A Brief Review of Influenza Surveillance Systems in Australia, 2013

Sheena G. Sullivan, Lucinda J. Franklin, Kate Pennington, Rachel de Kluyver, Jane Raupach and the National Influenza Surveillance Committee, for the Communicable Diseases Network Australia

Introduction

The World Health Organization (WHO) has estimated that worldwide 5-15% of the population are affected by influenza each year, including three and five million cases of severe illness and about 250,000 to 500,000 deaths [1]. In Australia , it has been estimated that the disease is associated with 36 respiratory and 1,400 all-cause deaths [2], 18,000 hospitalisations and over 300,000 general practice consultations [3] each year. The morbidity, mortality and subsequent economic burden of influenza epidemics vary annually. Although typically falling within the winter months in Australia, the onset and severity of annual epidemics varies and are associated with the circulating strains and vaccine composition. Therefore, surveillance is needed to guide prevention and controls efforts.

In Australia, the National Influenza Surveillance Scheme (the Scheme) began in 1994. Its objectives are to:

- ensure the early detection of influenza epidemics;
- trigger public health prevention and control activities;
- characterise the epidemic, especially identification of risk groups and disease severity;
- estimate the impact of the epidemic;
- characterise the circulating viruses to inform vaccine virus selection and assess the effectiveness of antiviral medications; and
- ensure flexibility to enable adaptability for responding to additional surveillance requirements during a pandemic or particularly severe season.

The Scheme is currently guided by the *Enhanced Influenza Surveillance Framework for Australia* developed by the Communicable Diseases Network of Australia (CDNA) after the rather severe 2007 influenza season. Ongoing monitoring and enhancement of the Framework is co-ordinated by the National Influenza Surveillance Committee (NISC), a subcommittee of CDNA. The Scheme is supported by a number of government and other surveillance systems which combine to monitor influenza severity, transmission and virology. These systems capture influenza activity in the community, GP clinics, emergency departments and hospitals, as well as influenza-associated deaths and laboratory- based virological surveillance. This paper provides a brief overview of influenza

surveillance systems which form the Scheme in 2013 and describes their respective strengths and limitations in informing the national picture of influenza activity. The Scheme is coordinated by the Australian Government Department of Health (AGDH) and influenza activity monitored through its systems is reported in the Australian Influenza Surveillance Report (AISR), which is published fortnightly during the influenza season. For a more detailed description and analysis of the Scheme, including surveillance systems that function outside of the Scheme, readers are referred to the paper *A Review of Influenza Surveillance Systems in Australia, 2013*[4].

National notifiable diseases

The primary source of influenza activity data across Australia is laboratory-confirmed notifications forwarded to the National Notifiable Diseases Surveillance System (NNDSS) on a daily basis. Under state and territory public health legislation, notifications are initially made to jurisdictional health authorities by laboratories and, in some states, medical practitioners. Aggregated data are available online and more detailed data can be requested from CDNA. An agreed surveillance case definition and core data specifications ensure national consistency in case counting and quality data on person, place and time. The system is considered acceptable, simple and valuable by stakeholder groups [5]. The quality and completeness of these data are affected by a range of factors including healthcare seeking behaviours of patients, testing and notification practices and case follow-up by jurisdictional health departments. The impact of these factors on the notified fraction (the cases notified as a proportion of all cases occurring in the community) varies over time and across jurisdictions and makes year on year comparisons difficult [6].

Community surveillance

Influenza-like illness (ILI) is widely used as a surrogate measure for influenza infection. Definitions vary, but typically include fever, cough, myalgia, sore throat or some combination of these symptoms [7, 8]. Two systems in Australia monitor ILI: FluTracking and the National Health Call Centre Network (NHCCN).

FluTracking, established in 2006, is an online health surveillance system in which participants are surveyed weekly, via email, during the influenza season regarding any ILI experienced by themselves or nominated household members [9, 10]. The information collected includes specific symptoms, absence from normal duties, medical consultation, clinical or laboratory diagnosis of influenza and influenza vaccination status. Over 14,000 people participated during 2013.

The NHCCN has provided free, 24-hour health triage advice and information services by telephone since 2007. The network services all states and territories, except Victoria and Queensland. Registered nurses use electronic decision support software to provide advice to roughly 90,000 callers per month. Data collected include demographic details of the patients, presenting issue, diagnosis and final triage disposition. Selected diagnoses are used to monitor ILI.

ILI surveillance was used during the 2009 H1N1 influenza pandemic to demonstrate that community attack rates were no higher than most other years and suggested that much of the increase in influenza notifications was due to an increased health care seeking behaviour coupled with increased testing of those patients [11]. ILI surveillance is an imperfect surrogate indicator for influenza because it is a non-specific set of symptoms that may be due to a number of respiratory pathogens. Moreover, these two systems which monitor national ILI activity use differing definitions for ILI. These systems are also not representative since a large proportion of the people reporting to FluTracking are healthcare workers, and participation from each state is not uniform. Similarly the NHCCN is largely skewed towards young children [12] and does not include data from Victoria or Queensland.

General Practice sentinel surveillance

The largest General Practitioner (GP)-based influenza surveillance in Australia is the Australian Sentinel Practices Research Network (ASPREN). Established in 1991, the Network collects de-identified information on ILI and other conditions seen in general practice. All patients presenting with ILI at participating practices are enumerated, and, since 2010, around 20% are swabbed for laboratory confirmation. GPs submit data using a web-based form or a data extraction tool which utilises practice management software to extract relevant information. ASPREN aims to achieve a participant rate of one GP per 200,000 population in urban settings and one GP per 50,000 population in rural and remote settings.

Western Australia manages its own sentinel practices network (SPNWA, established 2007), as does Victoria (VicSPN, established 1993 with swab testing since 2007). All three systems collect information from swabbed patients, including vaccination status and high risk conditions, to enable calculation of vaccine effectiveness. In contrast participation targets, laboratory testing practices and data collection are variable which is a barrier to data pooling.

In Victoria, ILI consultations are also monitored by the National Home Doctor Service (NHDS), a medical locum service providing in-home care, while in New South Wales, ILI surveillance is carried

out in GP clinics in three local health districts. These data are used locally to track influenza activity, but are not included in the AISR.

Emergency department surveillance

Emergency department (ED) surveillance systems for influenza that inform the National Influenza Surveillance Scheme operate in New South Wales, the Northern Territory and Western Australia. Queensland and South Australia also operate ED surveillance however their data are not incorporated in the AISR. Like GP ILI surveillance, ED surveillance can indicate the ILI burden in the community, and may capture sectors of the community under-represented in GP surveillance, especially the very young [13, 14].

In New South Wales, ED surveillance commenced in 2003 and includes 59 urban and rural hospitals. Influenza is monitored using provisional diagnosis codes recorded by either an International Classification of Diseases 9th or 10th revision (ICD-9 or ICD-10) code or a Systematized Nomenclature of Medicine – Clinical Terminology SNOMED-CT concept identifier. Although not necessarily laboratory confirmed, these presentations correlate well with laboratory-confirmed influenza reports [15]. In addition, incidents of related conditions including pneumonia, respiratory illness and fever or unspecified infections, are also monitored. Statistical signals trigger when indicators exceed expected thresholds [40].

In the Northern Territory, ED surveillance commenced in 2007 and comprises the Royal Darwin, Gove District, Katherine District, Tennant Creek and Alice Springs hospitals. These hospitals use the same information system, supporting easy and systematic extraction of information on presenting complaints and discharge diagnoses. The search terms used are “febrile illness”, “cough”, “respiratory infection” and “viral illness”. Data are abstracted each night and inspected daily for any signs of unusual activity. Data are included in the AISR.

Western Australia also uses EDIS for ED surveillance in nine public Perth metropolitan EDs and one regional hospital ED. Data on respiratory viral presentations (upper respiratory tract infection and viraemia) are extracted weekly. These diagnoses have been shown to correlate with notification and laboratory data for influenza (insert reference) and are used to monitor the number and rate of ILI hospital admissions through EDs and the proportion of hospitalised cases who are subsequently confirmed with influenza. In addition, since 2008, comprehensive surveillance of children aged 6-59 months is conducted in Perth’s only specialist paediatric hospital, the Princess Margaret Hospital for Children. Children presenting within 72 hours of the onset of ILI symptoms are swabbed and tested

for influenza. Collection of demographic and comorbidity data permits calculation of vaccine effectiveness against medically-attended influenza and hospitalisation.

In its current form, ED surveillance in Australia has limited capacity to build a nation-wide picture of ILI activity in our EDs. Each jurisdiction bases their definition of ILI on different codes, may use a different method of data collection/abstraction and some jurisdictions (ACT, Tasmania and Victoria) do not carry out ED surveillance. Year-on-year comparisons can also be hindered by upgrades to hospital information systems and the absence of reliable denominator data. Harmonisation of the diagnoses used and the methods of data extraction could enable pooling of data and comparison of activity among jurisdictions.

Hospital surveillance

Surveillance for hospitalised cases of influenza is useful for gauging the severity of a season and measuring the burden placed on health services. Hospitalisation status maybe recorded against a notified case in the NNDSS; however this is poorly completed due to the requirement for public health follow up. The Influenza Complications Alert Network (FluCAN) provides national, sentinel, hospital-based surveillance for severe influenza [16, 17]. FluCAN was first implemented in 2009 and in 2013 included 15 adult hospitals, with two paediatric hospitals added from the following year. Extensive information on all laboratory-confirmed influenza-positive patients admitted to participating sites is collated. In addition, collection of vaccination status and comorbidities permit the calculation of influenza vaccine effectiveness estimates against hospitalisation.

Queensland introduced near-real-time surveillance of public hospital admissions for ILI in 2009. Each admission is tracked through the public hospital system and data are supplemented with laboratory records through online linkage. New South Wales and Western Australia also perform surveillance of influenza-associated hospitalisations however surveillance data are not incorporated in the AISR.

The Australian Paediatric Surveillance Unit (APSU) has monitored children (<15 years) hospitalised with severe complications of influenza since 2008. Data are reported by paediatricians and other child health clinicians, who report demographics, diagnosis, treatments and short-term outcomes. These data are included in the AISR. In addition, the Unit runs the Paediatric Active Enhanced Disease Surveillance (PAEDS) system, which carries out enhanced surveillance of vaccine-preventable diseases, including influenza at two sites in Sydney and Perth. This effort is supported by FluCAN.

Enhanced surveillance of hospitalised cases provides useful information on the severity of an influenza season and its burden on hospitals. FluCAN, with its use of standard case definitions, facilitates uniform national reporting of hospital data, with influenza status confirmed by PCR. Other systems, such as PAEDS, can provide additional information during an epidemic, but are not reported routinely or in time to inform immediate public health responses.

There are further limitations to hospital data, including the lack of denominator (i.e. source population) data, which makes it impossible to calculate incidence rates. Further, while Queensland and Western Australia have the capacity to track patients through the public hospital system, it is currently not possible to track a patient's journey from community care (e.g. GP consultations) into the hospital system. This information would facilitate routine estimation of the risk of hospitalisation among patients with confirmed clinical disease. In addition, hospital admissions due to influenza cannot provide information on nosocomial influenza infections.

Mortality surveillance

As with hospital surveillance, influenza-related mortality surveillance provides an indication of the severity of a season. Three sources of national influenza death data are available. As with hospitalisations, the NNDSS records deaths associated with a laboratory-confirmed case of influenza however completion of this field is poor due to the requirement for public health follow-up. National death data compiled by the Australian Bureau of Statistics and the National Death Index report coded or all-cause death registrations but are not timely enough for public health response or inclusion in the AISR throughout the influenza season. However, retrospective analysis of mortality data can provide an estimate for the severity of an influenza season, and can be used to validate any real-time analyses that have been performed or are in development.

Laboratory surveillance

Laboratory-based surveillance provides increasing levels of detail on influenza. Some types of laboratory surveillance are useful for developing baselines and thresholds to indicate the start, end and severity of a season, while others are used to monitor antigenic drift and antiviral drug susceptibility.

National influenza centres (NICs) are part of the World Health Organization Global Influenza Surveillance and Response System (WHO GISRS), a network tasked with monitoring the frequent changes in influenza viruses with the aim of reducing the impact of influenza through the use of vaccines containing currently circulating strains. NICs collect virus specimens, perform preliminary

analysis (usually by RT-PCR) and ship representative and unusual clinical specimens and isolated viruses to WHO Collaborating Centres for advanced antigenic and genetic analysis. Australia has three NICs and one Collaborating Centre.

The WHO Collaborating Center (Melbourne) receives influenza virus samples from NICs, and other public and private health laboratories around Australia for virus identification. These viruses undergo various assays to assess antigenic and genetic drift, as well as sensitivity to antiviral drugs. These data are reported weekly to the AGDH however, the virological data generated by the WHO CC are primarily used to inform vaccine composition recommendations made by the WHO.

The proportion of respiratory tests positive for influenza provides a further indicator of influenza activity. This method is less biased than simply counting reported cases (as in the NNDSS), as it can control for annual fluctuations in testing behaviours. Further, the timing, severity and economic burden of influenza seasons is associated with the dominant circulating strain, so there is a compelling need to consider the A subtypes and B lineages separately. Many laboratories now use RT-PCR to confirm influenza infection; however few provide A subtypes and only the WHO CC and PathWest are able to the provide lineage of type B viruses. Thus there is variable determination of subtypes between jurisdictions which is a limitation of laboratory surveillance.

Conclusion

Australia's National Influenza Surveillance Scheme provides timely and accurate syndromic and laboratory surveillance of influenza from the community through to hospitalisation and death. Limitations of its surveillance systems must be taken into consideration when interpreting their outputs. Components of the scheme combine to inform control measures to lessen the burden of influenza in the Australian community and ensure that decision makers have access to the best available and timely information on which to base their decisions.

References

1. World Health Organization. *Fact sheet N°211: Influenza (Seasonal)*. 2009 [cited 2013 13 Apr]; Available from: http://www.who.int/mediacentre/factsheets/fs211/en/.
2. Muscatello, D.J., et al., *Mortality attributable to seasonal and pandemic influenza, Australia, 2003 to 2009, using a novel time series smoothing approach.* PLoS One, 2013. **8**(6): p. e64734.
3. Newall, A.T., P. Scuffham, and B. Hodgekinson, *Economic Report into the Cost of Influenza to the Australian Health System (March 2007)*, 2007, Influenza Specialist Group
4. Sullivan, S.G., et al., *A Review of Influenza Surveillance Systems in Australia, 2013.* Comm Dis Intell, 2015(Manuscript submitted for publication).
5. Glynn-Robinson AJ, et al., *Is the National Notifiable Surveillance System an effective surveillance system for flu? Poster session presented at: An era of change: global threats and harnessing new technologies.* , in *Communicable Diseases Control Conference*2015: Brisbane, Australia.
6. Kelly, H.A., et al., *The significance of increased influenza notifications during spring and summer of 2010-11 in Australia.* Influenza Other Respir Viruses, 2013. **7**(6): p. 1136-41.
7. Thursky, K., et al., *Working towards a simple case definition for influenza surveillance.* J Clin Virol, 2003. **27**(2): p. 170-9.
8. World Health Organization, *WHO Interim Global Epidemiological Surveillance Standards for Influenza (July 2012)*, 2012, World Health Organization: Geneva.
9. Dalton, C., et al., *Flutracking: a weekly Australian community online survey of influenza-like illness in 2006, 2007 and 2008.* Commun Dis Intell Q Rep, 2009. **33**(3): p. 316-22.
10. Dalton, C.B., et al., *Flutracking weekly online community survey of influenza-like illness annual report, 2010.* Commun Dis Intell Q Rep, 2011. **35**(4): p. 288-93.
11. Carlson, S.J., et al., *Online Flutracking survey of influenza-like illness during pandemic (H1N1) 2009, Australia.* Emerg Infect Dis, 2010. **16**(12): p. 1960-2.
12. Fitzgerald T, et al., *Evaluation of healthdirect Australia as a surveillance tool for seasonal influenza*, in *Communicable Diseases Control Conference*2015: Brisbane, Australia.
13. Kelly, H.A., et al., *Moderate influenza vaccine effectiveness with variable effectiveness by match between circulating and vaccine strains in Australian adults aged 20-64 years, 2007-2011.* Influenza Other Respi Viruses, 2013. **7**(5): p. 729-37.
14. Australian Institute of Health and Welfare, *Australian hospital statistics 2012–13: emergency department care.* , in *Health services series no. 52. Cat. no. HSE 142.*2013, AIHW: Canberra.
15. Zheng, W., et al., *Potential for early warning of viral influenza activity in the community by monitoring clinical diagnoses of influenza in hospital emergency departments.* BMC Public Health, 2007. **7**: p. 250.
16. Kelly, P.M., et al., *FluCAN 2009: initial results from sentinel surveillance for adult influenza and pneumonia in eight Australian hospitals.* Med J Aust, 2011. **194**(4): p. 169-74.
17. Cheng, A.C. and C.A.N.I. Flu, *Hospitalisation with confirmed influenza in a sentinel surveillance system in 2010 and 2011.* Med J Aust, 2012. **197**(4): p. 217.