Syndromic Surveillance Report
London 2012 Olympic and Paralympic Games

Contents:

What is syndromic surveillance and what were the aims of this surveillance during the Games?

Syndromic surveillance (see definition in Box 1) monitors changes in symptoms experienced by the general public and which are reported via routes such as general practice or emergency departments.

Box 1

Syndromic surveillance is the real-time (or near real-time) collection, analysis, interpretation and dissemination of health-related data to enable the early identification of the impact (or absence of impact) of potential public-health threats which require effective public health action

In the context of a mass gathering such as the Games the aims of syndromic surveillance could be summarised as follows:

- To provide early warning of incidents
- To describe the extent and spread of known incidents ("situational awareness")
- To provide reassurance about the lack of impact of incidents.

The Health Protection Agency (HPA) Real-time Syndromic Surveillance Team (ReSST) co-ordinates a suite of national syndromic schemes for the HPA.

What service did we provide pre-Games?

Since 1999 the HPA has co-ordinated the HPA/NHS Direct Syndromic Surveillance System, which provides "pre-primary care" data using telehealth call information for a range of syndromes. In 2005, a new GP surveillance system was developed by the HPA in collaboration with the University of Nottingham: the HPA/QSurveillance National GP Surveillance System. This is one of the largest GP surveillance systems in Europe, monitoring weekly consultation data from a network of over 3,500 GP practices across the UK.

How did the service need to be strengthened in advance of the Games?

Links with wider planning and surveillance

In the planning for the Games the ReSST linked in closely with the overall surveillance planning of the HPA, and attended the HPA Olympics Surveillance Group. One area that was lacking was felt to be the surveillance of those visitors who might attend an out of hours provider of primary care (GP services), or who might attend an emergency department because of their illness. It was also highlighted that data from all systems were needed daily in advance and throughout the Games period.

The need for surveillance in these health care settings had been previously highlighted as of potential importance, but the Games gave priority and impetus to the work.

Emergency Department Surveillance System

The Emergency Department Syndromic Surveillance System (EDSSS) was developed in collaboration with the College of Emergency Medicine and the development work started three to four years in advance of the Games. The work is described in more detail in the paper: *Establishing an emergency department syndromic surveillance system to support the London 2012 Olympic and Paralympic Games*. In summary, the EDSSS network monitors anonymised data from emergency departments (EDs) across England. The data contain information on attendances at each ED including age and gender, triage, diagnoses and outcome of attendance (e.g. whether the patient has been admitted or sent home). The scheme was reporting on a daily basis from 27 EDs by the time of the Games, continues to grow post Games, and is maintained as an active scheme of use in early warning, monitoring of incidents and for future mass gatherings.

GP out of hours surveillance

ReSST worked closely with a major UK provider of GP unscheduled care software and GP out of hours (OOH) providers to monitor daily GP OOH consultation data. The benefit of this is that consultation data from evenings, nights, weekends and public holidays could be monitored: none of the other GP surveillance systems were able to report on this. Work focussed particularly on ensuring that the GP OOH system had good coverage across London and once this had been established the work expanded to achieve good coverage across the rest of England. The work is described in more detail in the paper: *Developing a new syndromic surveillance system for the London 2012 Olympic and Paralympic Games*.

Statistical underpinning of the syndromic surveillance

It was important to analyse the syndromic data to detect any changes in acute community morbidity. This involved considerable development work and was complicated by the fact that, although two of the systems were well established and had several years' historical data, the two new systems had little historical data.
Appendix 1 gives the detail of the statistical methods and an example report used, but in summary:

Nearly 4,000 different 'signals' were tested daily to see if there had been a rise in activity against baselines based on previous years' data or recent activity if historical data was not available. Baselines were calculated taking into account many confounding factors including seasonal effects, days of the week, holidays, and changes in coverage. Significant increases generated 'alarms' that were further filtered and prioritised prior to a risk assessment (see below).

The ReSST daily Olympic report included counts of the number of consultations seen for key indicators at national and Strategic Health Authority level, and in Wales. Where a statistically significant increase in activity was noted this was highlighted in amber, and if it was considered to have a potential public health impact it was highlighted in red. Other issues of importance were highlighted in comments on the front page.

Prior to the Games, scenarios were developed to help quantify what size of incident would be detectable by the Syndromic systems and the timeliness of detection expected. It was also important that a daily report was not produced that had multiple un- interpreted statistical alarms – which would be of little use to the incident directors. In advance of the Games a process was developed by which all statistical alarms were assessed by both the scientists and the consultant epidemiologists.

This involved a two-stage scored risk assessment: the first stage by the scientist, and if the alarm was still considered to be of importance, a second stage public health assessment involving a consultant epidemiologist. The description of this process will be submitted for peer review, as it is the first time to our knowledge that such a public health assessment has been systematically incorporated into a working syndromic surveillance system.

How was the team structured to cope with the Olympic work schedule?

The enhanced surveillance requirements for the Games demanded seven-day-a-week reporting, including on weekends and public holidays. The ReSST are a small team and therefore there was not enough capacity within the team to cover these enhanced working requirements. In order to meet the surveillance requirements of the Games, the team was split into two separate reporting teams, each consisting of:

- three senior scientists
- two information officers
- a consultant epidemiologist

Scientists and information officers all undertook daily data analysis and interpretation as part of the daily surveillance service. The senior scientists took the role of 'Team Lead,' providing the daily lead for the team duties and the outputs, and providing a single point of contact for the consultant epidemiologist. The consultant provided the high level strategic support for the team and a single point of contact for national Olympic coordination teams.

A rota was developed enabling each team to work a ‘four days on, four days off’ working pattern. This provided a syndromic surveillance service during weekends and public holidays, whilst also providing staff with a more beneficial working pattern over the length of the Olympic reporting period. This arrangement also provided some flexibility within each team to allow for limited staff holiday leave, and also mitigated the risk of staff sickness absence.

The teams adhered to a structured handover process between shifts to ensure a smooth transition between teams. The handover process documented:

- all outstanding actions
- key messages on incidents alarms/alerts
- enquiries (internal/external)
- technical problems with IT systems

What did we do each day?

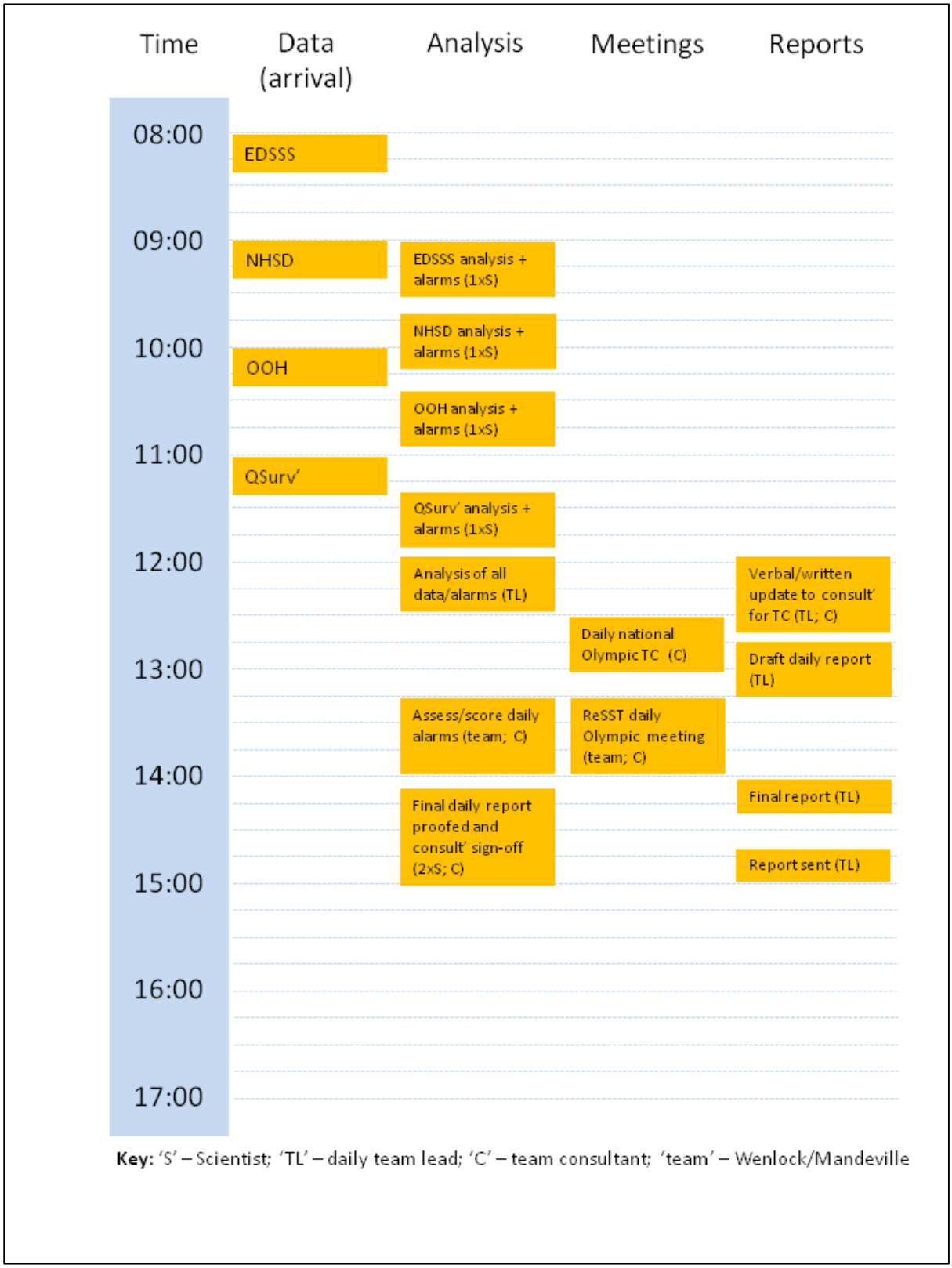
The roles of the ReSST during the Olympic and Paralympic periods were to:

- Produce an agreed routine daily surveillance output to be incorporated into the HPA’s overall surveillance output, which in turn informed the HPA’s daily sitrep to LOCOG and DH
- Alert HPA colleagues as necessary to syndromic surveillance trends that might carry public health implications
- Respond to national queries about routine syndromic surveillance Olympic outputs
- Respond, within the expectations agreed in advance of the period, to national requests for further information, analysis or interpretation should an incident with public health implications occur.

In addition, the ReSST continued to produce its routine, ‘externally facing’ syndromic surveillance bulletins each week, and kept a light hearted daily ‘team diary’ summarising, in text and pictures, key and everyday events for the Team during the enhanced service provision.

The Games service was provided each weekday between April and June, and each day including weekends between July and September.

Box 2: timescales for the daily 'battle rhythm' required to produce the daily syndromic surveillance Olympic bulletin



What syndromic surveillance systems were used and which indicators were monitored?

The syndromic surveillance service during the Games comprised monitoring data from a number of systems, including:

- NHS Direct 'telehealth calls'
- HPA/QSurveillance 'GP consultations'
- GP out of hours 'consultations'
- Emergency Department 'attendances'
- NHS24 (Scotland) 'telehealth calls.'

As described in Box 2, data from each syndromic surveillance system were received, processed, analysed and interpreted on a daily basis. During the Games a number of key clinical and syndromic indicators were monitored on a daily basis. The following figures illustrate a selection of the indicators that were monitored:

Figure 1: NHSD direct daily syndromic data for diarrhoea and vomiting calls

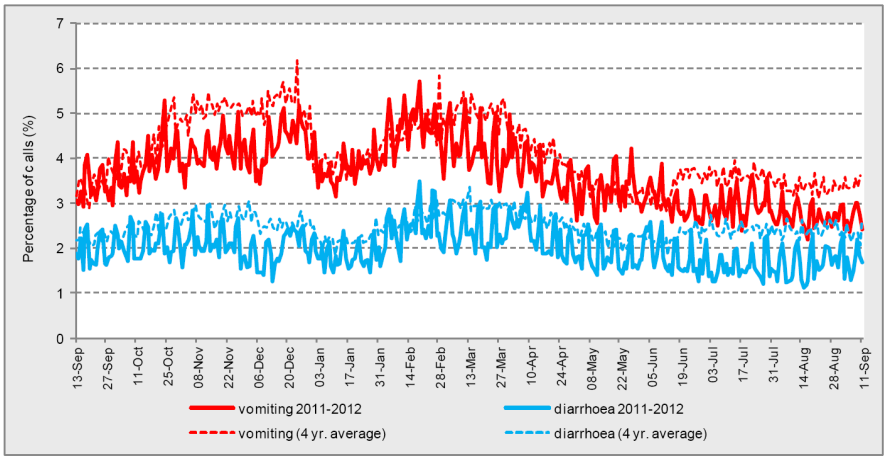


Figure 2: HPA/QSurveillance daily syndromic GP consultations for influenza-like illness

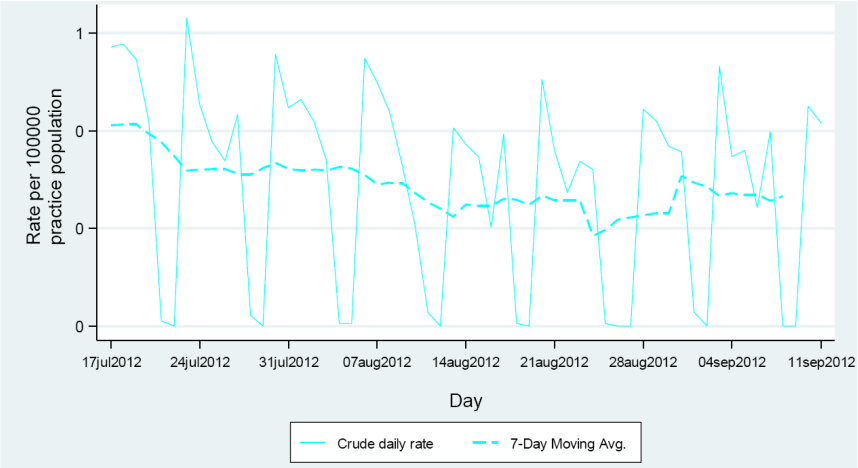


Figure 3: GP Out of Hours daily GP consultations for acute respiratory infection

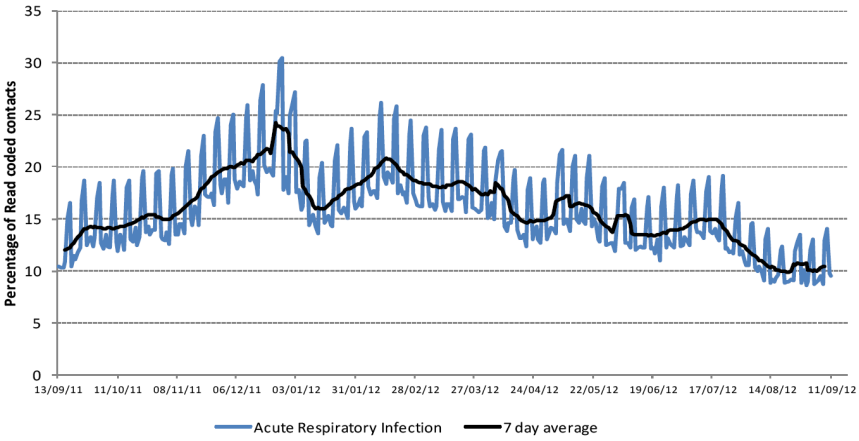
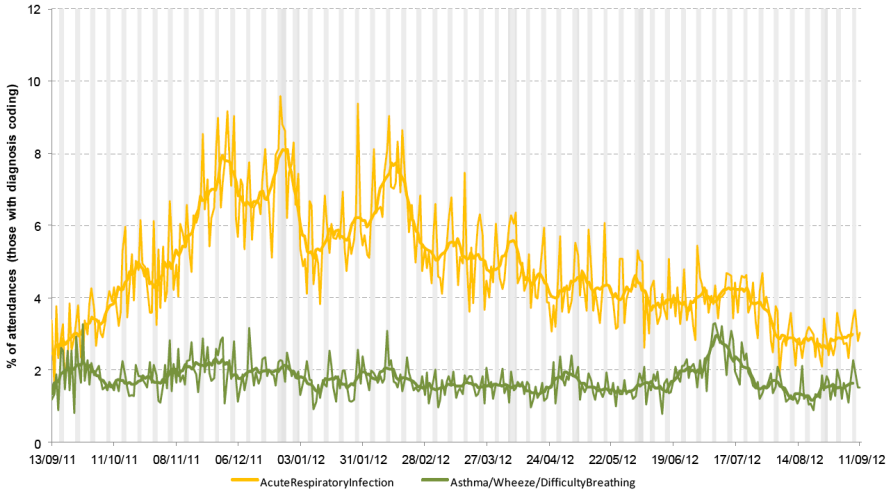


Figure 4: Emergency department attendances for acute respiratory infection and asthma/wheeze/difficulty breathing



Statistical analyses were undertaken each day, as described in Appendix 1. A summary table of the statistical results (i.e. whether signals were above expected levels) was included within the Olympic Bulletin at national and regional levels.

Figure 5: Syndromic signals overview table displaying warning signals for selected syndromes over a 14 day period

The numbers in each cell are the daily number of patient contacts (using a 7-day moving average for HPA/QSurveillance)

All areas		18/07/2012	19/07/2012	20/07/2012	21/07/2012	22/07/2012	23/07/2012	24/07/2012	25/07/2012	26/07/2012	27/07/2012	28/07/2012	29/07/2012	30/07/2012	31/07/2012	
Indicator	System															Excess cases
Lower respiratory tract infection	HPA/QSurveillance (GP)	2130	2144	2144			2079	2064	2012	1968	1921			1951	1935	0
Upper respiratory tract infection	HPA/QSurveillance (GP)	5586	5532	5440			5283	5163	5050	4940	4786			4620	4504	0
Acute respiratory infection	GP Out of hours	1485	1343	1276	5058	4522	1284	1166	1178	1157	1138	4216	3793	1186	1092	0
Acute respiratory infection	Emergency Departments	68	81	87	92	102	82	78	88	66	57	84	93	78	74	0
Difficulty breathing	NHS Direct	189	164	172	354	311	182	166	141	156	111	241	275	147	154	0
Asthma	HPA/QSurveillance (GP)	231	224	219			203	198	201	192	189			187	190	0
Asthma/Wheeze/Difficulty breathing	GP Out of hours	294	296	255	994	770	260	243	227	227	235	632	530	262	221	0
Asthma/Wheeze/Difficulty breathing	Emergency Departments	46	49	62	64	67	55	46	41	40	34	30	40	43	41	0
Cold/Flu	NHS Direct	39	32	34	42	59	27	40	31	35	29	46	36	39	36	0
Influenza-like illness	HPA/QSurveillance (GP)	95	96	94			90	85	78	72	73			71	70	0
Influenza-like illness	GP Out of hours	17	21	23	34	32	15	18	11	15	12	27	31	13	13	0
Fever 5-14 year olds	NHS Direct	43	35	38	58	74	40	45	57	48	40	53	49	42	28	0
Gastroenteritis	Emergency Departments	31	23	30	26	39	31	33	34	31	33	27	32	20	19	0
Diarrhoea	NHS Direct	111	108	121	0	223	118	105	102	99	85	221	243	110	122	0
Diarrhoea	HPA/QSurveillance (GP)	933	942	926			924	918	911	902	901			904	913	0
Diarrhoea	GP Out of hours	106	96	75	351	362	88	86	88	116	80	377	340	83	98	0
Vomiting	NHS Direct	206	188	230	340	384	260	215	208	218	216	295	378	220	225	0
Vomiting	HPA/QSurveillance (GP)	439	441	433			425	425	423	421	416			411	407	0
Vomiting	GP Out of hours	139	131	152	355	364	135	141	155	138	139	391	356	138	154	0
Rash	NHS Direct	328	332	366	611	625	353	342	363	373	357	619	696	383	353	0
Heat/Sun stroke	NHS Direct	3	2	4	3	18	16	33	38	12	11	7	4	3	4	0
Heat stroke	HPA/QSurveillance (GP)	1	1	1			1	1	2	4	5			5	4	2
Heat stroke and sun stroke	GP Out of hours	1	0	0	0	4	6	4	8	8	5	3	0	0	0	0
Impact of heat	Emergency Departments	24	21	25	18	26	32	31	36	34	32	22	19	28	18	0

GREEN: within expected variation

AMBER: above expected variation

RED: assessed as important by ReSST team

Excess cases: - the number of cases above the upper threshold (shown for the last date in the date range only).

The Daily Syndromic Surveillance Olympic and Paralympic Report

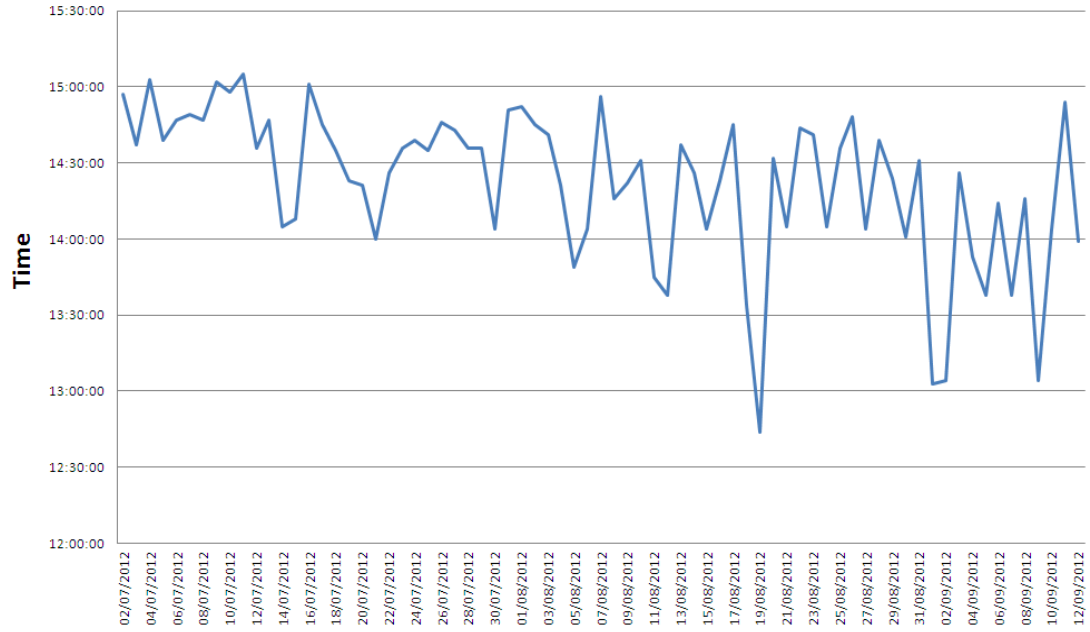
All key data were included within a single syndromic surveillance report that was produced each day during the Olympic and Paralympic periods. The aim of the bulletin was to provide a platform to illustrate the current trends in syndromic data, context with regard to historical data, and expert interpretation of the surveillance data. This meant that a number of key

messages could be provided that gave either notification of unusual findings, or reassurance that there was nothing of public health significance occurring.

The bulletin was developed to include a front page with an overall key message that pulled together data from all the systems. There were also key summary messages included for each individual system.

The bulletin was produced on a daily basis (as illustrated in Box 2), including on weekends and public holidays. Over the Olympic and Paralympic periods (July 2 – Sept 12) the ReSST produced 73 daily bulletins, with the majority of bulletins received by the relevant Olympic group stakeholders within the required deadline (Figure 6).

Figure 6: Time of email distribution (and therefore receipt by stakeholders) of daily syndromic surveillance Olympic and Paralympic bulletin (daily deadline for distribution 15:00 hours)



What did we find and how were we used?

Following the end of the Games ReSST Games service undertook an evaluation covering the following five areas:

- **Structure –** resources (building, staffing, financial resources, time)
- **Input –** system wide characteristics, including data and transmission standards to facilitate interoperability and data sharing between information systems; security; privacy and confidentiality; and data sources
- **Process –** data processing before analysis; statistical analysis; and epidemiological analysis, interpretation, and investigation
- **Output -** Alarms and alerts; reports; and daily Olympic Bulletins produced by ReSST, with an evaluation of their timeliness and validity. Assessments will be made, where possible, of outbreaks detected; false alarms; and outbreaks missed or detected late

- **Outcome –** estimating the impact of the ReSST service on the decision-making process of internal and external stakeholders, and ultimately on population health.

Data were gathered both during the ReSST Games Service (e.g. alarms and alerts, requests for information) and after it (debriefs and questionnaires). Initial findings include:

- Reassurance was provided and found to be useful (e.g. over total activity and with a lack of major outbreaks)
- 'The bulletin was a very useful source of information that enabled us to provide assurance to key stakeholders'. (OCC Director)
- Systems were able to pick up unusual activity, such as the asthma/difficulty breathing increases just prior to the Games
- The sensitivity of the systems was demonstrated (e.g. by picking up the impact of mild increases in temperature over the summer using syndromic heat indicators)
- Syndromic information was provided in a timely fashion (94% of the 73 bulletins were received by the 3pm deadline and the latest by 3.05pm)
- Changes in patterns over the Games were picked up (e.g. EDSSS total attendance decreasing in London whilst the triage severity increased)
- The feedback from the questionnaire was overwhelmingly positive, with the Olympic Bulletin viewed as a useful, concise document which informed the decision-making process
- The debrief highlighted the great morale within ReSST and excellent communication between the two teams (Mandeville and Wenlock!)
- Although the process was new and we were reliant on data from a number of external organisations, the data were received by the data providers on time for analysis 100% of the time for QSurveillance and for the GP out of hours service (GPOOHS); and 90% of the time for NHS Direct and EDSSS.

What additional resources were required?

In advance of the Games we had 8 whole time equivalent (wte) staff (including 2 wte staff appointed specifically for Games development) to deliver the service, including scientist, administrative and consultant epidemiologist support. During the Games time service we had the help of two additional temporary information officer staff for 4 months and additional consultant consultant epidemiologist cover (estimate one day a week worked flexibly) to provide the daily service.

What would be our 'top tips' for running a syndromic surveillance system for a similar mass gathering to the 2012 Olympic and Paralympic Games?

Our 'top tips' for running a syndromic surveillance system for a mass gathering would be:

- Plan early
- Use existing systems where possible –ideally a year's data is needed to enable historical comparisons
- Focus on a syndromic 'service' linked to public health response – not a 'stand alone' system
- Public health input is needed for interpretation
- Try to simplify outputs for end users
- Don't underestimate the value of reassurance
- Lots of cake for the team!

Appendices

Appendix One: Brief overview of statistical methods used

1. HPA/QSurveillance

Signals are created for each PCT in England, Wales and Northern Ireland for which data exists (approx. 161), and for each SHA and nation, across 23 different syndromic indicators. The 'Stroup' or 'Historic incidence ratio' (HIR) method used is to compare the weekly rate for each signal with the average for the signal from previous years at the same time of year. GP data does not include any weekend activity or bank holidays. To allow for this, rates are adjusted during weeks with bank holidays.

Baselines are calculated as the average of the previous 3 years, using the same week of the year as the current one, plus two weeks either side. Excluded from the baselines are data related to exceptional activity during the H1N1 pandemic.

Thresholds are based on the upper 99% prediction levels.

Thresholds have been modified in the following ways, to allow for individual problems with the data:

- A minimum threshold equivalent to a Poisson distribution is applied
- A smoothing factor was applied to remove step-changes caused by the H1N1 pandemic.

The Benjamini Hochberg formula is used to prioritise alarms based on their p-values. PCT alarms satisfying this criteria plus all SHA and national alarms are routinely assessed using a risk assessment scoring system.

2. HPA/NHS Direct

Signals are created for each of the 10 English SHAs, as well as separately for Wales and for England & Wales combined. Signals are modelled for nine different indicators and fixed thresholds are applied for 'Heat' and 'Double vision' indicators. A further indicator ('difficulty breathing') is assessed using the same methodology as for EDSSS (see below), due to a lack of historical data.

Models are based on daily data going back to 1st Jan 2003. Excluded from the data are days with known data issues (due to missing data etc.) and known incidents (e.g. the H1N1 pandemic).

The regression model uses a Poisson model, with the natural log of total calls as an offset and a scalar to allow for over-dispersion. The model includes the following factors: long-term trend, changes to coding algorithms, bank holidays, weekends, and month of year.

3. EDSSS

Signals are generated at site-level, alongside a combined signal for all London sites and all sites currently signed up. A Shewhart range chart is used to detect recent increases in activity, using a baseline based on the previous two weeks' activity.

4. GPOOHSS

To ensure that alarms are not generated just by changes to the number of providers, each day baselines, thresholds and that day's consultations are calculated considering just 'established' providers (i.e. those providers for which data exists fir that day and each of the previous 21 days).

Across the system, there is a big increase in consultations on non-working days (weekends and bank holidays). Therefore separate baselines and thresholds are calculated for working and non-working days – e.g. if the most recent data is for a Sunday, then the alarm threshold will be based on the data for non-working days within the previous three weeks.

A Shewhart range chart is used to detect recent increases in activity, using a baseline based on the previous three weeks' activity.

Appendix Two: Brief technical details of the data flows and systems