

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

3 ELLIOT AJ<sup>a,b</sup>, MORBEY R<sup>a,b</sup>, EDEGHERE O<sup>a,b</sup>, LAKE IR<sup>b,c</sup>, COLÓN-GONZÁLEZ FJ<sup>b,c</sup>, VIVANCOS  
4 R<sup>a,d,e</sup>, RUBIN GJ<sup>b,f</sup>, O'BRIEN S<sup>d,e</sup>, SMITH GE<sup>a,b</sup>

5 <sup>a</sup> Public Health England, National Infection Service

6 <sup>b</sup> NIHR Health Protection Research Unit in Emergency Preparedness and Response

7 <sup>c</sup> University of East Anglia, School of Environmental Sciences

8 <sup>d</sup> University of Liverpool, Institute for Infection and Global Health

9 <sup>e</sup> NIHR Health Protection Research Unit in Gastrointestinal Infections

10 <sup>f</sup> King's College London, Department of Psychological Medicine

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12 Corresponding Author: Dr Alex Elliot, Real-time Syndromic Surveillance Team, Public  
13 Health England, 6<sup>th</sup> Floor, 5 St Philips Place, Birmingham B3 2PW. +44 (0)121 232 9211;  
14 [alex.elliott@phe.gov.uk](mailto:alex.elliott@phe.gov.uk)

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20 **Abstract**

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

## 33 **Background**

34 Syndromic surveillance is the near real-time collection, analysis, interpretation and  
35 dissemination of health-related data to enable the early identification of the impact (or  
36 absence of impact) of potential health threats which may require public health action.<sup>1</sup> Public  
37 Health England (PHE) coordinates a programme of real-time syndromic surveillance across  
38 England and operates four national syndromic surveillance systems: general practitioner  
39 (family physician) in hours (GPIH) and general practitioner out of hours (GPOOH)  
40 consultations, sentinel emergency department attendances (EDSSS) and calls to a national  
41 telephone health line (NHS 111).<sup>2-4</sup> Data are collected, analysed, interpreted and assessed on  
42 a daily basis using statistical algorithms incorporating a multi-level hierarchical mixed effects  
43 model that compares contemporaneous data to historical data to identify statistically  
44 significant excess activity.<sup>5</sup> Data are aggregated into ‘syndromic indicators’ based upon  
45 symptoms and/or clinical diagnosis of disease (e.g. diarrhoea, acute respiratory infection),  
46 and trends and key public health messages are published on a weekly basis.<sup>6</sup>

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

52 In order that a national syndromic surveillance service is underpinned by scientifically valid  
53 and rigorous methods, it is important to ensure that there is a strong link with academia.  
54 Within the field of syndromic surveillance in the UK there has been an absence of a  
55 consistent and structured link between public health service activities and academia. Often,  
56 good quality syndromic surveillance research is undertaken in isolation in the academic  
57 setting with the benefits of this research not being translated into public health systems and  
58 practice. Likewise, syndromic surveillance ‘service’ work undertaken within the public health  
59 setting can be isolated from the potential benefits of linking with academic research groups.  
60 Public health organisations can provide access to health-related data and expertise in  
61 infectious and non-infectious disease epidemiology and clinical interpretation of data.  
62 Academic research can optimise and further develop methodological rigour, intellectual  
63 clarity and establish routes for applying to external research funding bodies to attract money  
64 to fund projects. Together, these specialist competencies can complement each other to

65 enhance the public health benefits of syndromic surveillance. In this commentary we provide  
66 our ‘vision’ for the development of a multidisciplinary syndromic surveillance academic  
67 research programme, making the case for this approach and illustrating the progress that has  
68 been made in England to achieving this goal.

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

## 80 **Current PHE syndromic surveillance academic research programmes**

### 81 *Health Protection Research Units (HPRU)*

82 The National Institute for Health Research (NIHR) funds health and care research, translating  
83 discoveries into practical products, treatments, devices and procedures, involving patients and  
84 the public. During 2014, thirteen Health Protection Research Units (HPRUs) were established  
85 following an open competition launched in 2012.<sup>8</sup> The HPRUs act as centres of excellence in  
86 multidisciplinary health protection research in England. Each HPRU focuses on a priority  
87 area of health protection (e.g. gastrointestinal infections) and is underpinned by a research  
88 partnership between a number of universities and PHE. The role of the HPRUs is to support  
89 PHE in delivering its objectives and functions for the protection of the public’s health.  
90 Research funding was provided for a five-year period starting 1 April 2014.

### 91 *HPRU in Emergency Preparedness and Response*

92 Public health incidents and emergencies often present as complex events, requiring different  
93 teams to co-ordinate their efforts in order to protect people’s health. The HPRU in  
94 Emergency Preparedness and Response (EPR) brings together groups of scientific experts to  
95 allow the identification of emergencies, determine how many people have been affected,

96 what types of countermeasures may be needed, who is most vulnerable and how to protect the  
97 physical and mental health of victims and emergency responders.<sup>9</sup> Syndromic surveillance  
98 plays an important role in this research and a research ‘theme’ within the EPR HPRU has  
99 been dedicated to quantifying the ability of existing syndromic surveillance systems to detect  
100 new outbreaks of disease or covert incidents involving a chemical, biological or radiological  
101 agent.<sup>10</sup> This theme also aims to assess whether new data links or novel statistical techniques  
102 (e.g. Bayesian Networks), or the inclusion of new data sources (e.g. social media) can  
103 enhance this surveillance activity.

#### 104 *HPRU research and syndromic surveillance*

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

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

125 Successes from this partnership are already beginning to appear (Table 1). In particular, the  
126 2015 possible *Cryptosporidium* exposure in the North West of England is a case in point  
127 where public health, epidemiology and academic experts collaborated to explore the potential

128 impact of media reporting in syndromic surveillance during this incident (Elliot et al. 2016,  
129 manuscript under review).

### 130 *Developing a central syndromic surveillance academic partnership*

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

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

154 In order to achieve these objectives, a strategy outline the aims of the collaboration and  
155 presents the short, medium and long term deliverables (Table 2). The example deliverables  
156 illustrate an innovative approach to integrating academic research into syndromic  
157 surveillance public health programmes. The approach taken in England has already  
158 contributed to a number of demonstrable benefits to the public health system, and it is  
159 anticipated that these benefits will expand as the collaboration matures (Table 2).

160 Whilst the establishment of such partnerships, as proposed, can be of significant benefit, it is  
161 usually not without significant challenges. In the fields of public health and academia,  
162 workloads are increasing against a backdrop of reducing funding and therefore finding the  
163 resource required to establish such partnerships, including developing strategies, terms of  
164 reference and management groups can be a challenge. It is therefore essential that such  
165 partnerships are based upon a genuine desire to collaborate rather than a business or  
166 contractual basis.

## 167 **The future**

168 The ‘vision’ and developments described in this paper are the primary steps towards the goal  
169 of integrating syndromic surveillance service related activities and academic research in  
170 England. The benefits and application of research findings to the PHE syndromic surveillance  
171 service are already demonstrable, however the next years will determine the overall success  
172 of this programme. Further expansion of the research agenda, developing a PhD and  
173 postdoctoral training programme and generating external funding to support research are all  
174 achievable medium and long term goals. PhD and postdoctoral researchers will integrate into  
175 the public health system, not just gaining access to syndromic surveillance data for research,  
176 but learning core public health skills and competencies and contributing to the delivery of the  
177 syndromic surveillance ‘service’. Another potential development is the establishment of  
178 international collaborations to share expertise and resource, particularly in countries with  
179 limited resources and where healthcare services do not support syndromic surveillance.  
180 Ultimately, building on the recent European Commission-funded Triple-S project,<sup>1</sup>  
181 developing a network of syndromic surveillance centres across Europe could be an  
182 achievable target, with ‘National Centres for Syndromic Surveillance Excellence’  
183 coordinating a harmonized approach to syndromic surveillance. Internationally there are  
184 other examples of syndromic surveillance collaboration and excellence, with particular  
185 reference to the International Society of Disease Surveillance (ISDS). ISDS has established a  
186 programme for coordinating collaboration amongst syndromic surveillance experts who may  
187 normally not interact but who, when brought together, can enable innovative approaches to  
188 public health problems and develop solutions that would not be possible without this  
189 collaboration.<sup>14</sup>

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

<b>Academic research area</b>	<b>Application/integration into public health</b>
Heatwave impact	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. <sup>13</sup>
Heatwave morbidity indicators	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. <sup>12</sup>
Air pollution impact	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. <sup>11</sup>
Incident scenarios	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).
European football tournament 2016: impact on health, including cardiovascular events	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).
Impact of media reporting on syndromic surveillance	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. <sup>15</sup>
Gastrointestinal infections	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).

256 **Table 2: Examples of short, medium and long term deliverables from the syndromic surveillance academic partnership between Public**  
 257 **Health England and the University of Liverpool and the expected outcomes.**

	<b>Short term (12-24 months)</b>	<b>Medium term (2-4 years)</b>	<b>Long term (5+ years)</b>
<b>Objective</b>	Memorandum of understanding between parties	Completed PhDs and ongoing programme of PhDs	Syndromic surveillance training programme for public health trainees
<b>Outcome</b>	Agreed collaborative principles and terms of reference for collaboration	Increased capacity for PHE and University	Increasing awareness of syndromic surveillance, integration into the public health training scheme and therefore local health protection
<b>Objective</b>	Establish a steering group to direct the collaboration	Regular syndromic surveillance scientific meetings/seminar programme	Centre for syndromic surveillance excellence attracting international placements
<b>Outcome</b>	Steer of project from range of experts	Dissemination of latest developments	Organisational reputation; international collaboration and coordination of projects
<b>Objective</b>	Honorary academic appointments for PHE syndromic surveillance staff	Jointly led research funding bids to attract funding to support research	-
<b>Outcome</b>	Professional development; improved capacity for University	Increased funding for PHE and University to support ongoing work	-
<b>Objective</b>	PhD studentship programme	-	-

<b>Outcome</b>	Training of future PHE specialists; improved capacity for PHE	-	-
<b>Objective</b>	Collaborative peer review publications	-	-
<b>Outcome</b>	Increased reputation and evidence base for syndromic surveillance	-	-

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