



Evaluating the impact of a mass gathering (2018 Commonwealth Games) on emergency department presentations with communicable diseases: A retrospective cohort study



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ABSTRACT

Objective: To identify the impact of a mass gathering event (MGE) on emergency department (ED) patient presentations with communicable diseases and underpinning syndromic indicators (SIs).

Methods: This retrospective observational cohort study was undertaken in one large public teaching hospital ED in Queensland, Australia. Routinely collected ED data for patient presentations with an ICD-10 diagnosis corresponding to a communicable disease were used to compare demographic characteristics, clinical characteristics, and outcomes before (March 23 to April 3), during (April 4 to April 15), and after (April 16 to April 27) the 2018 Commonwealth Games.

Results: Over the study period, there were 10 595 patient presentations to the ED; 14.2% ($n = 1503$) were diagnosed with a communicable disease. The median age of those with a communicable disease was 8 years, 50.5% ($n = 759$) were female, and 24.8% ($n = 373$) arrived by ambulance. The most common communicable disease profile was respiratory in nature (51.4%, $n = 772$). The most common SI was altered breathing (24.0%, $n = 185$). ED length of stay (LOS) increased over the study period (pre: 160 min; during: 163 min; post: 180 min, $p < 0.001$).

Conclusions: The 2018 Commonwealth Games had an impact on ED presentations with communicable diseases, in terms of LOS. A longer LOS and higher percentage of patients with a LOS of more than 4 hrs in the ED were noted following the MGE period. This outcome indicates a potential need to continue with up-scaled services. Future research is required to understand the broader impact on other EDs in the area, and longitudinal patient follow-up is needed to determine the potential spread of communicable diseases.

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Introduction

Mass gathering events (MGEs) are large events that frequently occur worldwide, including sports tournaments, music festivals, and religious activities. The World Health Organization (WHO) describe MGEs as planned or unplanned events attracting a large number of people that could strain the health resources of host countries (World Health Organization, 2008). MGEs are by nature characterized by large numbers and a high concentration of people, creating environments that can facilitate the transmission

of communicable diseases, which poses a major threat both locally and internationally (Abubakar et al., 2012; Tam et al., 2012).

Emergency departments (EDs) usually act as the first point of entry for people with urgent and non-urgent medical complaints to receive acute medical treatment (Australasian College for Emergency Medicine, 2014; Elliot et al., 2012). During a MGE, the surge in local population can impact the ED, depending on the type of event, event location, characteristics of event attendees, and environmental factors. The number of ED presentations from a MGE has been reported to range from seven (in a 10-day sporting event) (Chen et al., 2010) to 401 (in a 2-day religious event) (Al-Lami et al., 2013). Negative patient outcomes, such as increased mortality and morbidity, and delays in providing timely care can result if feasible prevention measures are not established (Ranse et al., 2018).

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Table 1
Demographic characteristics of patients presenting to the ED with communicable diseases pre, during, and post the 2018 Commonwealth Games.

	Total	Pre	During	Post	Statistic
Median age ^a , median (IQR)	8 (1–39)	5 (1–36)	12 (1–43)	10 (1–40)	$\chi^2 = 2.62$ $p = 0.27$
Age ^b , n (%)					
≤15 years old	807 (53.7)	288 (57.6)	262 (51.3)	257 (52.2)	$\chi^2 = 4.69$ $p = 0.096$
≥16 years old	696 (46.3)	212 (42.4)	249 (48.7)	235 (47.8)	
Sex ^c , n (%)					
Female	759 (50.5)	263 (52.6)	265 (51.9)	231 (47.0)	$\chi^2 = 3.74$ $p = 0.15$
Male	744 (49.5)	237 (47.4)	246 (48.1)	261 (53.0)	

ED, emergency department; IQR, interquartile range.

^a Analysis based on the Kruskal–Wallis test.

^b Analysis for age based on $n = 500$ (pre), $n = 511$ (during), and $n = 492$ (post) ED patient presentations.

^c Analysis based on the Chi-square test.

Table 2
ED characteristics of patients presenting to the ED with communicable diseases pre, during, and post the 2018 Commonwealth Games.

ED characteristic	Total	Pre	During	Post	Statistic
Priority of presentation, n (%)					
ATS 1 and ATS 2	275 (18.3)	90 (18.0)	96 (18.8)	89 (18.1)	$\chi^2 = 0.83$ $p = 0.93$
ATS 3	981 (65.3)	327 (65.4)	327 (64.0)	327 (66.5)	
ATS 4 and ATS 5	247 (16.4)	83 (16.6)	88 (17.2)	76 (15.4)	
Mode of arrival, n (%)					
Ambulance	373 (24.8)	107 (21.4)	133 (26.0)	133 (27.0)	$\chi^2 = 4.82$ $p = 0.09$
Other (includes police and walk-in)	1130 (75.2)	393 (78.6)	378 (74.0)	359 (73.0)	
Time of day, n (%)					
Morning shift (07:00–14:59)	613 (40.8)	212 (42.4)	196 (38.4)	205 (41.7)	$\chi^2 = 1.98$ $p = 0.74$
Afternoon shift (15:00–22:59)	554 (36.9)	178 (35.6)	197 (38.6)	179 (36.4)	
Night shift (23:00–06:59)	336 (22.4)	110 (22.0)	118 (23.1)	108 (22.0)	

ED, emergency department; ATS, Australasian Triage Scale. Analysis based on Chi-square test.

During MGEs, some EDs activate a targeted surveillance system to identify syndromic indicators (SIs), enabling early detection of communicable diseases and response to abnormal health events (Morbey et al., 2015; Todkill et al., 2016). The literature describing syndromes (such as fever, rash, and cough) for the monitoring of communicable disease incidence is limited (Chen et al., 2010; Lim et al., 2010). Furthermore, the literature on MGEs tends to focus on the MGE period itself, with pre and post timeframes often not included. Thus, the aim of this study was to identify the impact of a MGE on ED patient presentations with communicable diseases and corresponding SIs.

Methods

Design

This was a retrospective observational cohort study, comparing patient presentations made to one ED across three time-periods: pre, during, and post the 2018 Commonwealth Games.

Setting

The study was undertaken in a large public university teaching hospital ED located in South-East Queensland, Australia. The ED provided healthcare services for 109, 467 patient presentations in a 12-month period during 2017–2018 (Australian Institute of Health and Welfare, 2019). The 2018 Commonwealth Games was an international sporting MGE held in Queensland, Australia, between April 4 and April 15, 2018, and attracted more than 6600 athletes from 71 Commonwealth countries and around 591 500 tourists (both domestic and overseas) to the region over the 11 days of competition (Jones, 2018; Queensland Government, 2018).

Sample

The sample for this study included patients who presented to the ED between March 23 and April 27, 2018 and who were diagnosed with a communicable disease based on their ED International Classification of Diseases Tenth Revision (ICD-10) diagnosis (World Health Organisation, 2016). This study period reflects equal periods pre (March 23 to April 3), during (April 4 to April 15), and post (April 16 to April 27) the MGE.

Data collection

This study used routinely collected individual patient-level data that are entered prospectively into the Emergency Department Information System (EDIS) by experienced ED healthcare workers and administrative staff. These secondary data were extracted into an Excel spreadsheet by a qualified member of the hospital's Health Informatics Division. Data extracted included patient demographics (age, sex, post code), ED characteristics (presenting complaint at triage, mode of arrival, Australasian Triage Scale (ATS) category, arrival date and time, departure date and time, discharge diagnosis), and outcomes (time to be seen by a treating clinician, ED length of stay (LOS), discharge destination). The ATS is a clinical tool used throughout Australia and New Zealand to inform the timeframe for which patients should be seen, commensurate with their clinical urgency (Australasian College for Emergency Medicine, 2013). On a scale of five categories, ATS 1 patients should be seen immediately, whereas ATS 5 patients should be seen within 120 min (Australasian College for Emergency Medicine, 2013). Patient presentations were grouped into five groups by diagnoses/symptoms creating SIs such as 'respiratory', 'gastrointestinal', 'integumentary', and 'others'. All variables used were checked for outliers, cleaned, and coded prior to analysis.

Data analysis

Descriptive and comparative analyses were undertaken to describe and compare patient demographic characteristics, clinical characteristics, and outcomes pre, during, and post the 2018 Commonwealth Games. The median and interquartile range (IQR) were used to describe continuous variables that were not normally distributed, such as age and LOS. The Chi-square test was used to compare categorical data, including sex, diagnosis, triage category, mode of arrival, time of day, Australian National Emergency Access Target (NEAT), and discharge destinations from ED. Meeting the NEAT was defined as the proportion of ED patients who were seen by an ED clinician and either admitted or discharged from the ED within 4 h (Sullivan et al., 2016). The Kruskal–Wallis test was used to identify differences in non-normally distributed continuous variables, such as age, time to be seen by an ED clinician, and ED LOS. The data analysis was performed using IBM SPSS Statistics, version 24.0 (IBM Corp., Armonk, NY, USA) (IBM Corporation, 2016). Statistical significance was set at $p < 0.05$.

Ethics

This study received ethical approval from both Griffith University Human Research Ethics Committee (GU Ref No. 2018/833) and the Hospital and Health Services Human Research Ethics Committee (HREC/18/QGC/64).

Results

Demographic characteristics

A total of 10 595 patient presentations were made to the ED over the 36-day study period, with 14.2% ($n = 1503$) diagnosed with a communicable disease. Of the 1503 patient presentations diagnosed with a communicable disease, the percentage of females and males was similar (females 50.5%, $n = 795$) and the median age was 8 years (IQR 1–40 years) (see Table 1).

Emergency department characteristics

Characteristics of the ED patients who presented with communicable diseases are reported in Table 2. Over half of the ED presentations ($n = 981$, 65.3%) were categorized as ATS 3, 40.8% ($n = 613$) presented during the morning shift, and 24.8% ($n = 373$) arrived by ambulance. The only characteristic that differed significantly across the three time periods was the mode of arrival, with the proportion of patients arriving by ambulance increasing from 21.4% pre to 26.0% during and 27.0% post the 2018 Commonwealth Games.

There was no significant difference in the proportion of ED presentations with communicable diseases pre, during, and post the 2018 Commonwealth Games period (see Table 3). The most common presenting communicable disease profile across all periods was respiratory in nature ($n = 772$, 51.4%).

Further details of SIs that ED patients presented on arrival at triage were explored in this study, with all periods combined due to small numbers in some groups. Given that respiratory and intestinal infectious diseases were the two most common specific communicable disease-related presentations, the early SIs presented by the majority of patients are noted. For patients with communicable respiratory diseases, the SIs of altered breathing ($n = 185$, 24.0%) and cough/rhinorrhoea ($n = 134$, 17.4%) were the most commonly specified SIs (see Table 4). For intestinal infectious diseases, nearly one-third of patients presented with nausea and vomiting, and the remaining patients complained of either abdominal/pelvis/perineal pain ($n = 49$, 17.9%) or diarrhoea ($n = 42$, 15.4%).

Outcomes

Outcomes that were found to differ significantly over time included ED LOS and NEAT (see Table 5). This was mostly noted between the during and post periods, where ED LOS was longer (during: 162 min, IQR 109–217 min; post: 180 min, IQR 127–235 min), and there was a higher proportion ($\chi^2 = 10.65$, $p = 0.005$) of patients spending more than 4 h in the ED (during: 14.9%; post: 20.9%).

Discussion

Demographic characteristics

This study found that patients presenting to the ED with communicable diseases over the 2018 Commonwealth Games period were young (median 8 years of age). Of the patients presenting to Australian EDs in 2017–2018, those aged 5–14 years accounted for 10% (Australian Institute of Health and Welfare, 2018). Additionally, past studies have stated that young adults (age 20–35 years) were the most common age group seeking emergency medical services during MGE periods (Anikeeva et al., 2018; Crabtree et al., 2017; Locoh-Donou et al., 2013). Nevertheless, during the 2012 London Olympics, 25% of patients seeking medical attention were children aged <16 years (Burton et al., 2012). These results differ from those of the present study, in which nearly half (53.7%) were paediatric patients aged ≤ 15 years. When focusing on communicable diseases, such information is not widely reported. Jhung et al. (2013) reported that children or adolescents less than 18 years old accounted for the largest percentage (92%) of identified cases during a respiratory outbreak that occurred at an agricultural fair in the United States. Given the nature of MGEs and the young age of patients presenting, it is recommended that, for large-scale MGEs where mixed family members are expected, EDs are equipped with experienced paediatric clinicians (as was the case for this MGE) (Burton et al., 2012).

Presentation characteristics

An increase was observed in the percentage of ED patient presentations diagnosed with communicable respiratory diseases after the 2018 Commonwealth Games. This may be explained by the varied incubation periods of communicable respiratory diseases, which range from half a day (i.e., influenza B) to 12 days (i.e., measles) (Lessler et al., 2009), or by a group of people who may have been exposed to pathogens during the later period of the 2018 Commonwealth Games. These findings are important and highlight the impact of communicable diseases, especially respiratory diseases, on the local ED even after the 2018 Commonwealth Games period had ended, in addition to the importance of ongoing surveillance of communicable diseases after a MGE.

Outcome characteristics

Compared with the pre and during periods of the 2018 Commonwealth Games, the longer ED LOS and associated increase in proportion of patients staying longer than 4 h in the ED after the 2018 Commonwealth Games ended, reflect the necessity of providing extended services beyond the official end of the MGE. The possible need to adapt resourcing both during and after a MGE should be considered. For example, in the event of a communicable disease outbreak, specific clinical management pathways can be effective in reducing ED LOS and the admission rate (Ranse et al., 2016). To date, information about the extension of services after a

Table 3

ICD-10 grouping of patient presentations to the ED with communicable diseases pre, during, and post the 2018 Commonwealth Games.

ICD-10 grouping of ED patients	Total n = 1501	Pre n = 498	During n = 511	Post n = 492	Statistic
Communicable respiratory diseases, n (%)	772 (51.4)	254 (50.8)	248 (48.5)	270 (54.9)	$\chi^2 = 11.45$ $p = 0.18$
Other viral diseases, n (%)	380 (25.3)	118 (23.6)	133 (26.0)	129 (26.2)	
Intestinal infectious diseases, n (%)	273 (18.2)	100 (20.0)	99 (19.4)	74 (15.0)	
Viral infections characterized by skin and mucous membrane lesions, n (%)	54 (3.6)	19 (3.8)	24 (4.7)	11 (2.2)	
Other communicable diseases ^a , n (%)	24 (1.6)	9 (1.8)	7 (1.4)	8 (1.6)	
Total n (%)	1503 (100)	500 (100)	511 (100)	492 (100)	

ICD-10, International Classification of Diseases Tenth Revision; ED, emergency department. Analysis based on the Chi-square test.

^a Other communicable diseases included arthropod-borne viral fevers and viral haemorrhagic fevers; diseases transmitted by sex (HIV, mycoses, helminthiasis, pediculosis, acariasis).**Table 4**

ICD-10 codes for communicable diseases and corresponding syndromic indicators over the total study period.

ICD-10 codes	Presenting complaints (SIs)	n (%)
Communicable respiratory diseases (J00–J22) (n = 772)	Non-specific signs and symptoms	208 (26.9)
	Altered breathing	185 (24.0)
	Others	176 (22.8)
	Cough/rhinorrhoea	134 (17.4)
	Fever/hyperthermia	69 (8.9)
Other viral diseases (B25–B34) (n = 380)	Non-specific signs and symptoms	130 (34.2)
	Others	122 (32.3)
	Fever/hyperthermia	62 (16.3)
	Cough/rhinorrhoea	34 (8.9)
	Nausea/vomiting	32 (8.4)
Intestinal infectious diseases (A00–A09) (n = 273)	Nausea/vomiting	82 (30.0)
	Non-specific signs and symptoms	70 (25.6)
	Abdominal/pelvis/perineal pain	49 (17.9)
	Diarrhoea	42 (15.4)
	Others	30 (11.1)
Viral infections characterized by skin and mucous membrane lesions (B00–B09) (n = 54)	Skin complaint	19 (35.2)
	Others	16 (29.6)
	Non-specific signs and symptoms	12 (22.2)
	Eye or vision problems	4 (7.4)
	Nausea/vomiting	3 (5.6)

ICD-10, International Classification of Diseases Tenth Revision; SI, syndromic indicator.

Table 5

Outcomes of patients presenting to the ED with communicable diseases pre, during, and post the 2018 Commonwealth Games.

Outcome	Total	Pre	During	Post	Statistic	
Length of stay (LOS, in min), median (IQR) ^a	167 (113–222)	160 (108–216)	162 (109–217)	180 (127–235)	$\chi^2 = 19.20$ $p < 0.001$	
Time to be seen by clinicians (in min), median (IQR) ^a	33 (10.3–76)	29 (10–75.3)	30 (10–67)	37 (11–86)	$\chi^2 = 7.01$ $p = 0.30$	
National Emergency Access Target ^b , n (%)						
	≤ 4 h	1255 (83.5)	431 (86.2)	435 (85.1)	389 (79.1)	$\chi^2 = 10.65$ $p = 0.005$
> 4 h	248 (16.5)	69 (13.8)	76 (14.9)	103 (20.9)		
Discharge destination ^b , n (%)	Home	831 (55.3)	272 (54.4)	290 (56.8)	269 (54.7)	$\chi^2 = 8.10$ $p = 0.42$
	Short stay unit	444 (29.5)	161 (32.2)	148 (29.0)	135 (27.4)	
	Admitted	212 (14.1)	60 (12.0)	68 (13.3)	84 (17.1)	
	Left after treatment commenced	9 (0.6)	4 (0.8)	3 (0.6)	2 (0.4)	
	Transferred to other hospital	7 (0.5)	3 (0.6)	2 (0.4)	2 (0.4)	

ED, emergency department; IQR, interquartile range.

^a Analysis based on the Kruskal–Wallis test. The median LOS and IQR were analysed based on n = 500 (pre), n = 511 (during), and n = 492 (post) ED patient presentations. The median time to be seen by clinicians and IQR were analysed based on n = 498 (pre), n = 511 (during), and n = 491 (post) ED patient presentations.^b Analysis based on the Chi-square test.

MGE is limited. Future longitudinal research that involves a follow-up of patients who presented to the ED with a communicable disease would assist in determining an appropriate period of ED-related services post MGEs.

The long ED LOS and high percentage of presentations with communicable diseases staying over 4 h in the ED raises the

possibility of transmission of communicable diseases in the ED setting itself. Whilst not measured in the present study, previous research has indicated that long stays in EDs without the provision of protective measures to ED patients with communicable diseases, may facilitate the transmission of communicable diseases to other patients and healthcare staff (Maltezou and

Wicker, 2013; Foote et al., 2017; Quach et al., 2012). Fusco et al. (2012) pointed out that a lack of specific skills and training, and a high work load may delay the identification and isolation of potentially infectious presentations. Depending on the communicable disease, the suggestion of an assessment clinic separate from the ED may be useful to implement to improve ED capacity and reduce the spread of infection (Ranse et al., 2010). Furthermore, specific training programmes for ED staff in recognizing the SIs associated with certain communicable diseases may be of benefit (Zimmerman et al., 2016).

Limitations

This study analysed data from a single site and findings may not be generalizable to other EDs. As the study hospital is the major tertiary centre in the region and has a dedicated paediatric section in the ED, which invariably attracts children, this could be a potential reason why the age of those presenting to the ED in this study was relatively young. Additionally, determining the patient's usual place of residence was difficult due to inconsistencies in reporting, therefore an analysis could not be undertaken to compare local versus non-local populations. Furthermore, as the study was retrospective in design, causation cannot be established.

Conclusions

An impact was noted on ED presentations with communicable diseases, especially after the 2018 Commonwealth Games. The ED LOS evident in the post 2018 Commonwealth Games period reflects the potential need for extra healthcare resources in the ED after the official end date of a large MGE. The relatively young age of ED presentations with communicable diseases reflects the essential provision of experienced ED paediatric clinicians. Additionally, the increase in number of ED presentations with communicable diseases in the post MGE period once again reflects a potential need for additional healthcare resources and support even after MGEs have ended. To improve ED LOS and minimize the spread of communicable diseases in ED settings, clinical management pathways for specific SIs, separate assessment clinics, and specific staff training programmes are options to consider locally and at other similar large MGEs.

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Funding awarded from the Emergency Medicine Foundation facilitated the ability to undertake this study.

Ethical approval

Ethical approval was requested and received for this study from the following organizations: The Griffith University Human Research Ethics Committee (GU Ref No: 2018/833); The Gold Coast University Hospital Human Research Ethics (HREC/18/QGC/64).

Conflict of interest

None. There is nothing to disclose.

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