

Developing a national primary care-based early warning system for health protection—a surveillance tool for the future? Analysis of routinely collected data

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ABSTRACT

The increasing threat of infections with pandemic potential such as influenza has focussed attention on the information needed to inform those managing a pandemic. The Health Protection Agency, Nottingham University and EMIS have developed a new national health protection surveillance system using QRESEARCH, an established primary care-derived database, to provide timely and local information on trends in community illness and prescribing. This article describes the first year of the surveillance project. Data on consultations and prescribing were extracted from routinely generated computerized consultation records between November 2004 and December 2005. Weekly consultation and prescribing rates for a range of conditions including influenza-like illness and prescription of anti-viral drugs for influenza and vomiting were developed as 'key indicators'. These indicators were presented in a weekly bulletin showing data to strategic health authority level for use by those working in public health. The particular value of this scheme is the ability to produce timely data on illness to local level and to link prescribing to morbidity. The data were used 'real time' to reassure about lack of illness following the Buncefield Fuel Depot incident. This scheme is being further developed to provide daily local influenza-related information needed in an influenza pandemic.

Keywords health protection, primary care

Introduction

Most experts believe that it is not a question of whether there will be another severe influenza pandemic but when.¹ The increasing threat of emerging infections with pandemic potential such as influenza has focussed our attention on the primary care data which will be needed at national and local level to inform and help those managing a pandemic. In addition, concern about the use of bioterrorist agents and accidental toxic industrial releases underlines the need to be alerted, in a timely way, of an unusual increase in illness in the community.

There are several syndromic surveillance systems operating elsewhere in the world, especially in the United States, which are based particularly on emergency department data or over-the-counter pharmacy sales data.²⁻⁴

In the UK, there are several pre-primary care and primary care systems which provide information on illness in the community, for example, calls made to NHS Direct⁵ and the Royal College of General Practitioners' (RCGP) Weekly

Returns Service.⁶ Each of these systems provides important 'parts of the jigsaw' on community illness. However, there are key areas where information on acute morbidity in our community is lacking: there is no timely, routinely available information at a sub-regional level and no timely information on prescribing in the community linked to morbidity. The UK Influenza Pandemic Contingency Plan⁷ emphasizes the importance of timely, up-to-date surveillance for use by a variety of audiences at all levels (e.g. local, regional and national). One of the actions mentioned in the Plan to improve surveillance is to increase the coverage and fre-

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quency of reporting from general practice-based surveillance. Good population coverage (particularly covering London and other urban areas) is important for monitoring for possible chemical, biological, radiological and nuclear (CBRN) incidents. More localized information, below regional level, is necessary to be able to detect a confined increase in community illness, for example, such information was required in real time following the recent explosions and fire at the Buncefield Fuel Depot.

This article describes a collaborative project between the Health Protection Agency (HPA), University of Nottingham Division of Primary Care and EMIS to develop and implement a new national surveillance system using an established general practice research database (QRESEARCH) to monitor diseases/prescribing in the community for health protection purposes.

Methods

Description of the system

In 2002, the University of Nottingham Division of Primary Care (in collaboration with EMIS—the general practice computer system being used by 60% of general practices in England)⁸ created a new, primary care-derived database called QRESEARCH. The primary aim of QRESEARCH is to perform research and health analyses, and it is run as a non-profit-making venture.⁹ It contains coded data on the health needs, risks, care and outcome for a population of 3.8 million current patients,¹⁰ making it the largest such data set in Europe. A nationally representative sample of 525 volunteer practices contributes their data on an ongoing basis in return for comparative feedback on the quality of their data.¹¹ Some practices have up to 16 years of historical data on the database. Data are quality-assured, and census variables such as deprivation and rurality are uploaded onto the practice database. Patients and practices within the database are completely anonymous, and no personal/practice identifiers are recorded. The QRESEARCH database has been approved by Trent Multi-Centre Research Ethics Committee and the Patient Information Advisory Group, the Information Commissioner, The British Medical Association, the Royal College of General Practitioners (RCGP) and the General Practitioner Committee.

In 2004, a pilot collaborative project between the HPA and the Division of Primary Care at the University of Nottingham developed a set of 'key' conditions that could help to indicate a health protection problem. These conditions and prescriptions were aggregated into sets of Read codes [the codes were verified by both practicing general practitioners (GPs) and health protection epidemiologists]. At the beginning of the work, three 'key' indicators were developed

(influenza-like illness, influenza-like illness with prescription of anti-viral drugs and vomiting), although as the project has developed the scope of these indicators has been extended to include in addition: influenza vaccine uptake, pneumococcal vaccine uptake, upper and lower respiratory tract infections, pneumonia, severe asthma, wheeze, gastroenteritis, diarrhoea, oral rehydration therapy for children under 5 years with diarrhoea, measles, mumps, rubella, pertussis, impetigo, proportion of those with impetigo treated with fusidic acid and heatstroke.

National consultation data (first and new episodes only) on these conditions and prescribing are extracted weekly from the database and analysed using age, sex and strategic health authority (SHA) of residence. Confidence intervals (95%) are calculated for the incidence of each disease by SHA, and any SHA(s) with an incidence in excess of the upper 95% confidence limits are highlighted. A written bulletin is produced summarizing the activity during the previous week and comparing the data with the equivalent week of the previous year. During the pilot phase of this project (November 2004 to September 2005), the bulletin was distributed to a small number of people within the HPA to obtain feedback on the type and usefulness of the indicators used. Since October 2005, the bulletin has been distributed to all Health Protection Units in England, the HPA, people working in health protection in Wales, Scotland and Northern Ireland, Regional Directors of Public Health and others at the Department of Health. Feedback to the participating practices is being developed. If any indicator demonstrates an increase above expected at a national, regional or SHA level, then health protection consultants working on the project liaise with the relevant teams for the area advising of the increase and discuss whether further analyses to verify an alert or other public health action are warranted.

In addition to the routine weekly outputs described above, a series of more strategic projects have been established to examine morbidity and prescribing in greater detail. For example, the database is being used to examine uptake of influenza vaccine by underlying disease risk group and by socio-demographic status (results not presented here).

QRESEARCH has been validated using a number of methods,¹² for example, by comparing the rates of birth, death, consultation, prevalence and mortality with other data sources such as the General Household Survey and the General Practice Research Database (GPRD). The age/sex structure of the database has been compared with the 2001 Census and with the attribution data set for practices in England and Wales in 2004. There was good correspondence for all of these measures, although in some instances QRESEARCH values for prevalence were marginally higher than less recent

data. We have also compared practices taking part in regional research networks on the aforementioned measures and found good correspondence.¹³ For this work, we compared those indicators being monitored by other infectious disease surveillance systems, for example, influenza-like illness with the RCGP scheme.

Results

During the period November 2004 to December 2005, a mean of 296 practices contributed data to the scheme, covering an average registered practice population of 2.1 million. During the early stages of the pilot project, QRESEARCH was scaling up, and the technology to extract data was in its initial development phase. Towards the end of this period, the number of practices reporting each week increased to >450 with a registered practice population of 3.4 million.

The practices contributing to the database are well distributed across England and Wales with smaller numbers of practices from Scotland and Northern Ireland (Fig. 1).

It would not be possible to present the wide range of morbidity indicators in this section, thus this article gives results for the indicators developed in the initial pilot phase— influenza-like illness and anti-viral prescribing for influenza-like illness and vomiting. The use of the QRESEARCH data to help monitor the potential health effects of the Buncefield Fuel Depot explosion will also be described.

Influenza-like illness

During the 2004–05 influenza season, a season of low influenza activity, consultation rates for influenza-like illness were low and peaked at 28 per 100 000 in week 1 of 2005. The 2004–05 influenza activity occurred later than the 2003–04 activity, which peaked at 36.8 per 100 000 in week 47 of 2003 (Fig. 2).

An example of the data presented each week to regional and SHA levels in the weekly bulletin is summarized in Table 1. Any SHA with a significantly raised standardized incidence ratio (SIR) for the previous week is highlighted in the weekly table (Table 1). (For this article, we have used data from version 10 of the QRESEARCH database. The QRESEARCH database is periodically refreshed, and therefore data in version 10 are likely to be more complete and up-to-date than the data used for each of the bulletins at the time of their publication. The weekly bulletins are published using the most up-to-date data available at the time. Therefore, the data quoted in the text and used to construct the graphs may be different from those published in the weekly bulletins and hence in Table 1.)

The weekly bulletin also includes anti-viral drug prescribing for influenza, but as might be expected from the low

consultation rates for influenza, there was little anti-viral drug prescribing during the 2004–05 influenza season. During the season, in no SHA was there more than one prescription of anti-viral drug linked to an influenza diagnosis.

The consultation rates for influenza-like illness from the QRESEARCH database showed trends similar to the rates reported by the RCGP Weekly Returns Service, although the incidence rates for the QRESEARCH scheme were lower (Fig. 3).

Vomiting

The peak consultation rate for vomiting occurred in week 11 of 2005, coinciding with known periods of norovirus activity (Fig. 4). The apparent dip in consultations for vomiting during week 52 of 2004 (and week 52 of 2005) and week 1 of 2005 coincided with periods when the general practice surgeries are closed for part of the holiday weeks, and hence episode rates are spuriously low.

The Buncefield Fuel Depot Explosion

Following the explosions and subsequent fire at Buncefield, Hertfordshire in December 2005, incidence data (per 100 000) on wheeze, severe asthma, asthma admissions, pneumonia and upper and lower respiratory tract infections were provided for the relevant primary care trusts (PCTs) and SHAs to the incident team. The data showed no unusual increases and were used ‘real time’, alongside other primary and secondary care data, to reassure those managing the incident that there had been no increase in illness in the areas close to the fire.

Discussion

Main findings of this study

This study establishes the potential of using electronic coded records from general practice for health protection surveillance. The project has demonstrated the ability of the QRESEARCH database to provide timely information for health protection surveillance. The added value of this system is its ability to link morbidity to prescribing information. This facility has been used to develop indicators for prescribing of anti-virals with influenza-like illness, the proportion with impetigo prescribed with fusidic acid and prescribing of oral rehydration therapy with diarrhoea.

What is already known on this subject

The UK Influenza Pandemic Contingency Plan⁷ emphasizes the importance of timely, up-to-date surveillance for use by a variety of audiences at all levels (e.g. local, regional and national).



Fig. 1 The distribution of contributing practices in England and Wales, July 2005. In July 2005, there were seven practices in Scotland and two practices in Northern Ireland, which are not shown on this map. The total number of practices in Wales cannot be split down into strategic health authority (SHA) due to the low number of practices reporting. This map is based on QRESEARCH database version 7. Copyright QRESEARCH 2005; Boundaries Copyright © Crown Copyright. All Rights Reserved (HPA-10016969 2005).

One of the actions needed to improve surveillance is to increase the coverage and frequency of reporting from general practice-based systems.

Existing primary care surveillance systems are not able to provide data below regional level, nor can they provide timely data linked to prescribing.

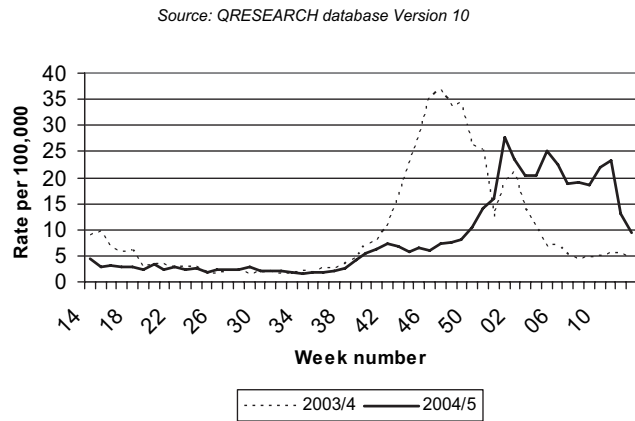


Fig. 2 Influenza-like illness: UK consultation rates 2003–04 and 2004–05.

What this study adds

This surveillance project is unique in the UK in being able to provide timely data on illness of health protection importance to a local (SHA) level. The scheme is national and has good coverage in areas ‘vulnerable’ to CBRN incidents, for example, London and major cities. The work has particular value in being able to provide timely prescribing information that can be linked to morbidity.

Importantly, this project uses automated extraction of routinely generated coded data with no added information, additional data input or verification requested of participating GPs. The work has ongoing input from those working in both the fields of primary care and health protection. This multi-agency input has two main benefits: (i) it enables the work to focus on areas of high priority for health protection purposes and to be integrated into a health protection response; (ii) it ensures input into interpretation from those with a working knowledge of how morbidity and prescribing data are recorded in the general practice setting.

Although data are currently extracted weekly, the work is being developed to enable extraction and analysis of data on a daily basis should this be necessary. In addition, the number of contributing practices is being expanded to enable presentation of data to PCT level. Daily data and local level data will be required in the event of an influenza pandemic and may be required in other emergencies such as the Buncefield explosions.

The trends in influenza-like illness mirror closely those obtained by established schemes including the RCGP Weekly Returns Service, although the actual incidence rates were lower for the QRESEARCH scheme. The reasons for the lower incidence rates may be that the QRESEARCH

scheme uses a wide range of practices, whereas the RCGP scheme has particular input from practices with a long record of contributing to, and providing specimens for, influenza surveillance. Validation work on this project continues, and further work will be presented as the project evolves.

Data on vomiting followed closely the trends in norovirus specimens (other than during the holiday periods when surgeries were closed for part of the week and vomiting episode rates were spuriously low).

Limitations of this study

Data are currently extracted only from practices using the EMIS system, although a similar methodology could be employed for other practice systems if the data extraction methodology were in place.

The project advises no ‘case definitions’ for the illnesses monitored but uses pre-defined sets of Read codes to extract illnesses which have been entered by the GP as part of routine work. The project group has tried to define these coding lists carefully with input from practicing GPs and health protection epidemiologists, the aim being to detect change in incidence of key illnesses from week to week, rather than to provide very specific incidence rates.

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Contributors

G.E.S. and J.H.C. led the conception, design and analysis of the article. J.H.C. is clinical custodian and co-founder of QRESEARCH. G.E.S. and S.E.H. wrote the first draft. All authors revised the manuscript. The article has been approved and read by all authors. G.E.S. and J.H.C. are guarantors for this article.

Ethical approval

QRESEARCH has been approved by Trent Multi-Centre Research Ethics Committee.

Table 1 Example of a table from the weekly bulletin showing data on influenza-like illness and pneumonia presented to regional and strategic health authority (SHA) levels

Week commencing 5 December 2005

Country, region and SHA	Denominator pop	Table 1: Influenza-like illness			Table 1: Pneumonia		
		Observed number of cases	Rate per 100 000	SIR (95% upper and lower confidence limits)	Observed number of cases	Rate per 100 000	SIR (95% upper and lower confidence limits)
<i>Scotland</i>	—	—	—	—	—	—	—
<i>North West</i>	282 601	30	10.6	112.1 (76.5–161.5)	4	1.4	87.6 (26.7–236.3)
Cumbria and Lancashire	97 795	5	5.1	54.0 (19.1–131.6)	3	3.0	189.9 (45.9–591.1)
Greater Manchester	80 824	8	9.8	104.5 (47.5–212.3)	1	1.2	76.6 (3.2–478.6)
Cheshire and Merseyside	103 982	17	16.3	172.6 (102.8–280.8)	0	0.0	0.0 (0.0–0.0)
<i>North East</i>	160 225	20	12.4	131.8 (82.0–206.4)	3	1.8	115.9 (28.0–360.8)
Northumberland and Tyne and Wear	141 105	17	12.0	127.2 (75.8–206.9)	2	1.4	87.7 (13.7–343.7)
County Durham and Tees Valley	—	—	—	—	—	—	—
<i>Yorkshire and Humberside</i>	283 069	19	6.7	70.8 (43.5–112.3)	3	1.0	65.6 (15.8–204.2)
North and East Yorkshire and Northern Lincolnshire	158 622	4	2.5	26.6 (8.1–71.8)	2	1.2	78.0 (12.2–305.8)
West Yorkshire	87 229	12	13.7	145.2 (77.6–259.3)	1	1.1	71.0 (3.0–443.4)
South Yorkshire	37 218	3	8.0	85.1 (20.6–264.9)	0	0.0	0.0 (0.0–0.0)
<i>East Midlands</i>	461 721	44	9.5	100.6 (73.7–136.0)	6	1.2	80.4 (31.7–181.9)
Trent	280 148	18	6.4	67.8 (41.1–108.8)	6	2.1	132.6 (52.3–299.8)
Leicestershire, Northamptonshire and Rutland	181 573	26	14.3	151.1 (100.2–223.9)	0	0.0	0.0 (0.0–0.0)
<i>West Midlands</i>	224 071	27	12.0	127.2 (85.0–187.0)	3	1.3	82.9 (20.0–258.0)
Shropshire and Staffordshire	62 900	7	11.1	117.5 (50.2–250.4)	0	0.0	0.0 (0.0–0.0)
Birmingham and the Black Country	105 149	10	9.5	100.4 (50.1–189.4)	3	2.8	176.6 (42.7–549.8)
West Midlands South	56 022	10	17.8	188.4 (94.1–355.4)	0	0.0	0.0 (0.0–0.0)
<i>East of England</i>	194 515	15	7.7	81.4 (46.8–136.7)	1	0.5	31.8 (1.3–198.9)
Norfolk, Suffolk and Cambridgeshire	89 870	6	6.6	70.5 (27.8–159.4)	0	0.0	0.0 (0.0–0.0)
Bedfordshire and Hertfordshire	84 253	9	10.6	112.8 (54.0–220.1)	0	0.0	0.0 (0.0–0.0)
<i>Essex</i>	—	—	—	—	—	—	—
<i>South East</i>	310 038	20	6.4	68.1 (42.4–106.6)	14	4.5	279.5 (157.2–478.0)
Surrey and Sussex	80 448	6	7.4	78.7 (31.0–178.1)	6	7.4	461.6 (182.0–1044.1)
Thames Valley	135 346	9	6.6	70.2 (33.6–137.0)	4	2.9	182.9 (55.8–493.3)
Hampshire and Isle of Wight	48 422	4	8.2	87.2 (26.6–235.2)	4	8.2	511.3 (156.1–1378.9)
Kent and Medway	45 822	1	2.1	23.0 (1.0–144.0)	0	0.0	0.0 (0.0–0.0)
<i>London</i>	334 545	38	11.3	119.9 (85.7–165.9)	1	0.2	18.5 (0.8–115.6)
North East London	77 256	9	11.6	123.0 (58.9–240.0)	0	0.0	0.0 (0.0–0.0)
North Central London	68 599	6	8.7	92.3 (36.4–208.8)	0	0.0	0.0 (0.0–0.0)
North West London	41 499	6	14.4	152.6 (60.2–345.2)	0	0.0	0.0 (0.0–0.0)
South East London	94 988	9	9.4	100.0 (47.9–195.2)	1	1.0	65.2 (2.7–407.2)
South West London	52 203	8	15.3	161.8 (73.6–328.6)	0	0.0	0.0 (0.0–0.0)
<i>South West</i>	377 289	39	10.3	109.1 (78.3–150.3)	8	2.1	131.2 (59.7–266.6)
Avon, Gloucestershire and Wiltshire	176 213	17	9.6	101.8 (60.7–165.7)	4	2.2	140.5 (42.9–378.9)
Dorset and Somerset	141 303	12	8.4	89.6 (47.9–160.0)	3	2.1	131.4 (31.7–409.1)
South West Peninsula	59 773	10	16.7	176.6 (88.2–333.1)	1	1.6	103.5 (4.3–647.1)
<i>Wales</i>	64 792	4	6.1	65.2 (19.9–175.7)	0	0.0	0.0 (0.0–0.0)

Table 1 Continued

Week commencing 5 December 2005

Country, region and SHA	Denominator pop	Table 1: Influenza-like illness			Table 1: Pneumonia		
		Observed number of cases	Rate per 100 000	SIR (95% upper and lower confidence limits)	Observed number of cases	Rate per 100 000	SIR (95% upper and lower confidence limits)
Northern Ireland	—	—	—	—	—	—	—
All England	2 628 074	252	9.5	101.2 (89.2–114.7)	43	1.6	101.3 (73.9–137.4)
UK	2 723 288	258	9.4	100.0 (88.3–113.1)	44	1.6	100.0 (73.3–135.2)
Unclassified	69 934	5	7.1	75.5 (26.8–184.1)	3	4.2	265.5 (64.1–826.6)

Shaded cells indicate a significantly high standardized incidence ratio (SIR).

Source: QRESEARCH database version 10 and RCGP Weekly Returns Service

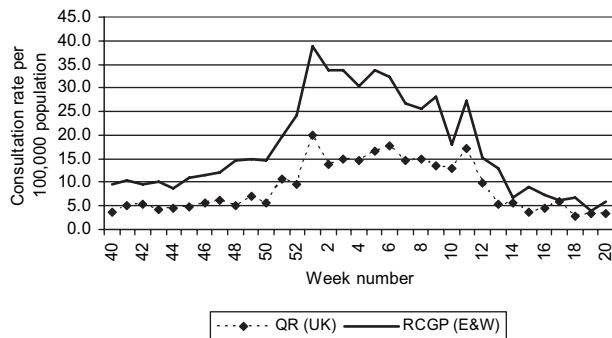


Fig. 3 Consultations for influenza-like illness QRESEARCH compared with the Royal College of General Practitioners' (RCGP) Weekly Returns Service, winter 2004–05.

Source: QRESEARCH Database Version 10 and LabBase

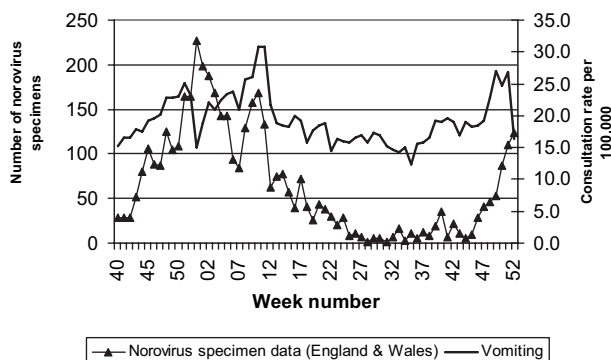


Fig. 4 UK consultation rates for vomiting, November 2004 to December 2005, and number of Norovirus specimens (England and Wales).

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Competing interests

J.H.C. is an unpaid director of QRESEARCH, which is 50% owned by the University of Nottingham and 50% owned by EMIS. It is possible that the publication of this work will further raise the profile of QRESEARCH and EMIS. All other authors declare that they have no competing interests.

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