ENHANCED SURVEILLANCE OF INFECTIOUS DISEASES: THE 2006 FIFA WORLD CUP EXPERIENCE, GERMANY

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The 2006 FIFA World Cup was held in 12 German cities between 9 June and 9 July 2006. We identified a need to accelerate and sensitise the pre-existing surveillance system for infectious diseases in order to timely detect adverse health events during the World Cup. Enhanced surveillance, based on Germany's pre-existing system of mandatory notifications was conducted between 7 June and 11July 2006 in the 12 World Cup cities by: accelerating frequency of electronic data transmission of case-definition based notifiable diseases from weekly to daily transmission, additional reporting of non-case definition-based infectious disease events, lay and expert press screening and intensifying communication between all stakeholders of the surveillance system. Median delay of notification data transmission from the community to the federal level was reduced from three days to one day. The enhanced reporting system detected a norovirus outbreak in the International Broadcast Centre in Munich with 61 epidemiologically linked cases within the first week after onset, as well as four single cases related to the World Cup, two of them with relevance for the International Health Regulations. After the World Cup, all surveillance stakeholders agreed that communication between local, state and federal levels had improved considerably. Unlike the majority of health planners of previous mass gatherings in the last decade we did not introduce syndromic surveillance. Nevertheless, enhancement of infectious disease surveillance successfully detected adverse health events in a timely manner during the FIFA World Cup. Additionally, it provided a valuable communication and networking exercise for potentially critical health-related events. We recommend continuing daily notification data transmission for routine infectious disease surveillance in Germany.

Euro Surveill. 2006;11(12): 234-8 Published online December 2006
Key words: 2006 FIFA World Cup, Germany, surveillance, mass gatherings

Introduction

The FIFA World Cup was held between 9 June and 9 July 9 2006 in 12 cities within nine federal states of Germany. According to preliminary reports of the Federal Office for Statistics, this international sporting event resulted in 2 million additional overnight stays from abroad.

Although serious medical illness during mass gatherings is uncommon [1] and recent mass gatherings such as the Olympic Games and previous World Cups have not been associated with an increased number of infectious disease outbreaks [2-9], security threats and the recent emergence of avian influenza in Europe have heightened the profile of and need for a good surveillance strategy during such events.

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The two main rationales for enhanced infectious disease surveillance at mass events include a perceived increased risk of infectious disease events, and a need to detect and respond to events more quickly, due to the short-lived nature of infectious diseases. Moreover, the requirements of the International Health Regulations (IHR) issued by the World Health Organization (WHO), which take effect in mid-2007, define the need for timely reporting of infectious diseases during international mass events [10].

Methods

An enhanced surveillance system for infectious diseases based on the existing German system of mandatory notifications and reporting was conducted between 7 June and 11 July. In brief, the enhanced surveillance system for the World Cup consisted of four major branches:

1) Acceleration of data transmission in the pre-existing, electronic notifiable-disease reporting system using existing case definitions.
2) Introduction of an additional free-text reporting system for relevant public health events, with 'relevant events' being defined individually by local and state health departments, and not necessarily based on case definitions.
3) Monitoring of domestic and international media sources for epidemiological events that could be relevant to the World Cup
4) Strengthening communication and interaction between the different public health stakeholders within Germany and internationally.

The system was designed to detect adverse health events of public health relevance in a timely fashion during the 2006 FIFA World Cup in the area under surveillance (the 12 World Cup cities).

The first branch of enhanced surveillance, acceleration of the data transmission process was accomplished by increasing the usual weekly transmission frequency of mandatory notification data to daily transmission (Monday to Saturday, excluding holidays) within the 12 World Cup cities and a few other cities that had been identified as relevant focal points by the State Health Department (SHD). Such relevant focal points could be cities neighbouring the World Cup cities, where World Cup-related mass gatherings such as public televised screenings took place. Mandatory notifications were transmitted from the local health department to their respective state health department and from there to the Robert Koch-Institut (RKI) on the same working day. In accordance to the pre-existing weekly procedure, data transmission was electronic and anonymous. Underlying case definitions for transmission of data (and therewith the underlying specificities) were not altered for the purpose of accelerated transmission. Cases not investigated and confirmed according to the pre-existing case definitions were not transmitted until they met the standard case-definitions for inclusion in the data.

Two additional modifications were made to the existing electronic notification system. The data included disease notifications of non-

residents of Germany, which are not routinely reported. Also, a 'World Cup-related' flag was created in the electronic data systems. Any case related to a World Cup event (such as spending time in a stadium, at public screening, or in the 'fan mile' areas set up within the World Cup cities) was flagged at the sole discretion of the local health departments based on their intimate knowledge of local events.

In the second branch of our enhanced strategy, a new reporting system was introduced. Information on outbreaks, clusters or any type of 'relevant' public health event was sent from the local and state health departments to the RKI in a standardised, free-text written report. Relevancy to the World Cup was determined by the sole and subjective judgement of the local health departments. In an effort to increase the sensitivity of the surveillance system, the information contained in these daily reports was not based on case definitions for mandatory notifications.

In the third branch of surveillance, international and German lay press and expert sources (ProMED-mail, the European Centre for Disease Prevention and Control (ECDC), the United States Centers for Disease Control and Prevention (CDC), the World Health Organization, etc.) were screened daily by the World Cup surveillance team at the RKI for infectious disease issues of public health relevance. Lay press sources were pre-screened daily with the help of an automatic press screening service after applying sensitive search terms relevant for infectious disease issues.

Regular telephone conferences were held in order to strengthen communication and outcome-orientated interaction between the stakeholders of the enhanced World Cup surveillance (local and state health departments and RKI). These telephone conferences also served as a tool for quality management, where questions and suggestions for process optimisation were discussed and documented. Also, information of international public health concern was exchanged in a daily telephone conference with the ECDC's Unit for Preparedness and Response. Discrepancies between different information sources (for example, between local health department reports and press sources) were clarified in these discussions. This strengthened communication system represented our fourth branch of surveillance.

Surveillance activities were coordinated by the RKI in cooperation with the 12 local health departments and nine state health departments affiliated with World Cup cities.

The RKI produced a daily report on the status of infectious disease epidemiology. Sources of information included all four branches of our strategy as well as weather data (daily temperatures) provided by the Deutscher Wetterdienst (German Meteorological Office) to provide prospective for outbreaks and other public health situations, in light of the European heat wave of 2003 [11]. In a final, summarised RKI daily report, the domestic and international infectious disease situation was assessed for eventual public health threats with relevance for the World Cup. The RKI daily report was distributed on the same afternoon to the local and state health departments, the German Ministries of Health and the Nationales Informations- und Kooperationszentrum (National Information and Cooperation Centre), which was the national security communication hub for the World Cup. An extended version was uploaded daily onto a restricted-access web-based communication and information forum for German public health institutions, and a short version was published daily on the public webpage of the RKI in both English and German.

All components of the enhanced World Cup surveillance were tested during a trial week in May 2006, involving all World Cup surveillance stakeholders.

After the World Cup, a preliminary analysis of aggregated mandatory notification data was undertaken in order to assess whether daily versus weekly data transmission actually influenced the mean data transmission delay from the LDH in the World Cup cities to RKI.

We compared transmission delay in days (25th, 50th and 75th percentiles) for all data transmitted between notification weeks 23 and 29, 2006 (the notification weeks of the World Cup period) with the transmission delay for the same time period in 2005, when weekly transmission was in place.

Results

Daily transmission of mandatory notification data

Table 1 gives comparative data for transmission delay in days (25th, 50th and 75th percentiles) for data transmitted between notification weeks 23 and 29, in the years 2005 and 2006.

Table 1

Mandatory notification data transmission delay (in days) for years 2005 and 2006 in World Cup cities

Percentile (days)	2005	2006
25%	2	0
50%	3	1
75%	7	1

In the period of enhanced surveillance, RKI received 69 World Cup-associated, electronically transmitted cases of gastroenteritis. Of those, 62 were norovirus infections (61 with an epidemiological link to a norovirus outbreak in Munich), 4 salmonella infections cases and 3 were cases of campylobacter infections.

One event (not associated to the World Cup) was detected neither by daily transmission of mandatory notification data nor by the written reports submitted to RKI. A single case of meningococcal disease in Bavaria was identified through daily routine screening of press sources for infectious-disease related events. The local health department had detected the case early and immediately began contact tracing and postexposure prophylaxis, but reported the case electronically to the SHD and the RKI with delay. Since this case was not connected with the World Cup, and was not relevant for IHR, the local health department did not include it in their daily reports or flag it as World Cup-related in the electronic data transmission system.

World Cup related infectious disease events: norovirus outbreak in the Munich International Broadcast Centre (IBC)

On 15 June the local health department in Munich was informed of a cluster of patients with gastrointestinal symptoms. That evening, the local health department took initial hygiene measures (see below), and the following day, within the first week after onset of the first case, the outbreak was reported via the additional, non-case definition-bound reporting system to the RKI. Patients came from several countries, including Mexico and the United States. All patients were temporarily employed at the IBC. Hygiene precautions, such as disinfecting surfaces and providing hand disinfection liquids in sanitary areas, were immediately implemented, and multilingual information leaflets giving hygiene advice were distributed within the IBC. Large-scale stool diagnostics were performed. The first five stool samples were proven to be positive for norovirus. Later, a sequential analysis detected genotype GGII.4-2006a. Altogether, 61 cases of gastroenteritis were epidemiologically linked to the norovirus outbreak in Munich. By the end of the second week of June 2006, the outbreak had come to an end.

Other infectious disease events during the World Cup

The World Cup coincided with the largest measles outbreak ever reported in Germany. This had raised concerns by the Pan American Health Organisation (PAHO) and various European national public health institutes which issued travel warnings for visitors to the World Cup events in Germany. Between 1 January and 7 June 2006 (the date when the enhanced World Cup surveillance began), a total

Table 2

Major public health relevant infectious disease events during FIFA World Cup 2006, Germany, in chronological order

Event: Date of onset/ duration, cases involved, history	Disease/ pathogen	Number of cases	World-Cup related?	IHR relevant?	Media attention?	Mode of detection (source)
June 4: Indonesian journalist with varicella virus infection (chicken pox) lands at Munich airport and reports immediately to local PH authorities	Varicella virus	1	Yes	Yes	Yes	LHD daily report
June 9: eight members of Croatian football team with gastrointestinal symptoms, subfebrile temperature; no diagnostic samples taken; suspicion of viral gastroenteritis	Unknown; suspected viral gastro-enteritis	8	Yes	No	Yes	Lay press screening, ECDC teleconference
June 15: Laboratory confirmed case of mumps in a 23 year old man from the UK who had visited World Cup match in Frankfurt on June 10	Mumps virus	1	Yes	Yes	No	LHD daily report
June 16 - 29: 22 persons from different countries working at the International Broadcasting Centre (IBC) in Munich with gastroenteritic symptoms; altogether, 61 persons with epidemiological link; stool samples show norovirus in majority of cases; sequencing detects genotype GGII.4-2006a	Norovirus	61	Yes	Yes	Yes	LHD daily report
June 25: Australian fan hospitalised with acute *Salmonella* Enteritidis gastroenteritis; visits World Cup match on June 26 against medical advice	*Salmonella* Enteritidis	1	Yes	No	No	LHD daily report, mandatory notification transmission

of 1406 measles cases were reported in North Rhine-Westphalia, primarily from cities of the Ruhr region and from the Lower Rhine region which borders the Netherlands. Genotyping revealed D6 as the predominant measles genotype in this region. During the World Cup period, the total number of measles cases since January 2006 rose to 1625, but no case of measles associated with the World Cup was observed during the enhanced World Cup surveillance.

Another coincidental event during the World Cup was an outbreak of haemolytic uraemic syndrome (HUS) in the federal states of North Rhine-Westphalia, Lower Saxony, Hamburg and Schleswig-Holstein in Northern Germany. Between 4 April and 6 July 2006, 15 cases of HUS were notified. Of these, only two occurred during the World Cup period. None was epidemiologically linked to the World Cup. Table 2 summarises the major public health relevant infectious disease events during the World Cup.

Communication

Participation in non case-definition based daily reporting by the affected local and state health departments was 100%. Telephone conferences were held at the beginning and ending of the trial week for the World Cup surveillance, and immediately before, during and after the World Cup period. After the World Cup, the majority of World Cup surveillance stakeholders agreed that communication and interaction between the local and state health departments and RKI has been considerably strengthened during the enhanced surveillance period.

Weather monitoring

The World Cup weather was pleasant and warm, with a temperature range in between 14 and 34 degrees Celsius (maximum day temperature). A heat wave comparable to that of 2003 was not observed during the tournament. Analysis of daily weather data did not find any temperature-related correlation to any public health relevant events in the World Cup cities.

Discussion

'Public health surveillance should be implemented at mass gatherings to facilitate rapid detection of outbreaks and other health-related events and enable public health teams to respond with timely control measures….' This was recommended in a recent CDC-published journal article [12]. Infectious disease surveillance is an important subset of public health surveillance, but why and how should it be increased at mass events?

It is worth considering which characteristics of mass events might increase the risk of infectious diseases. Table 3 summarises these characteristics, along with examples of different types of event.

Of the published results of surveillance at mass events, it is interesting to note that few identified any significant increase in infectious disease occurrences during the period studied. No increase in usage of healthcare services was found during the 1998 World Cup in France [5]. The evaluation of surveillance during the Euro 2004 football tournament in Portugal found no effect on numbers of infections in either visitors or the local population [22]. Two positive examples found were norovirus cases in a Virginia camping event [12], and the change in profile of sexually transmitted infection clinic attendances during the Sydney Olympic Games. During the millennium year in Rome, with 26 million visitors to the city, an increase in *Legionella* cases and foodborne outbreaks in foreign tourists was observed, but no increase was seen in overall cases or in cases in the local population [23].

Enhanced surveillance at mass gatherings has previously been conducted by a number of public health specialists organising preparations for such events. Syndrome-based surveillance has been undertaken at several previous mass gatherings [2-6]. However, at the current time, it is not clear whether, in regions with a well-functioning surveillance system in place, a syndrome-based system provides more than minimal additional information that is not identifiable through routine surveillance. Poor specificity and difficulties in determining epidemic thresholds are the most important limitations of syndromic surveillance [24,25]. In a study from the United Kingdom, syndromic surveillance data gained by National Health Service (NHS) direct calls using diarrhoea as a proxy for cryptosporidiosis were unable to detect a large scale local cryptosporidiosis outbreak [26]. During the 2006 Winter Olympic Games in Italy, syndromic surveillance did not provide any additional information that could not be identified through the pre-existing routine surveillance system [2].

More evidence-based research on the effectiveness and cost-effectiveness of syndromic surveillance at mass gatherings is needed, especially given the high cost of implementation. After careful consideration in consultation with the local and state health departments and in the light of a lack of documented outbreaks detected by syndrome surveillance that would not have been detected by routine surveillance alone, it was assumed that the enhanced mandatory notification surveillance system would be sufficient, and a syndrome-based surveillance system was not implemented for the 2006 World Cup in Germany.

Table 3

Aspects of (international) mass events with implications for infectious disease risks

Aspect of mass event		Potential effect on infectious disease occurrences	Example
Primary aspects	Absolute increase in population and increase in population density	Increase in absolute numbers of cases, frequency of person to person contacts, proximity of interpersonal contacts	Visitor numbers: 300 000 at the Sydney Olympics [13], 2 million to the Hajj [14], "hundreds of thousands" at the 1998 World Cup in France[5]; 430 000 at the 2002 World Cup in Korea and Japan [15], Increase in meningococcal carriage during Hajj [16]
	Population movement: exposure to "foreign" diseases	Visitors affected by locally endemic diseases Local population exposed to "imported" infections	Concern at World Cup about measles outbreak [17], and cholera in Angola [18], Malaria cases in travellers to endemic areas [19]
Secondary aspects	Target for bioterrorism	Deliberate release of pathogens	CDC scenario of anthrax release [20]
	Strain on infrastructure	Breakdown in public health safeguards e.g. water quality, accommodation standards	Refugee camps
	Changes in services/behaviour	Increase in numbers and turnover of food outlets may lead to a fall in hygiene standards	Environmental health inspections prior to Athens Olympic Games [21]
		Increased prevalence of risky sexual behaviour	Change in epidemiology of sexually transmitted infections at Sydney Olympic Games [13]

Our aim was to monitor all public health relevant events in order to distribute timely information to all stakeholders and thus to be able to respond immediately to events of public health concern. The enhanced surveillance system allowed us to timely detect a World Cup related norovirus outbreak with consequences for IHR. It seems quite likely that due to the improved alertness and communication conditions during enhanced surveillance (daily local health department reports, immediate telephone contacts) this outbreak was detected more quickly on the federal level than it would have been without enhanced surveillance in place.

The implementation of daily instead of weekly notification data transmission proved to be a successful strategy of accelerating transmission [Table 1] and was well-accepted by the participating local health departments of the World Cup cities. The state of North Rhine-Westphalia, the most heavily populated state in Germany, has continued daily transmission of notification data since the World Cup, with the majority of local health departments participating. Maintaining daily data transmission frequency could be problematic in small, resource-poor rural local health departments. Nevertheless, daily rather than weekly data transmission for all local and state health departments - routinely, not only during mass events - should be recommended as a future goal.

Introducing an additional, sensitive, non-case definition-based additional written report system was overall beneficial. Additional information which complemented daily transmission of notifiable data reached RKI in a timely manner. Daily reporting was practicable for local and state health departments and RKI and served as a method of increasing less formal, but nonetheless valuable, communication between the different levels of public health. We therefore recommend additional reporting systems that are flexible and not bound to case-definitions, provided that at least one case-definition system or syndrome-based system is in place.

Analysing the benefits of enhancing a pre-existing system of notification data surveillance versus introducing a syndromic surveillance system is difficult, since we lack comprehensive data from syndromic surveillance. Nevertheless, enhanced World Cup surveillance was found to accelerate data transmission and was clearly able to intensify communication and action-orientated cooperation between different players in the German public health system; therefore, it also benefited the routine infectious disease surveillance in Germany and provided a valuable communication and networking exercise for potential critical health-related events.

Acknowledgements

The authors would like to thank Dr. Petra Graf from the City of Munich Health department and Dr. Ulrich Van Treek from the Institute of Public Health, North Rhine-Westphalia in Münster. Also, we would like to thank all colleagues involved in the enhanced World Cup surveillance, namely from the following institutions of Public Health: the Local Health Departments in Berlin, Dortmund, Frankfurt, Gelsenkirchen, Hamburg, Hanover, Kaiserslautern, Cologne, Leipzig, Nuremberg, Munich and Stuttgart, and the State Health Institutions in Baden-Wurttemberg, Bavaria, Berlin, Hamburg, Hesse, Lower Saxony, North Rhine-Westphalia, Rhineland-Palatine and Saxony. We would also like to thank our colleagues in the department of Infectious Disease Epidemiology and the department of molecular Epidemiology at the Robert Koch Institute in Berlin, especially Doris Altmann for analysing notification data.

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