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Developing a multidisciplinary syndromic surveillance academic research programme in the United Kingdom: benefits for public health surveillance

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Abstract

Syndromic surveillance is growing in stature internationally as a recognised and innovative approach to public health surveillance. Syndromic surveillance research uses data captured by syndromic surveillance systems to investigate specific hypotheses or questions. However, this research is often undertaken either within established public health organisations or the academic setting, but often not together. Public health organisations can provide access to health-related data and expertise in infectious and non-infectious disease epidemiology and clinical interpretation of data. Academic institutions can optimise methodological rigour, intellectual clarity and establish routes for applying to external research funding bodies to attract money to fund projects. Together, these competencies can complement each other to enhance the public health benefits of syndromic surveillance research. This paper describes the development of a multidisciplinary syndromic surveillance academic research programme in England, United Kingdom, its aims, goals and benefits to public health.
Background

Syndromic surveillance is the 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 health threats which may require public health action.\(^1\) Public Health England (PHE) coordinates a programme of real-time syndromic surveillance across England and operates four national syndromic surveillance systems: general practitioner (family physician) in hours (GPIH) and general practitioner out of hours (GPOOH) consultations, sentinel emergency department attendances (EDSSS) and calls to a national telephone health line (NHS 111).\(^2-4\) Data are collected, analysed, interpreted and assessed on a daily basis using statistical algorithms incorporating a multi-level hierarchical mixed effects model that compares contemporaneous data to historical data to identify statistically significant excess activity.\(^5\) Data are aggregated into ‘syndromic indicators’ based upon symptoms and/or clinical diagnosis of disease (e.g. diarrhoea, acute respiratory infection), and trends and key public health messages are published on a weekly basis.\(^6\)

The underlying aims of this service are to provide: early warning of seasonal increases of disease; situational awareness during incidents; and reassurance of a lack of impact of specific risks (particularly valuable during mass gatherings such as the Olympic and Paralympic Games). Delivery of this service complements existing public health surveillance programmes within PHE (e.g. seasonal influenza surveillance).\(^7\)

In order that a national syndromic surveillance service is underpinned by scientifically valid and rigorous methods, it is important to ensure that there is a strong link with academia. Within the field of syndromic surveillance in the UK there has been an absence of a consistent and structured link between public health service activities and academia. Often, good quality syndromic surveillance research is undertaken in isolation in the academic setting with the benefits of this research not being translated into public health systems and practice. Likewise, syndromic surveillance ‘service’ work undertaken within the public health setting can be isolated from the potential benefits of linking with academic research groups. Public health organisations can provide access to health-related data and expertise in infectious and non-infectious disease epidemiology and clinical interpretation of data. Academic research can optimise and further develop methodological rigour, intellectual clarity and establish routes for applying to external research funding bodies to attract money to fund projects. Together, these specialist competencies can complement each other to
enhance the public health benefits of syndromic surveillance. In this commentary we provide our ‘vision’ for the development of a multidisciplinary syndromic surveillance academic research programme, making the case for this approach and illustrating the progress that has been made in England to achieving this goal.

PHE have previously undertaken numerous academic collaborations on specific syndromic surveillance research projects, however this approach to date has been reactive, waiting for calls of interest and then working with individual academic units on single disease subject areas rather than taking advantage of an existing structured collaborative approach. To address this issue and bring public health and academic expertise closer together, PHE are currently developing a model of academic partnership working, bringing together the PHE syndromic surveillance programme with a number of academic collaborators to maximise the public health benefits of syndromic surveillance. This approach will integrate experts from a number of disciplines including public health, medicine, informatics, epidemiology, statistics, modelling and environmental health amongst others. The structure and benefits of this approach are discussed in this commentary.

**Current PHE syndromic surveillance academic research programmes**

*Health Protection Research Units (HPRU)*

The National Institute for Health Research (NIHR) funds health and care research, translating discoveries into practical products, treatments, devices and procedures, involving patients and the public. During 2014, thirteen Health Protection Research Units (HPRUs) were established following an open competition launched in 2012. The HPRUs act as centres of excellence in multidisciplinary health protection research in England. Each HPRU focuses on a priority area of health protection (e.g. gastrointestinal infections) and is underpinned by a research partnership between a number of universities and PHE. The role of the HPRUs is to support PHE in delivering its objectives and functions for the protection of the public’s health. Research funding was provided for a five-year period starting 1 April 2014.

*HPRU in Emergency Preparedness and Response*

Public health incidents and emergencies often present as complex events, requiring different teams to co-ordinate their efforts in order to protect people’s health. The HPRU in Emergency Preparedness and Response (EPR) brings together groups of scientific experts to allow the identification of emergencies, determine how many people have been affected,
what types of countermeasures may be needed, who is most vulnerable and how to protect the
physical and mental health of victims and emergency responders.\textsuperscript{9} Syndromic surveillance
plays an important role in this research and a research ‘theme’ within the EPR HPRU has
been dedicated to quantifying the ability of existing syndromic surveillance systems to detect
new outbreaks of disease or covert incidents involving a chemical, biological or radiological
agent.\textsuperscript{10} This theme also aims to assess whether new data links or novel statistical techniques
(e.g. Bayesian Networks), or the inclusion of new data sources (e.g. social media) can
enhance this surveillance activity.

\textbf{HPRU research and syndromic surveillance}

The immediate benefit of the close integration of academic experts with syndromic
surveillance within the EPR HPRU is an improved understanding of the capabilities of the
development of a series of public health scenarios. These will test and compare the ability
and timeliness of specific syndromic surveillance systems to detect a real incident or refute an
intelligence-led false alarm about an incident. The knowledge generated from this work will
enhance the ability of PHE to respond to future incidents, and further strengthen messages of
reassurance and early warning.

Syndromic surveillance also plays an important research role in other NIHR HPRUs. The
value of syndromic data for testing hypotheses and complementing other scientific databases
has attracted interest from additional HPRU research groups, and syndromic data have been
utilised in a number of projects. Research on the impact of heatwaves, (including the use of
both specific and general morbidity indicators of heat impact) and air pollution on the
healthcare seeking behaviour of the population of England has been undertaken in
collaboration with the HPRU in Environmental Change and Health.\textsuperscript{11-13} Diarrhoea and
vomiting indicators from PHE syndromic surveillance systems are currently being explored
for use in analysing socioeconomic inequalities in gastrointestinal infections in England
(HPRU in Gastrointestinal Infections). These research projects also further highlight the wide
variety of public health work that syndromic surveillance can support, encompassing
infectious diseases and environmental factors.

Successes from this partnership are already beginning to appear (Table 1). In particular, the
2015 possible \textit{Cryptosporidium} exposure in the North West of England is a case in point
where public health, epidemiology and academic experts collaborated to explore the potential
impact of media reporting in syndromic surveillance during this incident (Elliot et al. 2016, manuscript under review).

**Developing a central syndromic surveillance academic partnership**

To further integrate academic and public health research in England, a central syndromic surveillance academic partnership is being developed between PHE and the University of Liverpool, building on a foundation of established close links with experts in the fields of public health and epidemiology at the University of Liverpool. The vision of this partnership is to develop a syndromic surveillance ‘Centre’ that becomes an innovator in real-time syndromic surveillance applied research and is at the leading edge of developments for syndromic surveillance. The development of this Centre will also fulfil a number of further objectives including:

- the integration of the unique syndromic surveillance system infrastructures and service expertise of the PHE syndromic surveillance team with a strong academic partner with skills and knowledge of application and translation into public health practice;
- proactively leading research on syndromic surveillance with a clear public health purpose;
- integrating expertise in attracting external funding to support syndromic surveillance research;
- increasing the scientific rigour of syndromic surveillance and ensuring translation into practice;
- ensuring a focus on the underlying methodologies of syndromic surveillance across all indicators/diseases;
- staying at the cutting edge of new syndromic surveillance developments including data sources, methodologies and technology;
- providing continual evidence of demonstrable public health impact.

In order to achieve these objectives, a strategy outline the aims of the collaboration and presents the short, medium and long term deliverables (Table 2). The example deliverables illustrate an innovative approach to integrating academic research into syndromic surveillance public health programmes. The approach taken in England has already contributed to a number of demonstrable benefits to the public health system, and it is anticipated that these benefits will expand as the collaboration matures (Table 2).
Whilst the establishment of such partnerships, as proposed, can be of significant benefit, it is usually not without significant challenges. In the fields of public health and academia, workloads are increasing against a backdrop of reducing funding and therefore finding the resource required to establish such partnerships, including developing strategies, terms of reference and management groups can be a challenge. It is therefore essential that such partnerships are based upon a genuine desire to collaborate rather than a business or contractual basis.

The future

The ‘vision’ and developments described in this paper are the primary steps towards the goal of integrating syndromic surveillance service related activities and academic research in England. The benefits and application of research findings to the PHE syndromic surveillance service are already demonstrable, however the next years will determine the overall success of this programme. Further expansion of the research agenda, developing a PhD and postdoctoral training programme and generating external funding to support research are all achievable medium and long term goals. PhD and postdoctoral researchers will integrate into the public health system, not just gaining access to syndromic surveillance data for research, but learning core public health skills and competencies and contributing to the delivery of the syndromic surveillance ‘service’. Another potential development is the establishment of international collaborations to share expertise and resource, particularly in countries with limited resources and where healthcare services do not support syndromic surveillance. Ultimately, building on the recent European Commission-funded Triple-S project, developing a network of syndromic surveillance centres across Europe could be an achievable target, with ‘National Centres for Syndromic Surveillance Excellence’ coordinating a harmonized approach to syndromic surveillance. Internationally there are other examples of syndromic surveillance collaboration and excellence, with particular reference to the International Society of Disease Surveillance (ISDS). ISDS has established a programme for coordinating collaboration amongst syndromic surveillance experts who may normally not interact but who, when brought together, can enable innovative approaches to public health problems and develop solutions that would not be possible without this collaboration.

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**References**


Table 1: syndromic surveillance academic research within Public Health England and the benefits applied to the public health system

<table>
<thead>
<tr>
<th>Academic research area</th>
<th>Application/integration into public health</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heatwave impact</td>
<td>Understanding of impact of heatwaves using indicators of heat and sun stroke: reassurance of sensitivity of indicators and development of baselines used for routine heatwave surveillance.¹³</td>
</tr>
<tr>
<td>Heatwave morbidity</td>
<td>Improved knowledge of the impact of extreme heat on a wider range of morbidity indicators. Strengthened heatwave surveillance and improved reassurance to public health incident teams about which indicators are important for surveillance during heatwaves.¹²</td>
</tr>
<tr>
<td>Air pollution impact</td>
<td>Improved understanding of the impact of air pollution incidents on health. Knowledge applied during incidents to provide reassurance of which indicators used, their sensitivity and the development of baselines used for surveillance during air pollution incidents.¹¹</td>
</tr>
<tr>
<td>Incident scenarios</td>
<td>Understanding of the characteristics of a range of public health incidents (e.g. pandemic flu, deliberate release) that can be identified using syndromic surveillance indicators. Developed improved reassurance during outbreaks or incidents about what syndromic surveillance can detect (unpublished work).</td>
</tr>
<tr>
<td>European football tournament 2016:</td>
<td>Planning for future mass gathering sports events. Determining the public health impact of mass gathering sporting events and updating guidance on which syndromic indicators should be routinely monitored during mass gatherings (unpublished work).</td>
</tr>
<tr>
<td>Impact of media reporting on syndromic surveillance</td>
<td>Understanding of the possible impact of media coverage on syndromic surveillance data and bias this can introduce to data analysis/statistics. Improved interpretation of key messages during public health incidents and clear recommendations to incident directors.¹⁵</td>
</tr>
<tr>
<td>Gastrointestinal infections</td>
<td>Improved understanding of utility of syndromic surveillance detecting local GI outbreaks. Improved reassurance during incidents e.g. flooding of what syndromic surveillance can detect (unpublished work).</td>
</tr>
</tbody>
</table>
Table 2: Examples of short, medium and long term deliverables from the syndromic surveillance academic partnership between Public Health England and the University of Liverpool and the expected outcomes.

<table>
<thead>
<tr>
<th>Short term (12-24 months)</th>
<th>Medium term (2-4 years)</th>
<th>Long term (5+ years)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objective</strong></td>
<td><strong>Outcome</strong></td>
<td></td>
</tr>
<tr>
<td>Memorandum of understanding between parties</td>
<td>Agreed collaborative principles and terms of reference for collaboration</td>
<td>Memorandum of understanding between parties</td>
</tr>
<tr>
<td><strong>Objective</strong></td>
<td><strong>Outcome</strong></td>
<td></td>
</tr>
<tr>
<td>Establish a steering group to direct the collaboration</td>
<td>Regular syndromic surveillance scientific meetings/seminar programme</td>
<td>Establish a steering group to direct the collaboration</td>
</tr>
<tr>
<td><strong>Objective</strong></td>
<td><strong>Outcome</strong></td>
<td></td>
</tr>
<tr>
<td>Honorary academic appointments for PHE syndromic surveillance staff</td>
<td>Professional development; improved capacity for University</td>
<td>Honorary academic appointments for PHE syndromic surveillance staff</td>
</tr>
<tr>
<td><strong>Outcome</strong></td>
<td><strong>Outcome</strong></td>
<td></td>
</tr>
<tr>
<td>PhD studentship programme</td>
<td>PhD studentship programme</td>
<td>PhD studentship programme</td>
</tr>
<tr>
<td><strong>Outcome</strong></td>
<td>Training of future PHE specialists; improved capacity for PHE</td>
<td></td>
</tr>
<tr>
<td><strong>Objective</strong></td>
<td>Collaborative peer review publications</td>
<td></td>
</tr>
<tr>
<td><strong>Outcome</strong></td>
<td>Increased reputation and evidence base for syndromic surveillance</td>
<td></td>
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