

# International infectious disease surveillance during the London Olympic and Paralympic Games 2012: process and outcomes

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Surveillance for possible international infectious disease threats to the Olympic and Paralympic Games in London, United Kingdom, was conducted from 2 July to 12 September 2012 by a collaborative team comprising representatives from the Health Protection Agency (Public Health England since April 2013), the European Centre for Disease Prevention and Control and the National Travel Health Network and Centre. Team members enhanced their usual international surveillance activities and undertook joint risk assessments of incidents identified as relevant through an agreed set of criteria designed for the Games and using tools developed for this purpose. Although team members responded to a range of international disease incidents as part of their routine roles during this period, no incident was identified that represented a threat to the Games. Six incidents were highlighted by the team that were likely to attract media attention and hence could generate political and public concern. Responding to such concern is an important aspect of the overall public health management of mass gathering events. The lessons learned about the process and outcomes of the enhanced international surveillance will help inform planning by future hosts of similar events.

## Introduction

The Olympic Games are the largest international sporting 'mass gathering' event in the world, followed by the Paralympic Games. In 2012, both events were hosted by the United Kingdom (UK), centred on the Olympic Park in East London, but with events also taking place in other venues across the country. The Games took

place from 27 July to 12 August (Olympics) and from 29 August to 9 September (Paralympics). More than 25,000 athletes and officials took part from over 200 countries. Many more tens of thousands of journalists, workers and volunteers were also involved, with total spectator attendance estimated to be around 10 million across both events at all venues combined.

In common with other mass gatherings, large international sports events present a range of complex challenges to host countries, including public health preparedness [1]. The types of infectious disease (ID) incidents that are relevant for mass gatherings have been previously described [2], but none were reported in association with any of the last four Olympic Games [3]. Considerable concern is, however, generated by the potential impact of such incidents on the Games, the host population and countries to which athletes and visitors return. Highly infectious diseases with airborne/droplet transmission and short incubation periods pose the greatest potential threat to large public gatherings such as the Games and there are examples where such infections have been transmitted in similar contexts [4-7]. Considerable effort is directed towards early identification of potential ID threats associated with such events, often including those that may arise outside the host country [8,9], so that appropriate responses may mitigate any significant risk detected.

With high levels of global travel, migration and economic interdependence as well as increased speed of transport around the world, international ID surveillance is now an important and routine part of many

countries' general public health preparedness. Both the World Health Organization (WHO) and the European Commission have established restricted-access web-based communication platforms so that Member States can share information about public health incidents; these include the WHO Event Information Site for International Health Regulations (IHR) national focal points and the European Early Warning and Response System (EWRS). These platforms provide alerts about significant international public health incidents to Member States, which may also perform additional information gathering of their own.

Epidemic Intelligence (EI) is a form of surveillance that refers to a process of rapid systematic collection, collation, validation, analysis and risk assessment of information about potential public health incidents from a variety of sources [10,11]. Its purpose is to permit earlier detection of potential health threats so that timely public health responses can be recommended and enacted. EI activities are implemented at different levels and using various modalities by many national and international public health institutions. They complement standard surveillance data with formal and informal reports about incidents of potential public health relevance (event-based surveillance, EBS) [12]. EBS has been revolutionised in the last 10 years by the rapid development of web technologies and electronic communication: these changes have defined a crucial role for open access online information for risk detection and monitoring activities, although they have also greatly increased the amount of background 'noise' of ID incidents requiring evaluation.

International ID surveillance for the 2012 Olympics and Paralympics (also known as London 2012) was conducted by a collaborative 'international team' comprising several organisations that have routine roles in EI. The work of these groups overlaps to a certain degree, but each has its own particular responsibilities and therefore also its own criteria for selection of items for further monitoring, assessment or response, as outlined below.

- The National Travel Health Network and Centre (NaTHNaC) and the Travel and Migrant Health Section (TMHS) of the Health Protection Agency (HPA) (Public Health England since 1 April 2013, but referred to throughout this article as the former organisation) are primarily concerned with international ID incidents that may have an impact on British travellers. They also produce clinical updates for health professionals about relevant incidents [13].
- The Emerging Infections and Zoonoses (EIZ) and Microbial Risk Assessment (MRA) sections of the HPA are concerned with assessing and responding to potential ID threats to UK public health. They provide evidence-based risk assessments of ID incidents to inform policy, planning, public health countermeasures and communications. Both

sections produce regular summaries of potential threats for relevant professionals.

- The European Centre for Disease Prevention and Control (ECDC) is concerned with detecting, monitoring, assessing and communicating ID issues of concern to the European Union and supporting the coordinated response to potential ID threats to the public health of the European Union [14]. ECDC produces regular reports, epidemiological updates and risk assessments.

The primary purpose of international ID surveillance during London 2012 was to identify ID incidents occurring anywhere in the world outside the UK that might have an adverse impact on London 2012, e.g. by affecting the health of competitors/visitors/others involved in the Games (with or without potential for subsequent export of disease from the UK and/or spread within the UK), or by affecting the smooth running of the Games and/or travel to and from the UK or by attracting media attention/public and political concern irrespective of whether that concern was justifiable.

Secondary purposes included identifying international ID incidents during London 2012 that might require provision of advice to clinicians seeing imported cases, or implementation of particular public/port health measures.

This paper outlines the international ID surveillance carried out during London 2012 and describes the results generated during the 10.5-week (73 days) enhanced surveillance period, along with its personnel requirements. It also aims to share lessons learned about the process and outcomes of this, as compared with routine activity, to help inform planning by future hosts of similar events.

## Methods

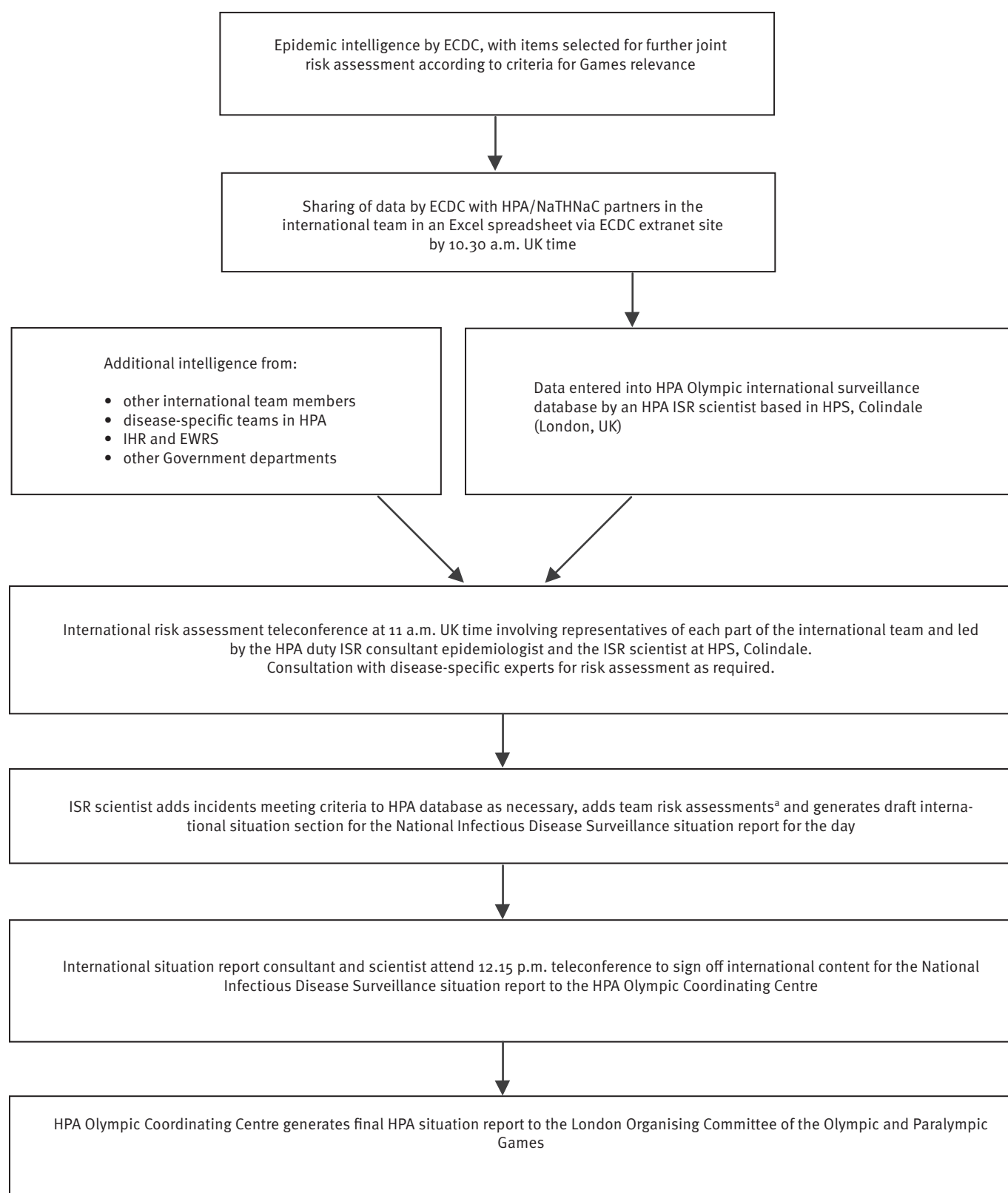
International surveillance for London 2012 was based on an enhanced 'business as usual' model and was part of wider surveillance activity that has been previously described [3]. The international team began working together early in 2010 and over the next two years, developed an enhancement of their normal processes that was extensively tested and refined to maximise sensitivity and specificity of identification of ID incidents relevant for the Games, and to use resources efficiently.

The process adopted for daily international surveillance is outlined in Figure 1. Of the collaborating groups, only ECDC has a dedicated unit that undertakes extensive EI on a 24/7 basis. Thus they led on this aspect of the process, enhancing and modifying their work to provide tailored support for the HPA to detect, monitor and assess potential international ID risks to London 2012.

ECDC EI activity focuses primarily on the use of open access web-based information. ECDC has collaborated

**FIGURE 1**

Daily scheme for international surveillance during the London Olympic and Paralympic Games 2012 (2 July–12 September 2012)



ECDC: European Centre for Disease Prevention and Control; EWRS: European Early Warning and Response System; HPA: Health Protection Agency (now Public Health England); HPS: Health Protection Services; IHR: International Health Regulations; ISR: international situation report; NaTHNaC: National Travel Health Network and Centre; UK: United Kingdom.

<sup>a</sup> In assessing the risk of selected items for inclusion in the daily situation report the following factors were considered: background epidemiology, number/demographics of people affected, setting, clinical severity, person-to-person transmissibility, likely connections between the affected population and Games attendees and or the UK population, ease of control, source of infection if known, how well the disease is understood, potential for spread and reliability of the source of the intelligence.

**TABLE 1**

Resources to support the international infectious disease incident surveillance function during London Olympic and Paralympic Games 2012 (2 July–12 September 2012)

| Resource category             | Resource and lead developer   | New/pre-existing/modified | Description  |
|-------------------------------|---|---------------------------|--|
| Epidemic intelligence         | Event-based surveillance systems (ECDC)   | Modified                  | Open-access web-based information (media and official sources): <ul style="list-style-type: none"> <li>• Global Public Health Intelligence Network, (GPHIN) (Public Health Agency of Canada) [27]</li> <li>• HealthMap (Harvard-MIT Division of Health Sciences and Technology, Boston, United States) [28]</li> <li>• MedISys (Joint Research Centre, European Commission) [29]</li> <li>• PULS, Pattern-based Understanding and Learning System (University of Helsinki, Finland) [30].</li> </ul> |
|                               | Epidemic Intelligence Information System, EPIS (ECDC) [31]                      | Pre-existing              | A communication platform tool that allows exchange of non-structured and semi-structured information regarding current or emerging public health threats with a potential impact in the European Union.  |
|                               | Routine fortnightly surveillance of influenza in the southern hemisphere (ECDC) | Pre-existing              | A combination of epidemic intelligence and more conventional surveillance that is used after pandemics and other changes in influenza viruses and which was reactivated for London 2012.   |
|                               | Weekly surveillance of measles outbreaks worldwide (ECDC)                       | Modified                  | A combination of epidemic intelligence and more conventional surveillance sources.   |
|                               | Criteria for London 2012 relevance (HPA, TMHS)                                  | New                       | See Table 2.   |
| Databases                     | Threat tracking tool [31] (ECDC)  | Modified                  | An internal ECDC-designed sharepoint platform that acts as a document repository and reporting tool (e.g. producing the daily and weekly ECDC reports). Dedicated sections of the tool were created for storing detailed information on relevant screened items and internal actions by ECDC.  |
|                               | HPA Olympic international surveillance database (HPA, TMHS)                     | New                       | An Access database in which all incidents identified that met London 2012 relevance criteria were recorded in a standardised way, risk assessments added and situation reports generated automatically.  |
| Communication                 | Extranet (ECDC)   | New                       | Password protected communication portal for sharing a database of daily screening results, information, protocols etc that all members of international team could access.   |
|                               | Shared drive (HPS, Colindale)   | New                       | Shared network drive for all members of the team based in HPS-Colindale to share information.  |
| Protocols                     | Standard operating procedures (HPA, TMHS, ECDC)                                 | New                       | Comprehensive guidance for all team members on daily processes.  |
|                               | International risk assessment teleconference resources (HPA, TMHS)              | New                       | Standard agenda for daily teleconferences with constant dial-in details and template for recording minutes.  |
| Risk assessment support tools | Epidemiological profiles (HPA, TMHS and EIZ)                                    | New                       | Up-to-date global epidemiology of a wide range of diseases including recent outbreaks.   |
|                               | Travel patterns (HPA, TMHS)   | New                       | Tables of historical travel connections for the months July to September inclusive between the United Kingdom and the rest of the world based on International Passenger Survey data [20].   |
|                               | Risk definitions (HPA, EIZ)   | Pre-existing              | Standard definitions of risk levels.   |

ECDC: European Centre for Disease Prevention and Control; EIZ: Emerging Infections and Zoonoses; HPA: Health Protection Agency (now Public Health England); HPS: Health Protection Services; MIT: Massachusetts Institute of Technology; TMHS: Travel and Migrant Health Section.

## Box

Criteria used during epidemic intelligence activity to select international infectious disease incidents of possible relevance to the London Olympic and Paralympic Games 2012 (2 July–12 September 2012)

### **Incidents generally excluded from further risk assessment unless significant change in epidemiology/clinical picture/potential for international spread**

- Chronic infectious disease of long latency, e.g. TB, HIV, chronic hepatitis B or C.
- Arthropod-borne disease with no current evidence for the occurrence of autochthonous transmission in the UK, e.g. malaria, dengue, chikungunya, leishmaniasis, yellow fever.
- Diseases that are normally endemic in the global area being reported with no significant change in epidemiology/clinical picture/implications for international spread.
- Localised outbreaks of gastrointestinal disease, unless an internationally distributed food source is implicated, or verocytotoxin-producing *Escherichia coli* (VTEC), or highly infectious person-to-person with large numbers affected e.g. norovirus.
- Outbreaks in defined population groups, e.g. school/hospital/refugee camp, where there is little chance of spread to the wider population, unless very unusual or severe.
- Environmentally acquired infections e.g. Legionnaires' disease.
- Sporadic cases of plague/anthrax/botulism or other agents that may be associated with bioterrorism but where the case has an obvious zoonotic exposure.

### **Incidents generally included for further risk assessment**

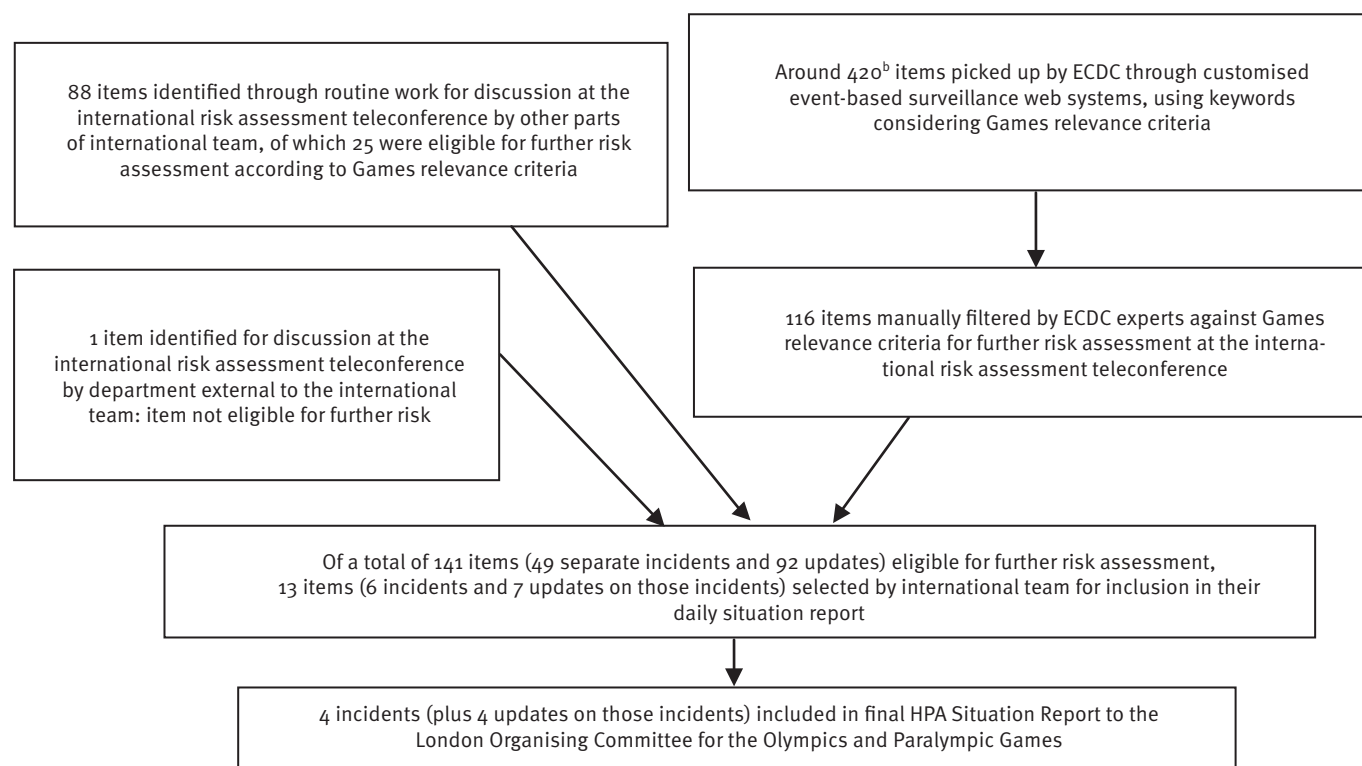
- Respiratory disease:
  - new incidents of influenza among humans, especially with a new subtype;
  - new incidents of Severe Acute Respiratory Syndrome
  - new incidents of other acute and severe respiratory infections, with or without a microbiological diagnosis.
- Gastrointestinal disease:
  - with significant changes in epidemiology/clinical picture;
  - large<sup>a</sup> outbreaks of viral infection spread by person to person contact, e.g. norovirus;
  - VTEC: significant numbers of cases over a short time frame in a small area;
  - if an internationally distributed food source is implicated.
- Vaccine-preventable disease where there has been a significant change in epidemiology in the global area being reported.
- Large<sup>a</sup> outbreaks or a change in clinical picture of meningococcal disease/encephalitides.
- Large<sup>a</sup> outbreaks or a change in clinical picture of sexually transmitted infection.
- Significant changes in the antibiotic resistance of an organism causing an outbreak.
- Zoonotic disease:
  - new incidents of avian influenza in birds in a previously unaffected area, especially with a new virus subtype;
  - other zoonotic disease that may have direct implications for the Games e.g. in horses.
- Incidents of serious undiagnosed illness of any type, especially with a high morbidity/mortality.
- Incidents of acute syndromes without a definitive diagnosis (e.g. fever, rash, jaundice, neurological, diarrhoea and vomiting, respiratory).
- Any incident of a disease with an unexpectedly high morbidity or mortality.
- Clusters of imported disease reported from countries outside the UK, which imply a problem in a third country and from which disease has not been previously reported.
- Incidents on cruise ships where the ship is destined for the UK.
- Any incident of disease with a significant potential for international spread.
- Any incident of disease that may interfere with trade or travel as advised by WHO or Foreign and Commonwealth Office.
- Any incident occurring outside the UK that might attract significant UK media attention or public or political interest.

HIV: human immunodeficiency virus; TB: tuberculosis; UK: United Kingdom; WHO: World Health Organization.

<sup>a</sup> Where 'large' is defined relative to the history of any previous outbreaks.

**FIGURE 2**

Results of enhanced daily international infectious disease surveillance for the London Olympic and Paralympic Games 2012 (2 July–12 September 2012)<sup>a</sup>



ECDC: European Centre for Disease Prevention and Control. HPA: Health Protection Agency (now Public Health England)

<sup>a</sup> Note that this does not include the weekly measles and fortnightly influenza surveillance activity.

<sup>b</sup> Estimation after de-duplication for language.

with the developers of several EBS web systems that are able to gather, filter and classify public health information in real-time. Most of these systems are fully automated; however, some of them include a human filtering component. The EBS systems that were modified for the specific surveillance needs of London 2012 are shown in Table 1. In addition to these systems, information was also obtained from online discussion forums, restricted-access website communication platforms for disease-specific European surveillance networks coordinated by ECDC, and other network sources for evaluation of anticipated threats, such as influenza epidemics in the southern hemisphere.

The criteria that were developed by the international team for ECDC to use to select ID incidents through their EI activity for further joint risk assessment are summarised in the Box. These criteria were aligned with the purposes of the surveillance activity as described above and were informed by a shared evidence-based understanding of the types of international ID incidents that would have the potential to have an impact on the Games. Other parts of the international team

contributed information from their own routine EI activity if it fulfilled these criteria, and all contributed to the joint risk assessment of incidents for the Games by means of a daily international risk assessment teleconference. Information about any international incidents identified by any HPA or other Government department personnel (e.g. Department of Health/Foreign and Commonwealth Office) were requested to be sent to the international team led from Health Protection Services, Colindale, rather than independently reported, so that all were subject to the same risk assessment process and a standard risk language was used to report them. Only newly reported incidents or significant changes to baseline epidemiology/clinical picture (e.g. increased severity) or significant changes to the status of ongoing incidents were considered for inclusion in the daily international situation report. In addition to the daily reporting, summaries of any significant changes in global measles and influenza epidemiology were also provided by the international team on a weekly and fortnightly basis respectively.

**TABLE 2**

Outcome of routine epidemic intelligence undertaken by parts of the international team during the surveillance period but outside the specific context of the London Olympic and Paralympic Games 2012 (2 July–12 September 2012)

| Part of international team | Outcome of routine work outside Olympic context during 2 July to 12 September 2012   |
|----------------------------|--|
| NaTHNaC and TMHS           | <ul style="list-style-type: none"> <li>• 401 items identified against NaTHNaC criteria for relevance to United Kingdom travellers (including both incidents and updates to incidents) for inclusion in NaTHNaC Outbreak Surveillance Database and in Daily Briefs to service users</li> <li>• 24 clinical updates posted on NaTHNaC website</li> </ul>   |
| EIZ                        | <ul style="list-style-type: none"> <li>• 305 items (including both incidents and updates to incidents) meeting EIZ criteria noted in daily log</li> <li>• 2 monthly Emerging Infection summaries produced giving details of 26 incidents of interest</li> <li>• Responded to 4 international infectious disease incidents</li> </ul>   |
| MRA                        | <ul style="list-style-type: none"> <li>• 964 items (including both incidents and updates to incidents) meeting MRA criteria included in the MRA database</li> <li>• 10 weekly and 2 monthly reports produced including these incidents</li> </ul>  |
| ECDC                       | <ul style="list-style-type: none"> <li>• 250 total items (including both incidents and updates to incidents) meeting ECDC routine criteria brought to daily ECDC risk assessment meeting</li> <li>• 8 new incidents included in the threat tracker tool</li> <li>• 6 incidents under continuous monitoring</li> <li>• 11 weekly Communicable Disease Threat Reports</li> <li>• 10 Rapid Risk Assessments</li> <li>• 4 Epidemiological Updates</li> </ul> |

ECDC: European Centre for Disease Prevention and Control; EIZ: Emerging Infections and Zoonoses; MRA: Microbial Risk Assessment; NaTHNaC: National Travel Health Network and Centre; TMHS: Travel and Migrant Health Section.

Note that TMHS, EIZ and MRA are all sections of the Health Protection Agency (now Public Health England).

Table 1 summarises the range of resources that were required to support the international surveillance function. Rotas were developed to cover necessary duties seven days a week throughout the London 2012 surveillance period. The HPA seconded four public health trainees to ECDC to support EI activity, and a liaison officer from ECDC was also stationed with the national and international infectious disease surveillance departments based at Colindale during the three weeks of the Olympics to facilitate the day-to-day collaboration.

Analysis of ID incidents identified during the surveillance period comprised: (i) analysis of incidents that fulfilled the criteria (all those contained within the HPA Olympic international surveillance database); and (ii) analysis of other incidents discussed at the international risk assessment teleconference but which did not fulfil the criteria and were not therefore imported into the database. This involved detailed review of all notes from the daily teleconference. All incidents were analysed in Microsoft Excel.

## Results

The results of daily international surveillance for London 2012 for the entire surveillance period are summarised in Figure 2. In total, 49 separate incidents were identified as relevant according to the Games criteria and therefore required further risk assessment by the international team. Of these, 17 were related to gastrointestinal infections such as salmonellosis,

cholera and *Escherichia coli* infection, 12 to childhood infections such as hand, foot and mouth disease, pertussis and measles, seven to influenza, seven to zoonoses such as anthrax and those due to infection with West Nile virus, hantavirus and Hendra virus, three to viral haemorrhagic fevers such as Lassa and Ebola and a further three to other infections. In terms of the geographical location of these incidents, 18 were reported in Europe, 10 in North America, eight in Asia, seven in Africa, four in Oceania and two in South and Central America. Of the 17 gastrointestinal disease incidents, nine had specific foods implicated as the source and the international team followed up six of these with the UK Food Standards Agency. None of these incidents involved food that was known to be imported into the UK.

The international team highlighted 13 items (six incidents and seven updates on those incidents) in their daily contributions to the national infectious disease surveillance situation report. None of these were assessed as posing an actual threat to the Games; however, all fulfilled the criterion of potentially 'attracting significant UK media attention or public or political interest'. The six new incidents included (with the initial source of the information) were:

1. Acute respiratory syndrome in Cambodia, later confirmed as hand, foot and mouth disease caused by enterovirus-71 (IHR)
2. Acute watery diarrhoea in Cuba, later confirmed as cholera (Cuban Ministry of Health)

**TABLE 3**

Estimated additional person-hours required over and above routine work for enhanced international infectious disease surveillance during the London Olympic and Paralympic Games 2012 (2 July–12 September 2012)

| Site of team           | Total number of staff involved in rota                           | Estimated average minutes of total time per day over and above routine work (a) | Total additional hours over whole surveillance period of 73 days <sup>a</sup> |
|------------------------|--|---|---|
| HPS Colindale          | 6 ISR scientists   | 120   | 146   |
|                        | 5 ISR consultants  | 90  | 110   |
| MRA <sup>b</sup>       | 3 scientists/risk assessors                                      | 45  | 40  |
| NaTHNaC <sup>b</sup>   | 1 information officer  | 50  | 44  |
|                        | 5 clinical practitioners   | 40  | 35  |
| ECDC                   | 7 duty officers  | 65  | 79  |
|                        | 6 epidemic intelligence mass gathering and other disease experts | 120   | 146   |
|                        | 5 trainees   | 120   | 146   |
| <b>Total all sites</b> | –  | –   | <b>746</b>  |

ECDC: European Centre for Disease Prevention and Control; ISR: international situation report; HPS: Health Protection Services; MRA: Microbial Risk Assessment; NaTHNaC: National Travel Health Network and Centre.

Note that HPS and MRA are parts of the Health Protection Agency (now Public Health England).

<sup>a</sup> Calculation: (a) x total number of days/60.

<sup>b</sup> Involved Monday to Friday only (53 days in total).

3. Swine-origin H3N2v influenza A in the United States (IHR)
4. Ebola in Uganda (WHO and Ugandan Government)
5. Cholera in Nepal (media report)
6. Hantavirus pulmonary syndrome in Yosemite National Park, United States (United States Centers for Disease Control and Prevention).

Incidents 1, 2, 4 and 6 (plus four updates to these incidents) were included in the final HPA daily situation report to the London Organising Committee for the Olympics and Paralympic Games by the HPA Olympics Coordinating Centre. Throughout the surveillance period, although the southern hemisphere influenza season had started and there were ongoing outbreaks of measles in several countries, there were no significant and/or unexpected changes to the global epidemiology of measles or influenza of relevance to London 2012.

Of the six incidents above, five were notified to the UK under the IHR: two were first identified through IHR and three were first identified through publicly available media and state sources and later reported under the IHR. The time gain of EI over IHR reporting in each case was 3 days (hantavirus pulmonary syndrome in the United States), 10 days (cholera in Cuba) and 15 days (Ebola in Uganda).

The outputs from the simultaneous routine EI activity undertaken by the individual parts of the international team outside the Olympic context are summarised in Table 2.

The personnel time required for operation of the enhanced international surveillance system is illustrated in Table 3. In total, 746 additional person-hours over and above routine roles were engaged in Games-specific activity throughout the surveillance period. This does not include the planning, preparation and exercising time by team members in the preceding two-year period.

## Discussion

During the London 2012 surveillance period, the individual parts of the international team continued their routine EI work as well as looking specifically for international ID incidents that might have an impact on the Games. International ID incidents occur all the time and Table 2 demonstrates that over the London 2012 surveillance period, the individual parts of the international team identified and responded to a considerable number of incidents as part of their routine work because they were relevant in some way to their public health perspectives. No international incidents detected during the surveillance period were assessed as likely to pose a disease threat to the Games and no public health responses were therefore developed. It is significant that the only incidents reported by the

international team were those that were judged (on the basis of past UK experience) as being likely to attract media attention and hence possible political and public concern. Alerting the press office to the possibility of media interest so that responses can be developed as necessary is an important aspect of the overall public health management of large public events.

The combination of the enhanced EI work of ECDC, supplemented by the routine EI work of the various groups in the international team, gave the system high sensitivity for detection of potential threats. It is very unlikely that any incidents of significance for the Games were missed – a view reinforced by the fact that during the surveillance period there were no reports of ID incidents associated with the Games that were linked to overseas incidents. The incident selection criteria developed for EI also gave the process high specificity, thus improving the efficiency of the joint risk assessment process.

The fact that no international ID incidents likely to impact on London 2012 were identified is perhaps not surprising. Likelihood of impact on an event from an overseas ID incident will broadly depend on the nature of the disease (including mode of transmission and incubation period), the number of cases likely to be imported in a relevant time frame (which in turn depends on population connections between the location of the international incident and the host country and, in particular, attendees of the event), the nature of the event, and the ID epidemiology and public health preparedness of the host country. The sanitary and public health infrastructure in the UK, and the absence of the requisite arthropods and/or environmental conditions for most tropical vector-borne diseases, both reduce the likelihood that importation of cases of many types of disease might lead to significant public health issues, either in or out of the Games context. The same may not be true for other countries that might host mass gathering events. The criteria that different countries will use in determining which international ID incidents might be significant in relation to any large public events they host will therefore vary according to their particular circumstances, their normal public health concerns and the nature of the event. The risks associated with a large international sporting event such as London 2012 are likely to be different from those associated with a large international religious event such as the Hajj [15]. Large public events occur very frequently in the UK and associated outbreaks of indigenous ID have occasionally been recorded [16-18]. Literature searches, however, identify no reports of large public events in the UK affected by international ID incidents.

Although athletes /officials and spectators attended London 2012 from all over the world, the majority of the nearly 600,000 international visitors to the UK in July and August who came wholly or partly for London 2012 were from mainland Europe [19]. It must be remembered that the UK, and London in particular, is a very

popular travel destination. During July to September each year, on average 9 million people visit the UK from overseas and nearly half of these include at least one overnight stay in London [20]. Although the overall epidemiology of ID in the UK is influenced by international population movement [21], with some examples of generally small-scale outbreaks associated with imported disease [22], it is rare for acute ID incidents occurring elsewhere in the world to have a significant impact on the UK, despite the global connectedness of London. This is partly for the reasons outlined above but also because ID incidents that involve significant international spread, while unpredictable, are infrequent. Since the implementation of the latest IHR (IHR 2005) in 2007, the Director-General of WHO has declared only one public health emergency of international concern (pandemic influenza A(H1N1) in 2009 [23]) and before that, the most recent serious global ID incident was Severe Acute Respiratory Syndrome (SARS) in 2003. Influenza A(H1N1)pdm09 involved global transmission over a period of months during which several mass gathering events took place with control measures implemented on a precautionary basis to minimise any potential public health impact [24-26].

The considerable time commitment in the two-year planning and preparation stage by the international team was invaluable. By the time the London 2012 surveillance period began, the enhanced process was established, the supporting resources were all developed and the activity quickly became part of the daily routine, thus allowing most of those involved to continue with their normal non-London 2012 roles. During the operational stage, international surveillance for London 2012 required a total of around 10 additional hours of personnel time per day, and resources available were used in the most efficient way possible by appropriate division of labour. In particular, ECDC had the lead expertise and responsibility for EI activity, enhancing their usual function in this regard, while the HPA took the lead in the risk assessment process. The international collaboration between UK partners and ECDC worked extremely well and also provided valuable training opportunities, with the involvement of both UK public health trainees and a European Programme for Intervention and Epidemiology Training (EPIET) fellow in ECDC activities. Some incidents included in the international situation reports were detected earlier as a result of EI, which could be very important for an actual threat in terms of response. Perhaps a more significant advantage of the robust system developed was, however, the continuous monitoring of incidents and real-time sharing of relevant information for assessment by a group of experts. Early trials demonstrated that there was value in conducting risk assessments with representatives from all parts of the team, since each group brought its own perspective and experience from routine work. Standardising the approach to assess incidents and report on risk, and having only one route for international information in the overall London 2012

surveillance system, were also demonstrated to be valuable in exercises.

The international surveillance model used worked well for the London 2012 situation and resources available. This does not, however, mean that this model is necessary for all other countries hosting similar events in the future. Of the six items identified for inclusion in the daily international situation report, five were reported to Member States by WHO under IHR, though there were time lags associated with three of these. Countries hosting large sporting events in the future will need to consider to what degree they will need to supplement alerting systems such as these with their own, and/or collaborative, EI processes, when determining how to allocate resources to international surveillance among the wide range of public health responses required for such events.

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