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Antiviral distribution data – a potential syndromic surveillance system to assist pandemic health service operational planning

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Abstract

A pilot study was conducted in rural northern New South Wales from 15 July to 28 August 2009, during Australia's Protect Phase response to the Influenza A H1N1 California 7/09 pandemic. This study explored the feasibility of using administrative data, generated from the distribution of stockpiled antivirals, as a syndromic surveillance system. The purpose was to identify recently affected towns or those with increasing influenza-like illness activity to assist in rural health service operational planning. Analysis of antiviral distribution data was restricted to 113 general practices in rural parts of the Hunter New England Area Health Service. By 2 September 2009 a total of 6,670 courses of antivirals for adults, of which 455 courses were replacement orders, had been distributed to these general practices. Distribution of replacement antivirals were mapped to local government areas on a weekly basis. The syndromic surveillance system delivered timely data on antiviral distribution; used readily available software to generate visual activity maps in less than 30 minutes; proved adaptable; was of low cost; and was well received by health service planners. Full evaluation of the system's utility was limited by the relatively large initial distribution of antivirals and the brief nature of Australia's first pandemic wave. The pilot study demonstrated that a syndromic surveillance system based on distribution of supplies, such as treatment or vaccines, can support local health service operational planning during health emergencies. *Commun Dis Intell* 2010;34(3):303–309.

Keywords: pandemic influenza, antiviral, syndromic surveillance, health service planning

Introduction

The World Health Organization global pandemic alert level was raised to Phase 6 on 11 June 2009,[1] indicating a global pandemic was underway and that it was considered no longer possible to contain the novel pandemic Influenza A H1N1 California 7/09 (pH1N1) virus within a particular geographical area. On 17 June 2009, the Australian Government announced a change in its pandemic response from the Contain Phase to the Protect Phase.[2] The newly developed Protect Phase focused on treating and caring for individuals who were more vulnerable to a severe outcome from pH1N1.

Antiviral medication was distributed from State and Commonwealth medical stockpiles during the Contain and Protect phases. Antiviral usage in the Contain Phase targeted the treatment of suspected pH1N1 cases and prophylaxis of individuals in close contact with suspected cases. In New South Wales, antivirals were mostly dispensed from hospital emergency departments with authorisation from public health units. In contrast, antiviral usage in the Protect Phase aimed to reduce disease impact through treatment of individuals with influenza-like illness (ILI) who were classified as being in defined vulnerable groups. During this phase in New South Wales, antivirals were dispensed through both hospitals and primary health care providers (PHCPs), including general practices and Aboriginal Medical Services.[3]

A pilot study was conducted during the Protect Phase in the Hunter New England (HNE) region of northern New South Wales to explore the feasibility of using data generated from the distribution of stockpiled antivirals for syndromic surveillance. Replacement orders of antivirals were only distributed to PHCPs once a line-list of patients who had received antivirals was provided. Thus replacement orders could be used to measure antiviral usage and serve as a proxy for local ILI activity. It was assumed that PHCPs adhered to the vulnerable group criteria, as defined in the Protect Phase plan, for dispensing antivirals and that they were experienced in ILI diagnosis.

This system aimed to assist rural HNE health services operationally plan their response to pH1N1 through early identification of towns recently affected via rapidly mapping increases in antiviral distribution. If successful, it could permit public health investigation and surging of area health service (AHS) and divisions of general practice resources in a timely manner.

Methods

Distribution of stockpiled antivirals in New South Wales during the pandemic response in 2009

The distribution of antiviral medication by the NSW Department of Health (NSW Health) occurred through the State Vaccine Centre (SVC), a well established system used for routine vaccine distribution throughout New South Wales. The antiviral distribution data were stratified by each quantity distributed to a PHCP and circulated daily as a Microsoft Excel spreadsheet from the SVC to NSW Health and from NSW Health to each AHS. All New South Wales PHCPs which ordered antivirals received an initial antiviral pack of 50 adult courses of oseltamivir (Tamiflu®) and 5 adult courses of zanamivir (Relenza®), regardless of the initial amount of antivirals ordered. Thus each initial antiviral pack contained 55 adult courses.

Data analysis

In HNE, a total of 261 PHCPs received an initial antiviral pack, including 249 general practices, 8 HNE Aboriginal Medical Services, 3 HNE Student Health Services and 1 HNE Nursing Home. Analysis of antiviral distribution data was restricted to 113 general practices in rural areas of HNE. Patients in urban areas of Newcastle and Lake Macquarie had ready access to 4 large public hospitals, community pharmacies and PHCPs, to obtain antivirals. This level of access was not available in rural HNE and therefore the distribution of antivirals to PHCPs was more likely to be representative of pH1N1 activity.

The number of full-time equivalent (FTE) General Practitioners (GPs) working in each general practice was obtained from the 4 divisions of general practice serving rural HNE. Due to privacy concerns certain divisions provided FTE data by geographical area (e.g. at the town level), rather than for a specific practice. Where this occurred the FTEs were allocated on a proportional basis to each practice in that geographic area. This allowed comparison of replacement antiviral distribution by general practice, town or Local Government Areas (LGA).

LGAs are a commonly used geospatial area in Australia. It was assumed that the demographic characteristics within an LGA were similar and that most residents would seek medical services from within that LGA. This allowed identification of differences in replacement antiviral rates between LGAs and between individual towns within a single LGA, thus alerting health planners to recent changes in ILI activity at a local level.

Using the statistical software SAS,[4] a program was developed that managed data for rural HNE general practices, removed duplicate entries, and assigned the number of FTE GPs to each general practice. Two outputs were generated from the program: a) the cumulative total of replacement antivirals distributed to each general practice, until 2 weeks prior to analysis; and b) the total replacement antivirals distributed to each general practice during the 2 weeks preceding analysis.

MapInfo[5] was used to display the surveillance system results. Geospatial data for HNE LGAs were combined with the SAS outputs to produce the following two data displays:

- The town replacement antiviral rate was displayed as town indicator using relative size and shaded classifications (Map 1). This reflected the average number of replacement antivirals per FTE GP distributed to that town during the 2 weeks preceding analysis. The same rate categories used for the LGA classifications were applied to allow comparison.

- The LGA replacement antiviral rate was displayed by shaded classification of LGAs (Map 2). This reflected the total number of replacement antivirals per FTE GP distributed to general practices in that LGA, until 2 weeks prior to analysis. MapInfo used 1 standard deviation increments bounded by the minimum and maximum values of the sample to determine the rate categories.

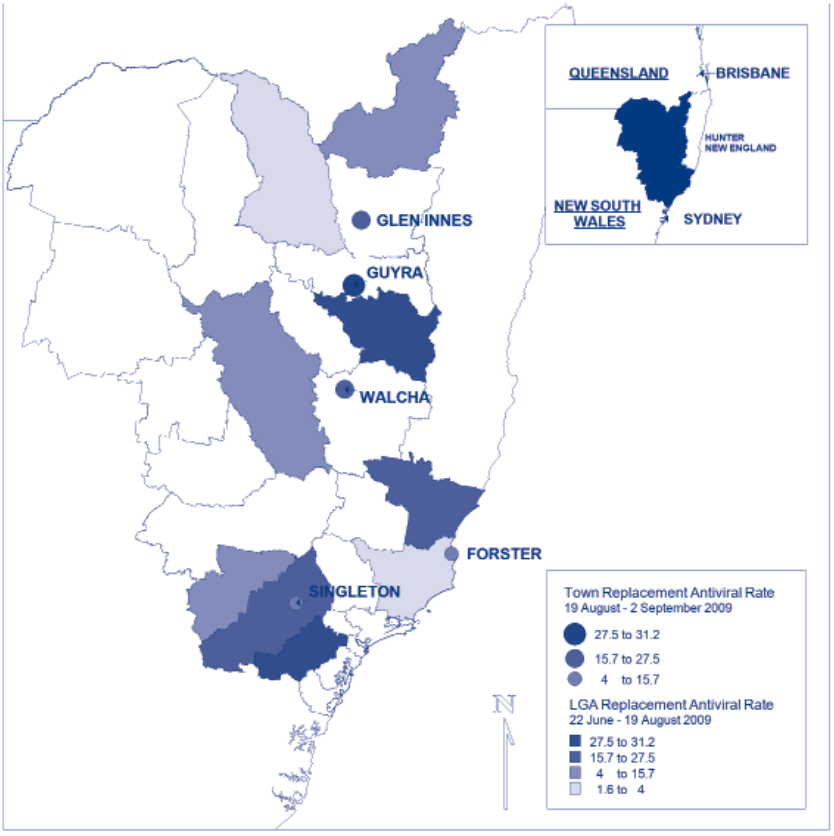
The mapping output was presented to the Area Health Service Pandemic Incident Controller and Divisions of general practice at regular operational planning meetings.

Results

The distribution of antivirals to rural HNE general practices (Figure 1) commenced on 22 June 2009 and by 2 July 2009, 9 working days later,

Map 1: Antiviral distribution in rural Hunter New England during the Protect Phase, 31 July 2009

Map 2: Antiviral distribution in rural Hunter New England during the Protect Phase, 2 September 2009



distribution of an initial antiviral pack had occurred to 82% (93/113) of rural HNE general practices; a total of 5,060 adult courses of antivirals. Following this, further initial antiviral packs were distributed, totalling 1,155 adult courses of antivirals.

The first distribution of replacement antivirals to rural HNE general practices occurred on 20 July 2009 and by 2 September 2009, 27 rural HNE general practices had been distributed replacement antivirals, representing a total of 455 adult courses. By 2 September 2009 a total of 6,670 adult courses of antivirals had been distributed to rural HNE general practices; approximately 5% of the antivirals distributed by the SVC in New South Wales.

Development and implementation of this pilot surveillance system occurred from 15 July to 2 September 2009. It delivered timely data on antiviral distribution, once replacement orders had been processed by the SVC. The system proved to be efficient with weekly data processing, statistical analysis and map generation taking less than 30 minutes.

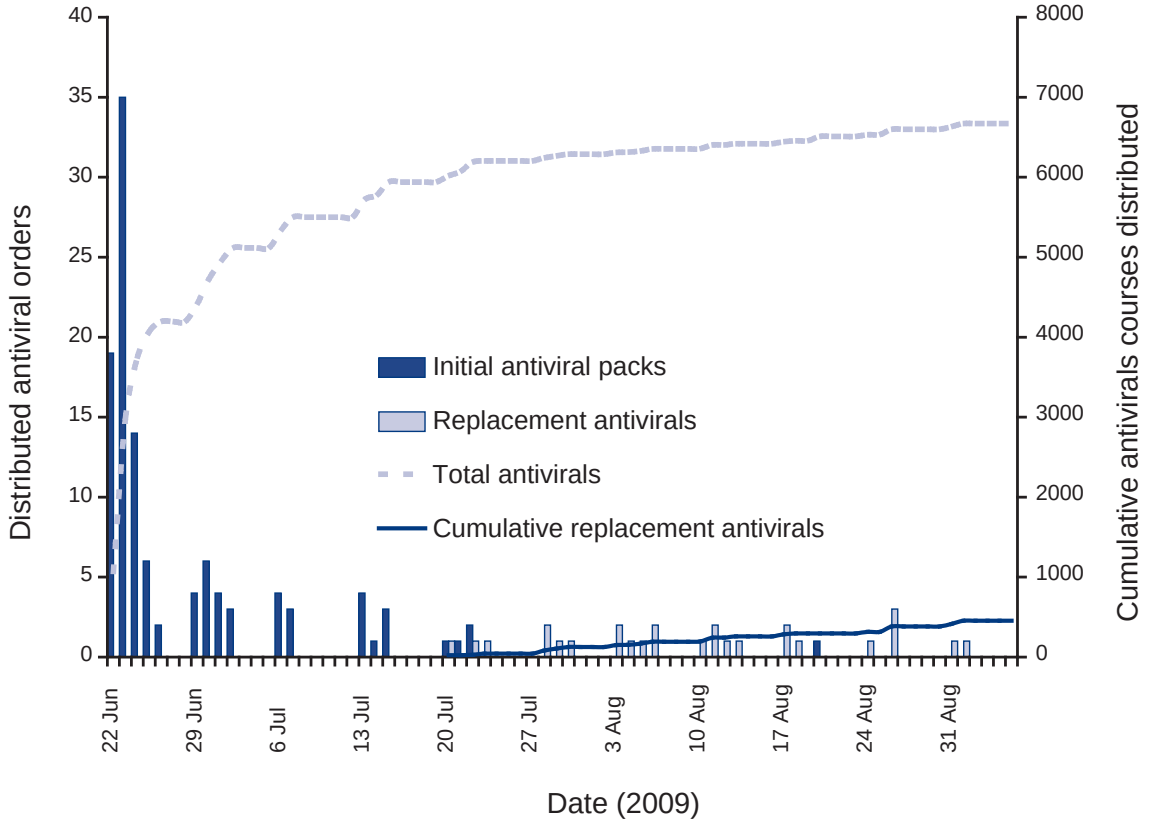
Recent change in ILI activity was noted on 31 July in Armidale, Cessnock, Taree, Muswellbrook and Singleton (Map 1). This result represented the first distribution of replacement antivirals to these towns. On 2 September, a recent change in ILI activity in Guyra was noted, with activity also prominent in Glen Innes, Walcha and Forster (Map 2). Singleton demonstrated a decrease in the replacement antiviral rate compared with the LGA replacement antiviral rate.

Discussion

This pilot surveillance system used existing administrative antiviral distribution data, which were available almost immediately. It was able to identify the spread and burden of ILI in vulnerable groups judged by GPs as requiring antiviral treatment within rural HNE. The system had similarities to a pilot syndromic surveillance system developed in Japan using over–the-counter influenza medication sales to describe influenza activity.[6] Both systems used pre-existing rapidly available data, which placed only a small burden on public health resources.

The described system was low cost. It used readily available software to generate visual activity maps, was easily customised to local needs, and was well received by health service planners. It

Figure 1: Antivirals distributed to rural Hunter New England general practices during the Protect Phase, 2 September 2009



could potentially be used for surveillance of any prolonged health emergency that requires distribution of a product.

Management of surveillance information during a pandemic is challenging because of the need to use multiple sources of imperfect data, with certain data items changed in response to the public health needs of an evolving pandemic.[7] Comprehensive influenza surveillance requires a number of complementary surveillance methods.[8] During pandemics, this may include 'conventional' methods used for seasonal influenza surveillance and 'novel' surveillance methods to more rapidly understand evolving situations and build more accurate 'surveillance pyramids'.[9] In addition to laboratory data and systems that capture ILI activity in health services, pandemic responses produce administrative data that can be used for surveillance. Intelligent use of all available data is essential to allow appropriate deployment of resources to best respond to demands on the health system.

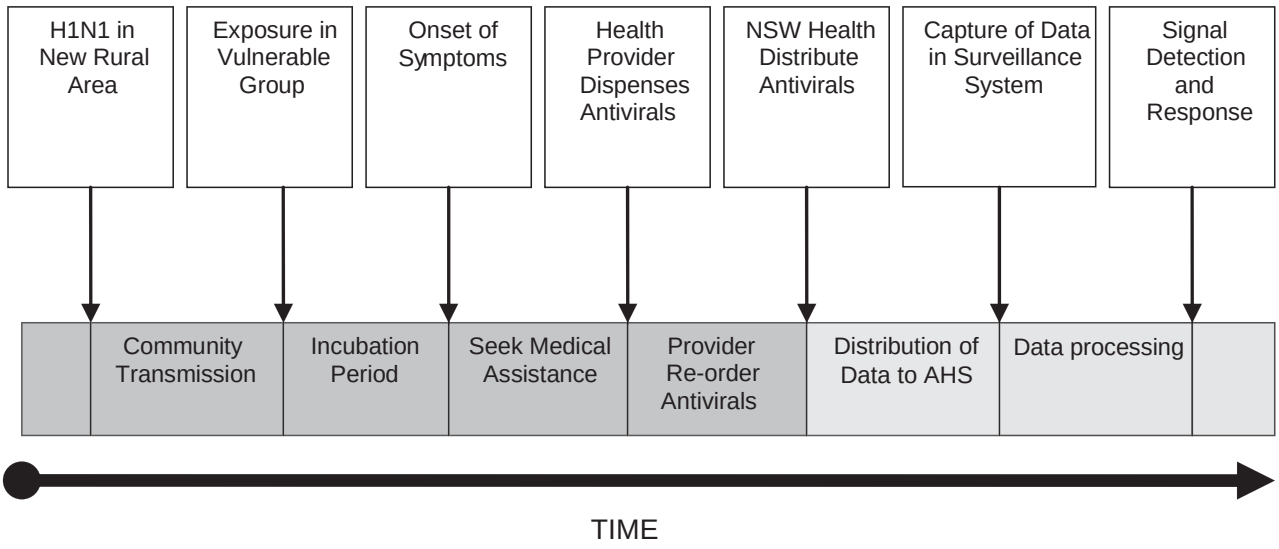
Syndromic surveillance (as defined by Henning)[10] has been used to detect outbreaks early; to monitor the size, geographic distribution, and evolution of outbreaks; to monitor disease trends; or provide reassurance that an outbreak has not occurred in high risk settings such as a mass event or following a natural disaster.[10–13] The piloted syndromic surveillance system, shows promise as a contributor to health system planning during appropriate emergency events.

The relatively large initial distribution of antivirals during the response to pH1N1 limited the sensitivity and evaluation of this piloted system. It is worth noting that the method of distribution chosen by NSW Health, through the SVC, appeared extremely efficient, with 82% of the initial antiviral medication distributed to HNE rural general practices occurring within 9 working days. Additionally, the relatively brief nature of Australia's first pandemic wave, with return to baseline influenza activity within 18 weeks,[14] meant that most general practices had dispensed little of the initial supply of antivirals and thus had not needed replacement antivirals. With a low number of general practices ordering replacement antivirals and no requirement to report progressive usage, the true antiviral usage remains unknown. The first replacement antivirals were distributed on 20 July, which was after the New South Wales peak of pH1N1 positive laboratory tests on 10 July 2009.[15]

Ideally the distribution of medical supplies should correspond closely to their demand, as this would ensure that adequate supplies of essential medicines are provided, prevent wastage of valuable resources and provide useful data for surveillance. If this is not possible, due to logistics or other reasons, then strict requirements for reporting of usage would ensure accountability and allow assessment of supply and demand. During this response the line-lists of patients who had received antivirals, which were required for ordering replacement antivirals, were unfortunately not collected or stored in a usable manner. Availability of these data would have allowed for a more sensitive and informative surveillance system as well as allowing for evaluation.

The contributors to completeness, representativeness and timeliness of the system are depicted in Figure 2. It is clear that personal knowledge of existing high risk medical conditions, community

Figure 2: Flow chart of contributors to completeness, representativeness and timeliness for antiviral distribution surveillance system



awareness and perceptions of disease severity, access to general practice, individual practitioners ability to assess patient risk and willingness to dispense antivirals, and availability of antivirals would all affect the representativeness and timeliness of the system. These factors would impact on any other PHCP surveillance system. The fact that the majority of rural HNE general practices were participating in the distribution of stockpiled antivirals to vulnerable groups provided reassurance of system coverage.

There is potential for further refining alert levels for individual towns and for establishing the ideal historical comparison period for each locality, factors that could not be adequately evaluated due to the study limitations. In addition, if used in a protracted emergency, the comparison LGA rates would need to be adjusted to reflect activity over a recent time period, rather than the entire emergency, to permit recognition of recent changes. The system was unable to be fully validated due to the absence of an appropriate dataset. Flutracking[16] data were unable to be used due to the relatively small number of participants within each LGA. Furthermore, due to laboratory capacity constraints, testing was scaled down in primary care (GPs) towards the end of the Delay Phase and restricted to individuals requiring hospitalisation. Thus laboratory test results did not allow validation either. We are not aware of any other dataset that would serve as a gold standard.

This syndromic surveillance system, as implemented during the Protect Phase, was biased towards ILI presentations of greater severity in higher risk groups and thus not fully representative of the introduction and spread of pandemic influenza into new populations and areas. Although it is theoretically possible to stratify by the estimated population prevalence of underlying risk factors, the primary purpose of the system was to monitor the burden on PHCPs thereby allowing rapid detection of increased activity that might require surging of emergency department or general practice resources. Thus this bias towards more severe presentations was a useful feature of the system.

Conclusions

The pilot study has demonstrated the concept used in this system has the potential to support rural health service planning during protracted health emergencies that require distribution of medical supplies. However, there is a need to gain further experience in other settings and during future events. Ideally, the distribution of medical supplies should correspond closely to their demand. This would ensure that adequate supplies of essential medicines are provided, prevent wastage of valuable resources and provide useful data for surveillance. This is certainly possible when an efficient logistic supplier, such as the SVC in New South Wales, is utilised. This type of system may complement other surveillance systems in tracking the epidemiology of a particular infectious disease threat and support planning at a local level.

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References

1. New influenza A (H1N1) virus: global epidemiological situation, June 2009. *Wkly Epidemiol Rec* 200919;84(25):249–257.

2. Australian Government, Department of Health and Ageing. Media Release from the Minister of Health and Ageing, Nicola Roxon, 17 June 2009. Available from: http://www.health.gov.au/internet/ministers/publishing.nsf/Content/mr-yr09-nr-nr082.htm?OpenDocument&yr=2009&mth=6

3. Australian Government, Department of Health and Ageing. Annex to the Australian Health Management Plan of Pandemic Influenza: Protect Phase. 2009.

4. SAS 9.1, SAS Institute Inc., SAS Campus Drive, Cary, North Carolina 27513, USA.

5. MapInfo 10.0, Pitney Bowes Software Inc, One Global View, Troy, New York,12180, USA.

6. Ohkusa Y, Shigematsu M, Taniguchi K, Okabe N. Experimental surveillance using data on sales of over-the-counter medications—Japan, November 2003–April 2004. *MMWR Morb Mortal Wkly Rep* 2005;54(Suppl):47–52.

7. Muscatello DJ, Cretikos MA, Bartlett MJ, Churches T, Carter IW, Eastwood K, et al. Planning for pandemic influenza surveillance in NSW. *N S W Public Health Bull* 2006;17(9–10):146–149.

8. Parrella A, Dalton CB, Pearce R, Litt JC, Stocks N. ASPREN surveillance system for influenza-like illness – A comparison with FluTracking and the National Notifiable Diseases Surveillance System. *Aust Fam Physician* 2009;38(11):932–936.

9. Armstrong P, Chant K. Preparing for the next influenza pandemic: a New South Wales perspective. *N S W Public Health Bull* 2006;17(7–8):114–117.

10. Henning KJ. What is syndromic surveillance? *MMWR Morb Mortal Wkly Rep* 2004;53(Suppl):5–11.

11. Hope K, Merritt T, Eastwood K, Main K, Durrheim DN, Muscatello D, et al. The public health value of emergency department syndromic surveillance following a natural disaster. *Commun Dis Intell* 2008;32(1):92–94.

12. Hope K, Durrheim DN, Muscatello D, Merritt T, Zheng W, Massey P, et al. Identifying pneumonia outbreaks of public health importance: can emergency department data assist in earlier identification? *Aust N Z J Public Health* 2008;32(4):361–363.

13. Hope K, Durrheim DN, d'Espaignet ET, Dalton C. Syndromic Surveillance: is it a useful tool for local outbreak detection? *J Epidemiol Community Health* 2006;60(5):374–375.

14. Bishop JF, Murnane MP, Owen R. Australia's winter with the 2009 pandemic influenza A (H1N1) virus. *N Engl J Med* 2009;361(27):2591–2594.

15. Progression and impact of the first winter wave of the 2009 pandemic H1N1 influenza in New South Wales, Australia. *Euro Surveill* 2009;14(42). Pii 19365.

16. Dalton C, Durrheim D, Fejsa J, Francis L, Carlson S, d'Espaignet ET, et al. 'Flutracking: a weekly Australian community online survey of influenza-like illness in 2006, 2007 and 2008.' *Commun Dis Intell* 2009;33(3):316–322.