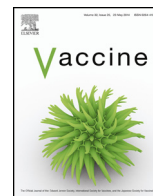




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Review

Burden of vaccine preventable diseases at large events

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ABSTRACT

Background: Large events or mass gatherings (MGs) are known to amplify the risk of infectious diseases, many of which can be prevented by vaccination. In this review we have evaluated the burden of vaccine preventable diseases (VPDs) in MGs.
Methods: Major databases like PubMed and Embase, Google Scholar and pertinent websites were searched by using MeSH terms and text words; this was supplemented by hand searching. Following data abstraction, the pooled estimate of the burden of VPDs was calculated when possible; otherwise a narrative synthesis was conducted.
Results: In the past, at religious MGs like Hajj and Kumbh Mela, cholera caused explosive outbreaks; but currently respiratory infections, notably influenza, are the commonest diseases not only at Hajj but also at World Youth Day and Winter Olympiad. The recent cumulative attack rate of influenza at Hajj is 8.7% (range 0.7–15.8%), and the cumulative prevalence is 3.6% (range: 0.3–38%). Small outbreaks of measles (13–42 cases per event) have been reported at sport, entertainment and religious events. A sizeable outbreak (>200 cases) was reported following a special Easter Festival in Austria. An outbreak of hepatitis A occurred following the 'Jam bands' music festival. Other VPDs including pneumococcal disease, pertussis and tuberculosis have been reported in relation to MG attendance.
Conclusion: VPDs not only affect the participants of MGs but also their contacts; vaccine uptake is variable and vaccine implementation is likely to have beneficial effects. Research to address the knowledge gaps surrounding VPDs at MGs is needed.

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1. Introduction

Q2 According to the World Health Organization (WHO) an organised or planned event can be classified as a mass gathering (MG) "if the number of people attending is sufficient to strain the planning and response resources of the community, state or nation hosting the event" [1]. MGs are held for various purposes including religious, political, socio-cultural, athletic and entertainment

pursuits. Obviously, health and safety of the attendees at such an event are essential elements that concern both the host country and international public health agencies.

MGs are known to increase the risk of infectious diseases with the potential for a pandemic i.e., 'globalisation' of a pathogen following the event [2]. The risk and pattern of diseases at MGs are influenced by the features of the event, particular activities, and also characteristics of the participants including their immunity to infectious agents [3]. Excessive crowding, shared accommodation and prolonged exposure resulting from close contact with infectious individuals all increase the risk of transmission of infectious agents [4,5].

Intercontinental outbreaks of meningococcal disease associated with the Hajj pilgrimage in 1987 and 2000/2001, and more recently, rapid international spread of influenza and other respiratory pathogens are all well-known examples of health hazards

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at MGs [2,6]. Other notable examples are, outbreaks of influenza at a World Youth Day (WYD) [7], a Winter Olympiad [8] and a Rock Festival [9], and historically of cholera at Kumbh Mela, one of the largest gatherings in the world that involves ritual bathing in the Ganges in India [10]. These and other health hazards associated with MGs have been well reviewed [11–15]. It is likely that a substantial proportion of these infections can be prevented by immunisations. Vaccinations against meningococcal disease, influenza, yellow fever and polio are recommended for attendees at certain MGs [3,16]. However, the burden of vaccine preventable diseases (VPDs) associated with MGs has not been quantified through a formal review.

The aim of this review is to evaluate the burden of VPDs during MGs.

2. Search strategy

2.1. Search strategy and selection criteria

Studies were identified through searching electronic databases including; PubMed and Embase from database inception to April 30, 2015. We used a combination of MeSH terms and text words including: 'mass gathering' OR 'holiday' OR 'sport' OR 'festival' OR 'Hajj' OR 'FIFA', OR 'pilgrimage' AND 'infection' OR 'disease outbreak' OR 'respiratory disease' OR 'influenza' OR 'communicable disease' AND 'vaccine' OR 'vaccination' OR 'immunisation' OR 'vaccine uptake'. Google Scholar and pertinent websites including the online Saudi Epidemiology Bulletin were also searched for relevant studies. Finally, manual searches were performed reviewing reference lists of included studies to identify additional potentially relevant papers.

Inclusion criteria were all observational studies that reported the rate of infectious diseases preventable by vaccine e.g., influenza, meningococcal and pneumococcal diseases, pertussis, diphtheria, measles, mumps, rubella, hepatitis A and B, tetanus, diphtheria and varicella. The target population of this review was attendees at MGs of any age, gender and country. Only English language studies were included.

We excluded case reports, case series and studies involving healthcare workers or that focussed on health services or

infrastructure during MGs. Studies reporting infections not preventable by vaccine were also excluded.

A selective strategy was used for older papers that reported occurrence of repeated outbreaks such as cholera at Hajj and Kubh Mela whereby only the most comprehensive articles were included. Similarly, for the meningococcal outbreaks at Hajj, only the key outbreak reports were included.

Two authors (ASA and MA) independently reviewed the titles and abstracts to identify potentially relevant papers. Full texts of all potentially relevant papers were reviewed by both authors to determine those which met the selection criteria. The 'preferred reporting items for systematic reviews and meta-analyses (PRISMA)' statement was used to guide and report the search methodology (Fig. 1).

2.2. Data extraction

Two authors (ASA and MA) independently extracted the data from each study into a data extraction sheet which was divided in sections for each MG event, while a third author (HR) arbitrated when a discrepancy occurred. The following data were abstracted in each extraction sheet: study design, year and country of conducting the study, sample size, age group, diagnostic method used, type and prevalence of infection, vaccination rate and effectiveness of vaccine, if available. Whenever possible we provided a pooled estimate of the burden of VPDs otherwise a narrative synthesis was conducted.

3. Disease burden at MGs

3.1. Summary of included studies

Of 3036 records identified, 66 full texts were reviewed and 39 studies were finally included in this review (Fig. 1); of these, 31 studies reported the burden of VPDs at religious MGs (Hajj, Kumbh Mela, WYD, Taizé meeting and Easter Festival), 4 reported on sport events (Winter Olympics, Asian Youth Games, International Youth Sport Event and International Special Olympic Games) and the remaining 4 studies reported on entertainment MGs (music concert, International Dog Show and fun gatherings at Disney parks). The characteristics of these MGs have been listed in Table 1.

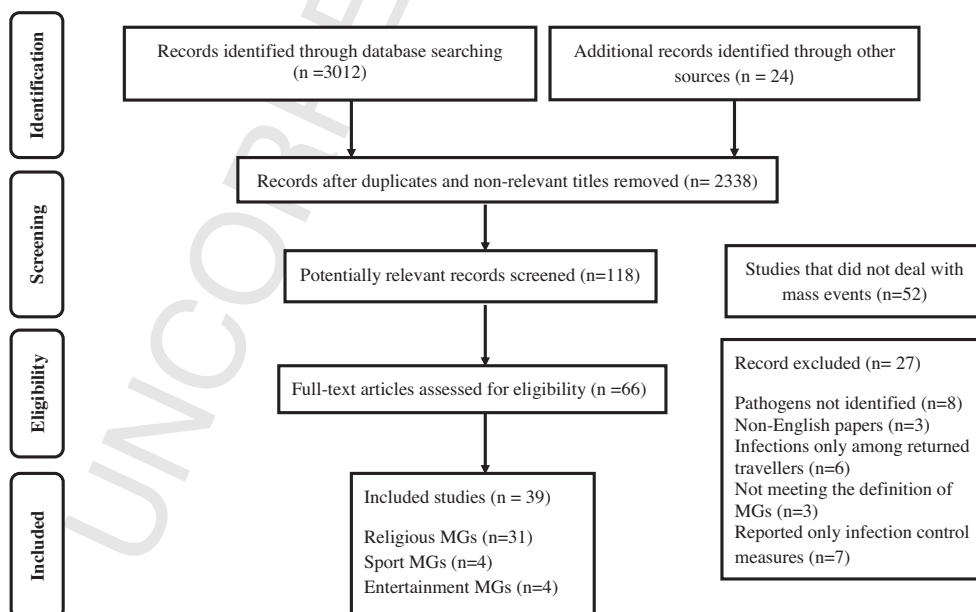


Fig. 1. Flow diagram of searching strategy.

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