

Report on Intensive Care Unit Surveillance Systems operational during the Pandemic (H1N1) 2009 Influenza Response

This is a report that considers the Intensive Care Unit surveillance systems operated by NSW Health during the 2009 influenza pandemic. During the 2009 pandemic response NSW Health relied on both established Intensive Care surveillance systems and established new systems to collect additional data. This report considers the systems used and makes recommendations for future system development.

Contents

Introduction	3
The 2009 pandemic in NSW ICUs.....	3
NSW Health Intensive Care Unit Surveillance Systems.....	3
NSW Health pandemic reporting.....	4
Evaluating the NSW Health Surveillance Systems	4
Theoretical framework	4
ANZIC-RC INFINITE FluA Registry (ANZIC-RC Registry).....	4
Evaluating the Performance of the ANZIC-RC Registry.....	5
Public Health Realtime Emergency Department Surveillance System (PHREDSS)	7
Evaluating the Performance of PHREDSS.....	7
Influenza in Intensive Care Units Data Collection Facility (FluICU).....	11
Evaluating the Performance of FluICU	11
NSW Health Swine flu surveillance and outbreak database (NetEpi).....	14
Evaluating the Performance of NetEpi	14
An “Ideal” Intensive Care Surveillance System	14
Recommendations	15

Introduction

For many years NSW Health has been preparing for a large-scale infectious disease emergency, such as an influenza pandemic. The 2009 pandemic of a novel H1N1 influenza virus (pH1N109) was a time of high demand on our hospital system, particularly intensive care units. Intensive care units (ICUs) are separate and self-contained sections of hospitals that are especially staffed and equipped for the management of patients with life threatening or potentially life threatening conditions [1].

Monitoring the level of activity in intensive care units due to a particular disease can give an idea of the severity of an infectious disease emergency. Closely examining the characteristics of people admitted to intensive care during an emergency (eg particular ages, health conditions) can allow a better understanding of those who are most at risk of severe outcomes from a disease. Recognition of a disease outbreak can also come about due to the presence of people admitted to intensive care with similar symptoms.

During the 2009 pandemic response NSW Health relied on both established Intensive Care surveillance systems and established new systems to collect additional data. This report considers the systems used and makes recommendations for future system development, especially when considering the potential for ICU surveillance systems to be used to detect a potential outbreak of severe illness.

The 2009 pandemic in NSW ICUs

The epidemic (period of increased disease activity) of pH1N109 influenza lasted approximately 10 weeks in NSW ICUs. By 31 August 2009, 1,214 people with pandemic H1N1 influenza infection had been hospitalised (17.2 per 100,000 population), 225 people were admitted to intensive care (3.2 per 100,000), and 48 people had died (0.7 per 100,000). Children aged 0-4 years had the highest hospitalisation rates, while adults aged 50-54 had the highest rates of intensive care admission [3].

Overall presentations to emergency departments (EDs) for all causes during the pandemic were only 6% higher during the pandemic than in the same period in 2008. However, ICUs were more severely affected, with 15% of NSW public hospital adult ICU beds occupied by confirmed pH1N109 influenza patients, and a further 15% of adult ICU beds occupied by patients with untyped influenza A or influenza-like illness (ILI). This increased demand for intensive care during the epidemic led to the postponement of elective surgery in several public hospitals [3].

NSW Health Intensive Care Unit Surveillance Systems

A number of surveillance systems were in operation in NSW during the pH1N109 influenza response, each with different priorities and attributes:

- the Australia and New Zealand Intensive Care Research Centre INFINITE FluA Registry (the ANZIC-RC Registry) – a web-based patient database recording comprehensive demographic and clinical data on all laboratory confirmed influenza A ICU cases (including pH1N109) for Australia and New Zealand. NSW Health funded the ANZIC-RC to report all NSW data daily from 1 June 2009.

- the Public Health Realtime Emergency Department Surveillance System (PHREDSS) – an ED-based automated syndromic surveillance system which reported daily on influenza-like-illness admissions from (reporting) EDs to critical care wards.
- the Influenza in Intensive Care Units Data Collection Facility (FluICU) – a web-based aggregate data collection tool that provided a census of ICU bed occupation by suspected and confirmed pH1N109 patients on a daily basis from 1 July to 1 September 2009.
- NetEpi Collection (NetEpi) – a web-based patient database that collects structured information about cases and contacts [4, 5]. During the H1N109 response, ICU staff reported on suspected and confirmed pH1N109 ICU cases to PHUs who performed the data entry.

NSW Health pandemic reporting

NSW Health produced a publicly available summary report, the Weekly Influenza Epidemiology Report (produced monthly from 1 October 2009) and an internally circulated Weekly Intensive Care Influenza Epidemiology Report during the peak months of the pandemic – July, August and September 2009.

Evaluating the NSW Health Surveillance Systems

Theoretical framework

The evaluation used mixed methods and involved an assessment of the attributes, importance and usefulness of each Intensive Care Unit Surveillance System (ICUSS). To gain a deeper understanding of the attributes and acceptability of the databases and the attributes of an ideal surveillance system, key informant interviews were undertaken.

ANZIC-RC INFINITE FluA Registry (ANZIC-RC Registry)

The Australian and New Zealand Intensive Care Research Centre (ANZIC-RC), based at Monash University in Melbourne, Victoria, rapidly developed an internet-accessible database (the ANZIC-RC Registry) which is supported for Australian and New Zealand data entry. The ANZIC-RC was funded by NSW Health to report data on a daily basis on all patients with confirmed influenza A admitted to ICUs across NSW from 1 June 2009 onwards [3].

The ANZIC-RC Registry is accessible via the Internet and does not require any compatibility with other software. Access is password protected and there are multiple user access levels. Several public health staff at the NSW Department of Health (DOH) had access to read, enter or edit data for all of the ICUs in NSW. Individual ICUs had access only to their own data, but could also view a graphical representation (via Google Maps) of the ICU cases for the whole of Australia and New Zealand.

The ANZIC-RC is independent of the Australian and New Zealand Intensive Care Society (ANZICS) although the President of ANZICS sits on the board of the ANZIC-RC. ANZICS is the peak professional body for intensive care medicine in Australia and New Zealand and is also partially funded by NSW Health.

Evaluating the Performance of the ANZIC-RC Registry

The ANZIC-RC Registry was developed to be a complete database of pandemic (H1N1) 2009 influenza patients in intensive care for both Australia and New Zealand. To better understand the underlying health status of people being at risk of severe illness, a large amount of data was collected about each patient. In November 2009, the ANZIC-RC Registry reached approximately full case-ascertainment for the period of interest June 1 2009 through to 31 August 2010, after an intensive period of retrospective data entry and cleaning [6]. A snap-shot of the database taken from after this date is likely to be representative of all the influenza A positive patients seen in NSW ICUs during the pandemic.

The ANZIC-RC Registry website was seen by users as reasonably intuitive, however some smaller ICUs found that the data entry requirements during a time of high activity was difficult. The NSW Department of Health provided assistance to many ICUs to allow data entry to be completed. The ANZIC-RC Registry is very broad, encompassing nearly all of the public health data required during the pandemic. It is a simple database and new data items can be added easily and in fact were during the pandemic. The addition of new data items sometimes meant that data entry for these new items needed to be completed centrally

As case ascertainment is approaching full and extensive retrospective data cleaning has been undertaken, data quality is high. However, as with many large databases with data added by many users there are still several missing or obviously incorrect data fields, particularly for those items added to the database after its initial deployment.

The Registry was seen by ICU staff interviewed as appropriate and necessary – even considering the extensive data to be collected. The data produced was provided daily to the DOH in a Microsoft EXCEL spreadsheet by the ANZIC-RC. This facilitated the tracking of trends by DOH public health staff and enhanced daily reporting to the Australian Department of Health and Ageing.

The sensitivity of a surveillance system can be considered on two levels. Firstly, at the level of case reporting, sensitivity refers to the proportion of cases of a disease (or other health-related event) detected by the surveillance system. Secondly, sensitivity can refer to the ability to detect outbreaks, including the ability to monitor changes in the number of cases over time [7].

For the ANZIC-RC Registry sensitivity can be estimated by using case numbers from the height of the pandemic, 1 July – 31 August 2009 (extracted 01/09/09) versus those for the same period from database approximately full case ascertainment was reached in November 2009 (extracted 02/12/09).

Inherent delays exist in testing and reporting pathology samples and also many busy ICUs saw the ANZIC-RC Registry data entry as something that could wait during busy times, particularly for smaller regional ICUs. Therefore several ICUs did not log any data until after the ICU surge had dissipated, resulting in considerable “lag time” in reporting.

It is possible to estimate the average reporting lag by subtracting the date of patient admission to ICU, from the date their Registry record was first created. Using data downloaded on 01/09/09 and omitting ICU admission dates prior to 01/07/09, gives the following results:

ANZIC-RC Registry data entry time-lag

Average time from ICU admission to data entry = 10.63 days

Shortest time to data entry = 0.11 days

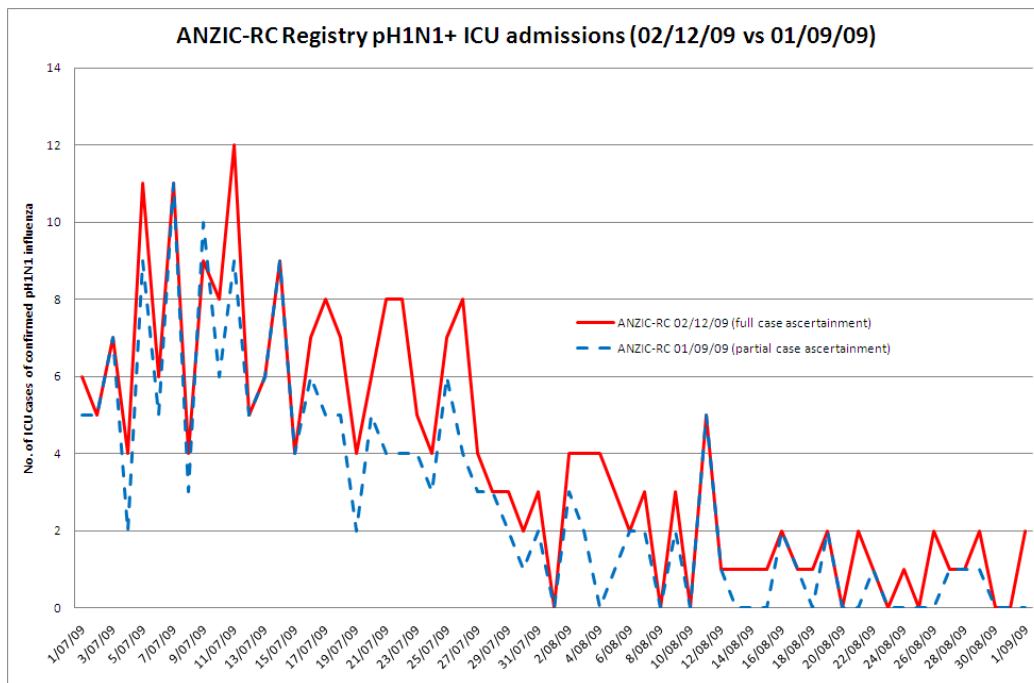
Longest time to data entry = 53.09 days

Median time to data entry = 7.94 days

Interquartile range = 9.95 days

On average, larger metropolitan hospitals had the shortest data entry lag time with smaller metro, rural and private hospitals having longer lag times. As at 1 September, several hospitals had not yet entered any records into the Registry. This meant that during the pandemic the ANZIC-RC Registry was incomplete, (see figure 1).

Figure 1: Comparison of case ascertainment for the ANZIC-RC Registry post-pandemic surge vs. pandemic surge



The second ICU admission curve (blue dotted line) demonstrates a reduced number of cases recorded overall and decreasing accuracy over time as data entrants have a smaller window from date of ICU admission to date of retrospective data entry. Thus the ANZIC-RC Registry was unlikely to provide an early warning if a second wave of pH1N109 influenza were to have occurred in 2010.

The inherent time-lag in the ANZIC-RC Registry database makes it a poor choice for monitoring developing epidemic outbreaks of influenza A. However, as the large metropolitan hospitals demonstrated the shortest lag-times and also saw the most patients, in future a study of “sentinel sites” could provide a relatively accurate snapshot of an influenza epidemic as it occurs.

Public Health Realtime Emergency Department Surveillance System (PHREDSS)

Established by NSW Health in 2003, PHREDSS is a near real-time ED-based syndromic surveillance system, which includes patient visits with influenza as the primary provisional diagnosis amongst the syndromes able to be monitored on a daily basis. Counts of ED presentations for influenza syndrome from this system form part of an enhanced surveillance effort during the annual influenza season and the 2009 pandemic response.

PHREDSS allows a daily assessment of the number of emergency department (ED) presentations with assigned diagnoses of general respiratory illness, fever, unspecified infections, influenza-like illness and pneumonia [3].

PHREDSS uses data routinely recorded in ED information systems and transmitted by real-time electronic messaging or frequent batch files to a surveillance database at NSW Health. This system currently includes most of the public hospital EDs in NSW (72% of the state's 2.4 million annual ED presentations). ED diagnoses are grouped into 'syndromes', such as influenza-like illness or pneumonia [3].

PHREDSS was running throughout the pandemic requiring no stand-up time. Specific "swine flu" free-text searches of ED and Ambulance triage text were rapidly initiated on Monday 27 April 2009 to complement the normal monitoring of influenza, pneumonia and other respiratory syndromes and ambulance call-outs for breathing difficulties. It is important to note that ED diagnoses of influenza reported in PHREDSS syndromes are clinical diagnoses and in most cases, are not laboratory confirmed meaning that PHREDSS cannot distinguish between the strains of influenza, or distinguish influenza A from other influenza-like-illnesses (ILI).

Daily Public Health Situation Reports began on the morning of Tuesday 28 April 2009 and PHREDSS data was the only epidemiological data included in these reports until the ANZIC-RC Registry came online in June 2009.

Evaluating the Performance of PHREDSS

PHREDSS daily reports are generated automatically but some training is required to interpret these reports. The NSW Health Centre for Epidemiology and Research's PHREDSS team provides timely reports based on signals detected in daily reporting. The PHREDSS team monitor the reports 7 days a week and situation reports can be generated and disseminated very rapidly.

As at December 2009, PHREDSS was receiving data from 53 of the total 90 EDs in NSW. Greater Western Area Health Service (GWAHS) began providing data to PHREDSS in December 2009 bringing the total to 56 EDs. The remaining EDs are in the greater part small regional hospitals and bringing them online represents a large cost-benefit issue.

Private hospitals remain an obvious blind spot. However, it is unlikely that a significant trend would have occurred in the 3 private hospital EDs in NSW without also appearing simultaneously in the NSW public hospital EDs.

As with all syndromic surveillance systems, PHREDSS data are only as good as the data source, which are the electronic ED patient records of NSW public hospitals. Added to this is an ICU definitional issue. Not all public hospitals in NSW classify their critical care services the same way.

Also it has been reported that for a period of time during the pandemic response some SWAHS EDs utilising SNOMED nomenclature were not being correctly received by PHREDSS. This issue has since been resolved.

As PHREDSS is based on ED data and that data is collected automatically, PHREDSS was not highly recognised by the ICU staff interviewed. However, they were very appreciative of the trend data that was provided in the weekly epidemiology reports, particularly early in the pandemic and this data was provided solely by PHREDSS before FluICU was implemented.

As a syndromic surveillance system, PHREDSS cannot pinpoint confirmed cases of pH1N109 influenza. Given the breadth of its “influenza like illness” and “pneumonia” syndromes it is very unlikely to miss a positive case of influenza in ICU, but there is a background of false positives from many other diseases producing ILI symptoms.

PHREDSS data is reported automatically in near real-time and reports are monitored daily by surveillance team staff. Thus an absolute maximum of 24 hours could elapse between registration of a patient admitted from ED to critical care to development and dissemination of a situation report by surveillance staff. PHREDSS has permanent funding from NSW Health and is well supported within the DOH.

PHREDSS daily reports are accessible via a password protected Internet page and authorised users can interface with the wide range of different electronic ED patient record systems currently in use in NSW public hospitals. PHREDSS situation reports are emailed out to pre-determined recipient lists. During the pandemic, PHREDSS situation reports were incorporated into the weekly publicly available NSW Influenza Epidemiology Reports and the Intensive Care Epidemiology Reports that were circulated on a more limited basis to protect patient confidentiality.

PHREDSS currently reports on 39 syndromes, the following of which can be used to monitor respiratory related admissions to ICUs:

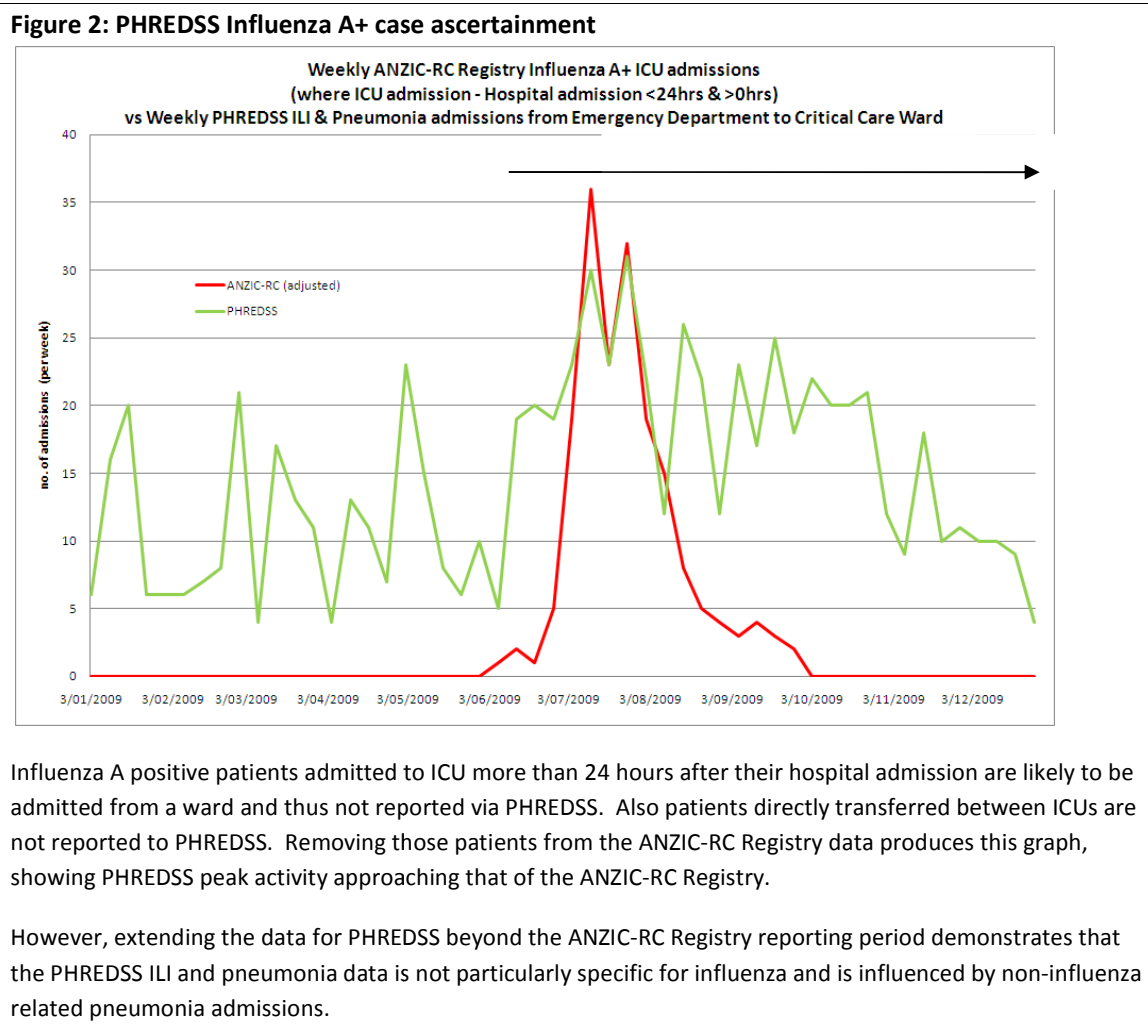
- All respiratory problems;
- Influenza-like illness;
- Pneumonia;
- Other/unspecified respiratory infections;
- Breathing problems;
- Cough; and
- Admitted to Critical Care Ward (all causes).

The creation of new syndromes requires significant resources. The current syndromes monitored by PHREDSS are the result of several years of effort. Different NSW EDs alternately use ICD9, ICD10 or SNOMED diagnosis codes, so if a new syndrome were to be created, all possible diagnosis codes would need to be identified – a very significant endeavour.

PHREDSS is less attuned to ICU than ED surveillance, however it is possible to design “macros” (short programs) for interrogating a combination of syndromes simultaneously, including ICU admissions. For example, since the pandemic the PHREDSS team have reported daily on combined ILI and pneumonia presentations to ED that resulted in admission to a critical care ward. This combination was crucial for ICU reporting throughout the pandemic response. ILI is a common and non-specific marker of influenza and is tracked in sentinel settings to detect the onset of a highly predictable influenza season by watching for a rise in syndrome cases above the baseline incidence. In this instance, the system is designed to identify an aberrant pattern of disease rather than individual

cases [8]. Pneumonia is a common complication of influenza seen in ICUs and is often listed as the cause of admission rather than ILI.

Excess admissions from ED to critical care (for all causes) in one or more hospitals will also signal a PHREDSS alert demonstrating the early warning potential of PHREDSS. Comparing PHREDSS ILI and pneumonia syndrome admissions to critical care with the ANZIC-RC Registry influenza A+ patient data allows us to see how closely the combined ILI and pneumonia syndromes mapped to the actual progression of influenza A+ admissions to intensive care units during the pandemic (see figure 2).



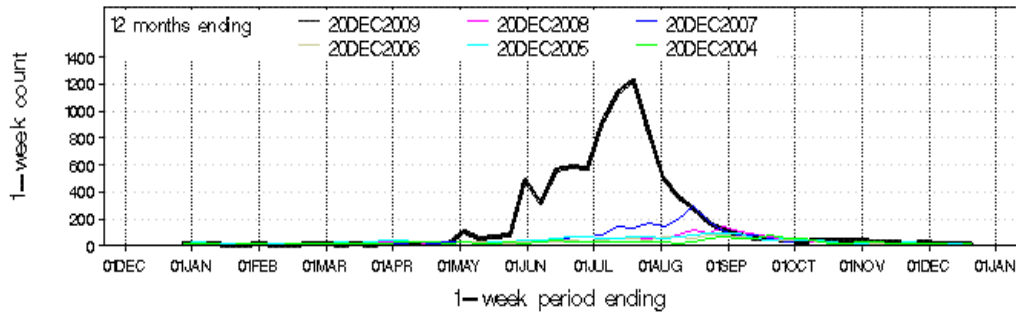
ED presentations and admissions for ILI also rose in advance of the critical care admissions, demonstrating the early warning capacity of PHREDSS (see figure 3).

Figure 3: Influenza early warning potential of PHREDSS

Presentations to emergency departments for influenza-like illness

Category: All visits with the above inclusions

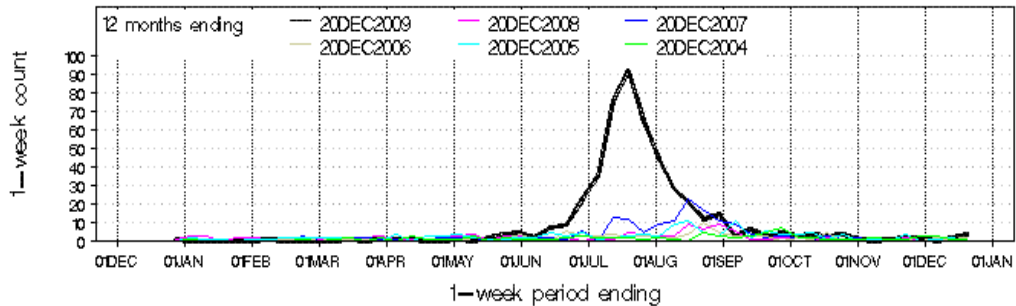
Total 1-week counts



Presentations to emergency departments for influenza-like illness that were admitted to any ward

Category: All visits with the above inclusions

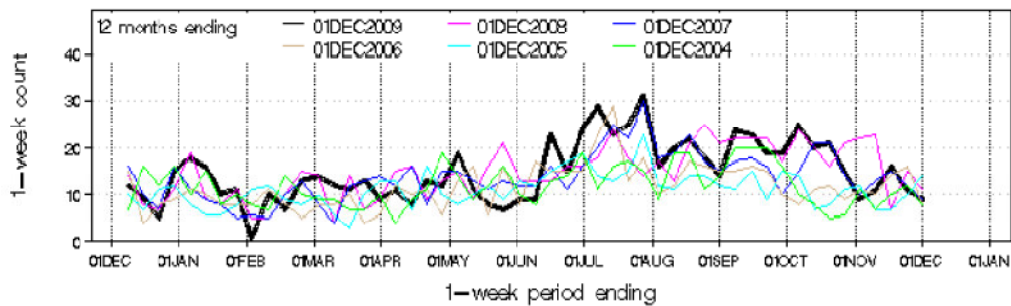
Total 1-week counts



Presentations to emergency departments for influenza-like illness that were admitted to a critical care ward

Category: All visits with the above inclusions

Total 1-week counts



Graphs 1 and 2 show that ED presentations and admissions for ILI rose rapidly in June 2009 earlier and well above the seasonal rises in previous years. Graph 3 shows a sharp rise in ILI and pneumonia admissions from ED to critical care in June 2009 above the seasonal epidemics of the previous 5 years. The ED presentations and admissions rose in advance of the critical care admissions, further demonstrating the early influenza warning capacity of PHREDSS.

Critical care admissions alone can signal an alert in a single ICU or multiple ICUs across the state. This means that PHREDSS is both responsive enough and flexible enough to detect outbreaks of almost any acute disease or syndrome in intensive care, with the aforementioned caveat that critical care admissions must be directly from ED to be reported in PHREDSS.

This is an important limitation when looking for the number of critical care admissions from a novel disease required to trigger an alert regarding a public health threat. However, the vast majority of these critical care admissions will be admitted first via ED so the presentations there should signal an alert.

Another potential source of syndromic surveillance data is the NSW Ambulance emergency calls data. NSW Health currently receives hourly batches of ambulance emergency call data for the Sydney Operations Region. This information is used for rapid public health surveillance, and complements PHREDSS. The alert potential of this dataset should be investigated further.

Influenza in Intensive Care Units Data Collection Facility (FluICU)

FluICU is a simple, internet-accessible, form-based, operational reporting tool used by NSW Health to record daily totals of patients in intensive care units in NSW public hospitals – the main purpose of the system was to understand the burden the pandemic was placing on ICUs. FluICU data was collected by NSW Health between 14 July and 31 August 2009. Data was reported by ICUs by midday each day, counting the numbers in the ICU as at 0800 that morning. Note this data shows the total number of patients in ICU each day, not the number of new patients admitted daily.

The database that was rapidly developed by NSW Health for recording daily aggregate influenza-related ICU activity, including: total number of suspected or confirmed influenza cases in adults, children and neonates; total number of pregnant patients with suspected or confirmed influenza; and total number of patients requiring treatment with extracorporeal membrane oxygenation (ECMO) [3].

Evaluating the Performance of FluICU

ICUs were directed to report once daily before 12.00pm and previously entered data was able to be changed anytime within 3 weeks. The benefits of retrospectively updating previously entered data in a simple aggregation database are questionable. The free-text section was only used by some ICUs and did not add value to the data.

FluICU counted beds occupied by both suspect and confirmed cases of pH1N109, so a layer of complexity was added by the need to wait for pathology results. This factor could lead to a bed holding a suspect case on Monday being relabelled as a confirmed case on Tuesday, with no way for someone accessing the data to know that detail.

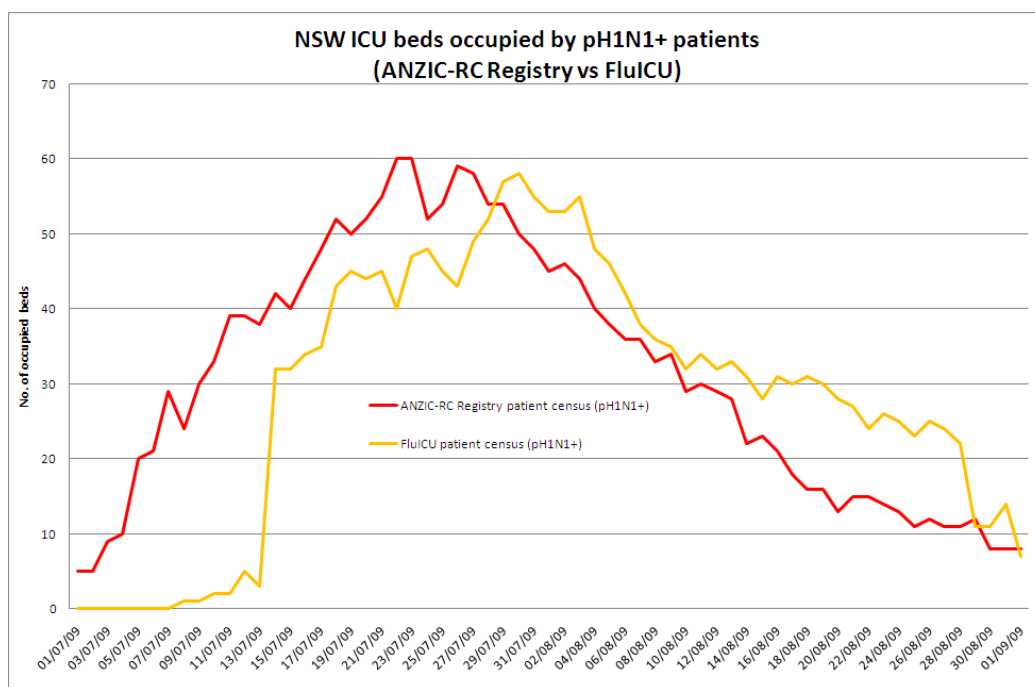
In its current form, FluICU is not a flexible database, it was designed to be a very simple and straightforward aggregation tool. However, the software platform is very flexible and a multitude of enhancements are possible without changing the current basic structure.

Potential changes need to be weighed against the extra time and complexity they will invoke in data entry. However, modest changes, including separating patients into new and continuing categories would not constitute an onerous data-entry burden and could increase the usefulness of the data collected to public health operations.

FluICU has the capacity to automatically generate and view a snapshot report for an individual ICU or the entire state. The ability to see patient numbers in all ICUs in the state could prove useful to those ICUs needing to transport patients to another ICU. This issue was raised by the Director of a rural ICU.

As can be seen from Figure 4, FluICU was only activated between 7 July 2009 and 1 September 2009. However, reporting did not begin in earnest until 15 July. When making a simple comparison between FluICU and the ANZIC-RC Registry (as at 2 December 2009) it is clear that FluICU cannot be used to accurately portray the number of confirmed pH1N109 cases in ICU at any one point in time, because it is limited by sample testing delays, depicted by the right shift of the red curve. However, as FluICU was updated every day, it provided the most accurate picture of the burden shouldered by ICUs during the pandemic, while the pandemic was actually occurring.

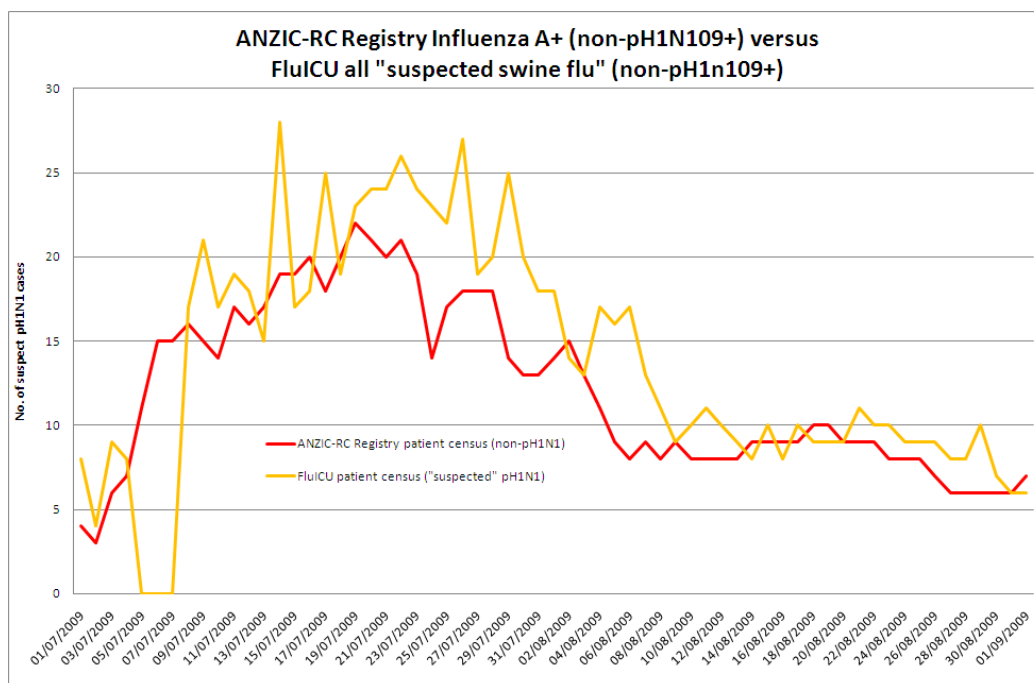
Figure 4: FluICU pH1N1+ case ascertainment



Comparing the daily FluICU reporting against the complete ANZIC-RC Registry with an average data lag of 10 days, shows that when FluICU was operating with a majority of NSW ICUs reporting, this simple daily census data proved highly accurate. The FluICU curve (in gold) shows a time-shift of 2-3 days, representing time elapsed between admission and receipt of a pH1N109 positive test result.

An interesting finding was that the FluICU “suspected influenza illness or confirmed influenza A (unsubtyped)” category mapped closely with the influenza A positive but pH1N109 negative patients recorded in the ANZIC-RC Registry. This indicates that clinician diagnosis was very reliable even before pathology test results were received and that a high degree of suspicion for pandemic influenza picked up cases that would normally have not been designated an influenza diagnosis. (see figure. 5).

Figure 5: Sensitivity of FluICU for suspected ILI and untyped influenza A



The number of patients in NSW ICUs who were reported in FluICU as suspected swine flu or other influenza A was very accurate and this accuracy improved over time.

FluICU data was gathered in a once daily ICU bed count. As such it does not rely on clinician recall. However, FluICU does discount the possibility of a patient transferring in after a census time and transferring out again on the same day before the next census, reducing its usefulness as a case finding tool.

Initially ICU bed occupancy data was gathered via telephone ring-around, a very labour intensive and potentially error-prone process. ICU staff interviewed were thus supportive of the introduction of FluICU. The number of ICUs supplying data to FluICU increased rapidly after 15 July 2009, but FluICU never reached full subscription and data entry gradually decreased from 17 August 2009 onwards.

FluICU provided our most timely ICU patient data, making it an extremely useful operational tool. However as a census program, it could only report the number of patients occupying beds on a given day. FluICU cannot be used to locate a specific patient, determine length of stay or determine other patient specific data.

FluICU is built with the same software used for NetEpi (see below) and is hosted on a NetEpi back-up server. It is a simple, low-cost and stable database. As an aggregate system recording only ICU bed occupation, FluICU has limited outbreak detection potential. If the system is initialised and on a given day the amount of ICU beds occupied by people suffering symptoms of ILI rose substantially in a single or multiple ICUs, then FluICU could be used to trigger an alert and a public health response. This would require centralised monitoring and close to full ICU subscription.

NSW Health Swine flu surveillance and outbreak database (NetEpi)

NetEpi is an open-source, web-based outbreak database system. NetEpi has been used in NSW for recording cases and contacts for enteric and rabies/lyssa virus outbreaks and NetEpi was the primary database used for public health activity during World Youth Day in 2008 [6]. During the pandemic a new “instance” (essentially a separate database) of NetEpi was created and implemented in one day when the “swine flu” outbreak was first detected in Mexico. Public health staff entered information on suspected and confirmed pH1N109 positive cases and their contacts. All laboratory notifications of confirmed pH1N109 infection were also entered [3].

Evaluating the Performance of NetEpi

Public health unit staff interviewed described NetEpi as a simple and straightforward database to use, however there were administrative challenges, particularly when the national pandemic phase changed from CONTAIN to PROTECT and the NetEpi case forms were updated less quickly than in other phase changes (potentially because the need to collect data for quarantine and isolation purposes was less intense hence *less* data was required in the PROTECT phase).

NetEpi is accessible over the Internet which proved very useful during the pandemic because case data was entered in public health units, at DOH, in the airport clinics and at pathology laboratories. NetEpi ICU data was entered manually following either a report to the public health unit, or a request for “swine flu” pathology tests was sent by an ICU to a laboratory. Therefore, it cannot be used to detect an outbreak; it is by nature a retrospective tool.

NetEpi was the foremost case ascertainment tool for NSW Health and as such was dependent on the current national pandemic phase and the current national case definitions for suspected and confirmed cases of pH1N109. Any change in the case or contact definitions or national pandemic phase precipitate a change in the NetEpi case and contact forms. This is not an arduous task and can be completed quickly, but is dependent on first receiving information from the Commonwealth.

NetEpi has data on all confirmed cases of pH1N109 in NSW. However, information on ICU admissions is limited. NetEpi currently only records ICU admission as “yes”, “no”, or “not answered”. NetEpi does not record the dates of ICU admission or discharge. Data regarding ICU admissions was collected either by PHU staff contacting ICU staff verbally, or via retrospective comparison with cases recorded in the ANZIC-RC Registry. The total ICU and HDU admissions of pH1N109 positive patients recorded in NetEpi (ICU or HDU admission = “yes”) is 264. Over the same period the ANZIC-RC Registry reported a total number of 283 patients with confirmed pH1N109 influenza. Therefore NetEpi is not currently a useful tool for tracking ICU admissions, but it does have comprehensive demographic data on every case recorded, thus can be retrospectively matched with ANZIC-RC Registry data if required.

An “Ideal” Intensive Care Surveillance System

Stakeholders in the Department and in intensive care agreed that whilst current systems served their purposes, an ideal ICU surveillance system would update in real-time from the ICU Clinical Information System (CIS) reducing the burden of data entry seen with FluICU, the ANZICs database and NetEpi. This is a difficult objective however, as there is not currently a standard ICU CIS collecting this type of data across the State.

Anecdotal reports suggest that the Australian and New Zealand Intensive Care Society (ANZICS) are working towards a system of automatic ICU data upload to their comprehensive Adult Patient Database (APD). However, this is expected to be at least two years in the future.

One real-time electronic database currently exists in NSW ICUs, the Critical Care Resource management System (CCRS). The CCRS is a web-based program that lists all of the ICU and HDU beds in NSW and automatically updates every hour [9]. It was used in conjunction with FluICU during the pandemic to manage ECMO transfers and bed demand. However, the CCRS records only whether a bed is occupied or not, so as such has very limited public health applicability.

The potential exists for the CCRS to be upgraded to record more patient specific data which would prove very beneficial to public health surveillance. Several respondents indicated that upgrading the CCRS would be preferable to creating a wholly new system.

In the absence of automated ICU specific surveillance systems, strong communication networks are essential to rapid dissemination of information on developing epidemics. ICUs and PHUs should maintain strong links to enable two-way information transfer regarding communicable diseases outbreaks.

Recommendations

In preparing for a possible resurgence of pH1N109 or future infectious disease emergencies in NSW ICUs, the following may be considered:

- NSW Health was able to monitor ICU activity at a commendable level. Monitoring ICU activity is resource-intensive and automated systems would relieve the burden of data-entry and provide a clear picture across all ICUs.
- Data from ICUs proved vital to the public health response to the 2009 pandemic. Therefore, consideration should be given to the potential for public health data collection in any future enhancements to the NSW CCRS or in the event a statewide electronic ICU patient admission system is developed.
- The ANZIC-RC Registry provides valuable retrospective risk factor data and full case ascertainment. During a period of high ILI activity in ICU, assessing data from large metropolitan ICUs “sentinel sites” may provide accurate information more rapidly without increasing the burden of data collection at smaller sites.
- Collecting more detailed information on patient co-morbidities in the ANZIC-RC Registry could provide greater insight into the conditions that confer higher risk of serious influenza infection or risk factors serious illness due to other emerging infectious diseases.
- PHREDSS reporting of ILI and pneumonia admissions from ED to ICU proved to be very useful in the pandemic and potentially for future outbreaks. The PHREDSS team continues to monitor these syndromes daily.
- Alternate datasets accessible to PHREDSS, including ASNSW emergency calls data, could potentially provide additional early warning capacity.

- FluICU provides timely public health data with minimal administrative impact on operational staff and can be rapidly redeployed if required.
- The link between data collected and the purposes for the data collection should be emphasized when an infectious disease emergency occurs. Data reporting, such as the epidemiology reports, helps busy clinicians understand the contribution they are making to better understanding the progress of an epidemic.

References

1. ANZCA-FIC, *Minimum Standards for Intensive Care Units*. 1997, Australian and New Zealand College of Anaesthetists - Faculty of Intensive Care: Melbourne, Australia.
2. CDC, *Outbreak of West Nile-Like Viral Encephalitis -- New York, 1999*. MMWR, 1999. **48**(38): p. 845-849.
3. NSW public health network, et al., *Progression and impact of the first winter wave of pandemic (H1N1) 2009 influenza in New South Wales, Australia*. Eurosurveillance, 2009;pii=19365. Available online: www.eurosurveillance.org/ViewArticle.aspx?ArticleId=19365
4. Viney, K.A. and J.M. McAnulty, *The evaluation of web-based data collection for enhanced surveillance of cryptosporidiosis*. NSW Public Health Bulletin, 2008. **19**(1-2): p. 15-19.
5. Fizzell, J. and P.K. Armstrong, *Blessings in disguise: public health emergency preparedness for World Youth Day 2008*. The Medical Journal of Australia, 2008. **189**(11/12): p. 633-636.
6. The ANZIC Influenza Investigators, *Critical Care Services and 2009 H1N1 Influenza in Australia and New Zealand*. N Engl J Med, 2009. **361**(20): p. 1925-1934.9.
7. CDC *Updated guidelines for evaluating public health surveillance systems: recommendations from the guidelines working group* MMWR 2001 (50)(RR-13)
8. Sosin DM *Draft framework for evaluating syndromic surveillance systems* Journal of Urban Health 2003;80(2 Suppl 1); pi8-13.
9. NSW Health, *Health Care Advisory Council (HCAC) Newsletter*. March 2010.