. Secure funding in advance for health promotion activities, ensuring that there is no conflict of interest with sponsors.
- d. Calculate the opportunity costs of the public health staff volunteering in their work time.

### Public transport and reduction of asthma events

- a. Liaise with transport departments to determine how to reduce road traffic.
- b. Liaise with environmental health to measure air quality.
- c. Ensure that surveillance programmes monitor asthma events.
- d. Measure incidents of asthma during the Games period for all ages and compare with pre- and post-Games data.

### Preparing athletes for potential allergies

- a. Pre-test Olympic venues for seasonal allergens in the years building up to the Games.
- b. Notify athletes of the allergen risks so that management, within drug regulations, can be instituted.

### Limitations of this review

Several areas have not been discussed in this review as no literature was found to inform the subjects. However, these are important and should be given careful consideration by the Games organizers. These relate specifically to establishing clear lines of accountability:

- a. the hierarchy of relationships between the different stakeholders, e.g. local authorities, London Strategic Health Authority, Department of Health, Olympic Development Authority and London Organizing Committee for 2012 Olympic Games;
- b. the Games surveillance and command centre and its relationship and accountability with the public health surveillance and command centre; and
- c. the role, relationships and hierarchical decision making of the Games managers alongside professionals providing services.

### Conclusion

The 2012 Games will provide an exciting challenge for public health providers and systems. The emerging themes from this review suggest that the critical success factors to the public health interventions at the Games are:

Detailed planning of deliverables and defined funding; adequate staffing in all areas; pre-identification of critical success factors for public

health; management of risk by detailed contingency planning; testing planned interventions in the years preceding the Games; co-ordination and planning of interventions with sponsors; and costing data collection implemented.

### Ethical approval

None sought.

### Funding

None declared.

### Competing interests

None declared.

### References

- Sanders AB, Criss E, Steckl P, Meislin HW, Raife J, Allen D. An analysis of medical care at mass gatherings. *Ann Emerg Med* 1986;15:515–9.
- International Olympic Committee. *Medical services: technical manual on medical services*. IOC, [http://www.olympic.org/uk/index\\_uk.asp](http://www.olympic.org/uk/index_uk.asp); 2005.
- Indig D, Thackway S, Jorm L, Salmon A, Owen T. Illicit drug-related harm during the Sydney 2000 Olympic Games: implications for public health surveillance and action. *Addiction* 2003;98:97–102.
- Jorm LR, Thackway SV, Churches TR, Hills MW. Watching the games: public health surveillance for the Sydney 2000 Olympic games. *J Epidemiol Community Health* 2003;57:102–8.
- Meehan P, Toomey KE, Drinnon J, Cunningham S, Anderson N, Baker E. Public health response for the 1996 Olympic Games. *JAMA* 1998;279:1469–73.
- Janicke DM, Jacob DJ, LaFountain RB, Pundt MR, Young GE. Emergency medical care in the athletes' village: World University Games, 1993. *Prehosp Disaster Med* 1995;10:113–7.
- Shaw K. Olympics EMS truths. *Emerg Med Serv* 1997;18:20.
- Stiel D. *Final report to IOC Commission: medical program Sydney 2000 Olympic Games* [http://www.olympic.org/uk/index\\_uk.asp](http://www.olympic.org/uk/index_uk.asp).
- Stiel D, Trethowan P, Vance N. Medical planning for the Sydney 2000 Olympic and Paralympic Games. *Med J Aust* 1997;167:593–4.
- Weiss BP, Mascola L, Fannin SL. Public health at the 1984 Summer Olympics: the Los Angeles County experience. *Am J Public Health* 1988;78:686–8.
- Panella H, Plasencia A, Sanz M, Cayla JA. An evaluation of the epidemiological surveillance system for infectious diseases in the Barcelona Olympic Games of 1992. *Gac Sanit* 1995;9:84–90.
- Brennan RJ, Keim ME, Sharp TW, Wetterhall SF, Williams RJ, Baker EL, et al. Medical and public health services at the 1996 Atlanta Olympic Games: an overview. *Med J Aust* 1997;167:595–8.
- Bernardo LM, Veenema TG. Paediatric emergency preparedness for mass gatherings and special events. *Disaster Manag Response* 2004;2:118–22.
- Michael JA, Barbera JA. Mass gathering medical care: a twenty-five year review. *Prehosp Disaster Med* 1997;12:305–12.
- Butler 2nd WC, Gesner DE. Crowded venues. Avoid an EMS quagmire by preparing for mass gatherings. *JEMS* 1999;24:62–5. 67, 73.
- Hill MD. Sizzling special events. Does air temperature affect patient encounters at mass gatherings? *Emerg Med Serv* 2000;29:74–6. quiz 77.
- Varon J, Fromm RE, Chanin K, Filbin M, Vutpakdi K. Critical illness at mass gatherings is uncommon. *J Emerg Med* 2003;25:409–13.
- Hnatow DA, Gordan DJ. Medical planning for mass gatherings: a retrospective review of the San Antonio Papal Mass. *Prehosp Disaster Med* 1991;6:443–50.
- Grange JT. Planning for large events. *Curr Sports Med Rep* 2002;1:156–61.
- Adil M. Presentation to regional public health meeting. Manchester; March 13th 2002.
- Gaffney JK. *Mass gathering medicine*. Teaching material notes, [http://medicom.org/public/tadmat/training/NDMS/Mass\\_Gatherings.pdf](http://medicom.org/public/tadmat/training/NDMS/Mass_Gatherings.pdf)
- Oberg KC, Gabram SA, Brewer PA. The remote location of an air medical service to the 1995 Special Olympic World Games. *Air Med J* 1996;15:177–80.
- Martinez JM. Medical coverage of cycling events. *Curr Sports Med Rep* 2006;5:125–30.
- Arbon P. Planning medical coverage for mass gatherings in Australia: what we currently know. *J Emerg Nurs* 2005;31:346–50.
- Wetterhall SF, Coulombier DM, Herndon JM, Zaza S, Cantwell JD. Medical care delivery at the 1996 Olympic Games. Centers for Disease Control and Prevention Olympics Surveillance Unit. *JAMA* 1998;279:1463–8.
- Arbon P, Bridgewater FHG, Smith C. Mass gathering medicine: a predictive model for patient presentation and transport rates. *Prehosp Disaster Med* 2001;16:109–16.
- 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 Disaster Med* 2004;19:278–84.
- World Health Organization. *Global infection disease surveillance*. Factsheet No. 200. Geneva: WHO; 1998.
- Centers for Disease Control and Prevention. Public health surveillance during the XV11 Central American and Caribbean Games, Puerto Rico, November 1993. 1996;45:581–4.
- Medical Data Centre A. *Olympic medical surveillance system: final report*. 2000, [http://www.olympic.org/uk/index\\_uk.asp](http://www.olympic.org/uk/index_uk.asp).
- Thackway SV, Delpech VC, Jorm LR, McAnulty JM, Visotina M. Monitoring acute diseases during the Sydney 2000 Olympic and Paralympic Games. *Med J Aust* 2000;173:318–21.
- Lukins JL, Feldman MJ, Summers JA, Verbeek PR. A paramedic-staffed medical rehydration unit at a mass gathering. *Prehosp Emerg Care* 2004;8:411–6.
- Centers for Disease Control and Prevention. Surveillance for early detection of disease outbreaks at an outdoor mass gathering. *JAMA* 2006;295:1115–8.
- Leggat PA, Seelan ST. Preparedness of general practitioners in Australia for the Sydney 2000 Olympic and Paralympic Games. *J Travel Med* 2002;9:322–5.
- Jerrard DA, Beurle J. Male patient visits to the emergency department decline during major sporting events. *SAEM Annual Meeting*, 2005, Abstract. vol. 12, No 5, Suppl 1. New York: ACAD Emer Med; May 2005.
- Goodman RA, Thacker SB, Solomon SL, Osterholm MT, Hughes JM. Infectious diseases in competitive sports. *JAMA* 1994;271:862–7.

37. Milsten AM, Maguire BJ, Bissell RA, Seaman KG. Mass-gathering medical care: a review of the literature. *Prehosp Disaster Med* 2002;**17**:151–62.
38. Zeitz KM, Zeitz CJ, Kadow-Griffin C. Injury occurrences at a mass gathering event. *J Emerg Prim Health Care* 2005;**3**.
39. Milsten AM, Seaman KG, Liu P, Bissell RA, Maguire BJ. Variables influencing medical usage rates, injury patterns, and levels of care for mass gatherings. *Prehosp Disaster Med* 2003;**18**:334–46.
40. De Lorenzo RA. Mass gathering medicine: a review. *Prehosp Disaster Med* 1997;**12**:68–72.
41. Centers for Disease Control and Prevention. Prevention and management of health-related illness among spectators and staff during the Olympic Games – Atlanta, July 6-23. *Morb Mortal Wkly Rep* 1996;**45**:631-633.
42. Friedman MS, Powell KE, Hutwagner L, Graham LM, Teague WG. Impact of changes in transportation and commuting behaviors during the 1996 Summer Olympic Games in Atlanta on air quality and childhood asthma. *JAMA* 2001;**285**:897–905.
43. Milne C, Shaw M, Steinweg J. Medical issues relating to the Sydney Olympic Games. *Sports Med* 1999;**28**:287–98.
44. Shaw M, Leggat PA. Traveling to Australia for the Sydney 2000 Olympic and Paralympic Games. *J Travel Med* 2000;**7**:200–4.
45. US Environmental Protection Agency Office of Air and Radiation. *What can you do to reduce air pollution?*. Washington, DC: EPA; 1992. p. 12.
46. Friedman MS, Powell KE, Hutwagner L, Graham LM, Teague WG. Impact of changes in transportation and commuting behaviors during the 1996 summer olympic games in Atlanta on air quality and childhood asthma. *JAMA* 2001;**285**:897–905, <http://jama.ama-assn.org/cgi/content/full/285/7/897>.
47. Katelaris CH, Carrozzi FM, Burke TV, Byth K. A springtime olympics demands special consideration for allergic athletes. *J Allergy Clin Immunol* 2000;**106**:260–6.

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