The Seasonality of Influenza in the Asia-Pacific Region

Lance C Jennings[1], on behalf of the Asia-Pacific Advisory Committee on Influenza (APACI).
[1]Canterbury Health Laboratories, Christchurch Hospital, and Department of Pathology, University of Otago, Christchurch, NEW ZEALAND.

Abstract

Background

The Asia-Pacific region spans a full range of climates. In temperate countries, both the periodicity and the seasonality of influenza virus infections are well established, with often a clear peak in activity during the winter months. In tropical or subtropical countries, influenza activity is either poorly defined or occurs throughout the year, with periods of increased activity during the winter and rainy seasons.

Objective

Surveillance activity in the Asia-Pacific has been limited thus far. This review aims to promote both the introduction and increased intensity of surveillance programmes, to improve the understanding of the influenza disease burden in the region, and to clarify the appropriate implementation of vaccination strategies.

Methods

Influenza identification spanning 3 years or more was collected from eight Asia-Pacific countries. Circulating A(H1N1), A(H3N2) and B viruses were examined, with attention being given to peaks of seasonal activity throughout the calendar year.

Results

Every country with established surveillance has demonstrated influenza virus activity. The comparison of surveillance data for influenza A(H1N1), A(H3N2) and B viruses over multiple years from eight countries spanning the Asia-Pacific climatic regions highlights the continuous or near continuous circulation of influenza in tropical and subtropical regions. In these regions, both wet and dry season periods of increased activity, as well as the annual variation within each country and geographical variation, were identified.

Conclusions

The seasonality of influenza needs to be established for individual countries to assist in the development of health policies for the timing of influenza vaccine administration and hence, appropriate vaccine formulation (Northern or Southern Hemisphere vaccine).

Background

The Asia-Pacific region spans a wide range of climate conditions, from temperate, to subtropical, through to tropical. The periodicity and seasonality of influenza virus infections are well established in those countries with temperate climates, and there is often a clear peak in activity during the winter months.[1] However, in countries with tropical or subtropical climates, influenza activity is either poorly defined or occurs throughout the year with periods of increased activity during the rainy and winter seasons.[2–4] In the South-East Asian tropical zone, the first systematic attempt to describe the population incidence of influenza using active surveillance and comprehensive laboratory confirmation was carried out in the Sa Kaeo province of Thailand.[5,6] Influenza activity was found to occur throughout the year and was identified in 11% of hospitalised pneumonia inpatients.[6] A series of studies have confirmed that influenza hospitalisation rates in Hong Kong, a subtropical city, are similar to those in temperate countries.[7–9] There is accumulating evidence on the year-round circulation of seasonal influenza viruses in the South-East Asian tropical zone and the importance of this region as a source of seasonal viruses for temperate countries.[10]

Objective

Following the development in 2002 of the Global Agenda for Influenza Surveillance and Control, the World Health Organization (WHO) has intensified efforts to encourage countries to include the surveillance of influenza within their seasonal influenza control strategies as a priority on their public health agendas.[11,12]

Influenza surveillance activity in the Asia-Pacific region has been limited thus far to the identification of circulating viruses in a few countries. The epidemiology of influenza in many other countries, especially those in the tropical and subtropical zones, remains poorly understood. With the current level of global concern over the spread of the highly pathogenic avian influenza A(H5N1) and the threat of another human pandemic, the associated pandemic-preparedness activities have allowed a renewed focus on the laboratory surveillance of influenza in the region.

The main objective of this study, therefore, is to support the WHO initiative to promote the introduction and increased intensity of surveillance programmes over a period of years in order to improve the understanding of the seasonality of influenza in Asia-Pacific countries, and thus clarify the appropriate implementation of vaccination strategies. This study presents existing surveillance data from multiple countries to demonstrate and compare the annual fluctuations in influenza activity.

Methods

Data contributions were sought from infectious disease experts and organisations from the 12 member countries of the Asia-Pacific Advisory Committee on Influenza (APACI). APACI members with an established laboratory-based influenza surveillance system were invited to provide influenza identification data spanning 5 years or more, including information on influenza type, subtype and distribution per month.

While there were variations in data collection protocols between different countries, all laboratory surveillance centres were designated WHO National Influenza Centres. Laboratory identification of influenza was most commonly achieved by viral isolation through standard culture; however, direct detection of the viral antigen and, increasingly, reverse transcriptase polymerase chain reaction methods were used by member countries. Where possible, influenza A viruses were further subtyped as either A(H1N1) or A(H3N2) subtypes.

Once collated, the influenza data from each country were then analysed, with the main goal of identifying the location and magnitude of seasonal peaks of influenza activity throughout the calendar year.

Results

Eight countries provided influenza identification data: these were Australia, China, Hong Kong, New Zealand, the Philippines, Taiwan, Thailand and Vietnam (Table 1). In addition, China provided separate data for its northern and southern provinces. Variations existed between countries regarding data collection periods: seven of the eight countries provided data spanning a 3-year period or greater, while one country provided data across an 18-month period up to June 2005.

Table 1. APACI seasonality data contributors, time period and influenza subtype classification

Member country	Data collection period	Type/subtype classification
Australia	January 2000 to December 2006	Type A, A(H1N1), A(H3N2) and B
China		
Northern provinces:	September 2003 to June 2006	
Southern provinces:	March 2003 to August 2006	Type A, A(H1N1), A(H3N2) and B
Hong Kong	January 2000 to December 2006	Type A and B
New Zealand	January 2000 to December 2006	Type A, A(H1N1), A(H3N2) and B
The Philippines	January 2000 to December 2005	Type A and B
Taiwan	January 2000 to October 2005	Type A, A(H1N1), A(H3N2) and B
Thailand	January 2004 to June 2005	Type A(H1N1), A(H3N2) and B
Vietnam	March 2001 to December 2003; January 2005 to December 2006	Type A(H1N1), A(H3N2) and B

Influenza identification data from **Thailand** showed that influenza activity occurred in most months of the year, with a major peak of activity during the wet season in September/October 2004 and smaller seasonal peaks occurring around January/February in both 2004 and 2005 (Figure 1). The highest peak of A(H1N1) activity coincided with the country's rainy season in October 2004, while the A(H3N2) and B strains showed increased activity during other months as well.

Despite its small sample size, surveillance in **Vietnam** showed clear annual trends in influenza virus activity, with major seasonal peaks occurring between May and July of each year (Figure 2). In 2001, influenza B was the major contributor to the seasonal peak in May. In 2002 and 2003, A(H3N2) showed the largest seasonal spikes in activity during the May to July period.

Two tropical/subtropical countries provided isolate data over a 3-year period with differentiation between A and B strains; both demonstrated peaks of seasonal activity each year. In **Hong Kong**, the primary seasonal activity peak occurred during the winter (increasing during February/March), with a smaller summer peak during July/August clearly observed in 2003 and 2004 (Figure 4). Data from **the Philippines** (Figure 5) showed clear seasonal activity with peaks in influenza activity during each rainy season (May to August).

Three countries provided data on monthly influenza isolates over a 3-year period, examining levels of circulating A(H1N1), A(H3N2) and B viruses throughout the calendar year. In northern **China**, clearly defined seasonal peaks of influenza activity could be identified during the winter months, December to February, each year (Figure 6). Subtype activity varied between years, with the 2003/2004 activity mainly the result of the A(H3N2) subtype, while the 2005/2006 season showed increased A(H1N1) activity instead. In southern China, influenza activity occurred in most months of the year with a major peak of activity during the winter months of January to March each year (Figure 7).

Influenza data over the 2003 to 2005 period in **Taiwan** (Figure 8) generally showed two seasonal peaks each year, with the primary peak occurring during the winter months (January/February) and largely being due to A(H3N2) activity. Influenza B showed a particularly strong increase between January and April 2005. In comparison, data from **New Zealand** (Figure 9) showed a predictable increase in seasonal influenza activity during the winter period, with peak activity during June to August each year.

The comparison of influenza identification data between APACI member countries is difficult due to a lack of standardisation in data collection and variability in climatic and seasonal conditions. However, the surveillance data for influenza A(H1N1), A(H3N2) and B viruses over multiple years from the eight countries spanning the Asia-Pacific climatic region indicate a continuous or near-continuous circulation of influenza viruses. Annual variations were apparent within each country and geographical region, with increased activity during the rainy seasons in tropical and subtropical countries, while more temperate countries showed peaks of influenza activity during their respective winter seasons. Season-by-season comparison also highlighted the fluctuating proportions of influenza subtypes in contributing to total influenza activity (Figures 10–13).

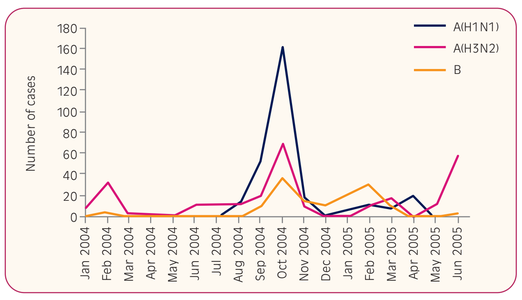


Figure 1. Monthly influenza data collected in Thailand between January 2004 and June 2005.

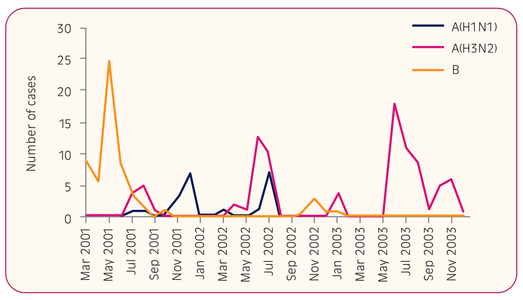


Figure 2. Monthly influenza data collected in Vietnam between March 2001 and November 2003. Data courtesy of the US Centers for Disease Control and Prevention and the National Influenza Surveillance Scheme, Vietnam.

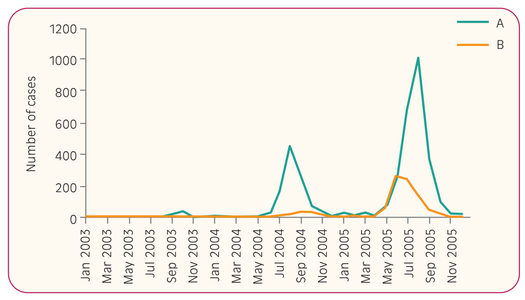


Figure 3. Monthly influenza data collected in Australia between January 2003 and December 2005.

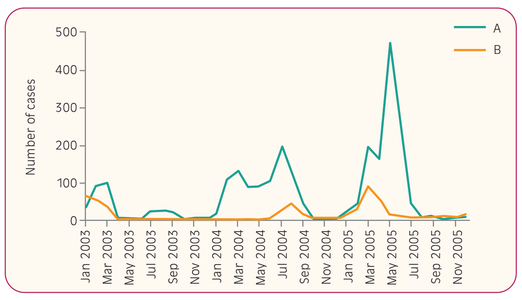


Figure 4. Monthly influenza data collected in Hong Kong between January 2003 and December 2005.

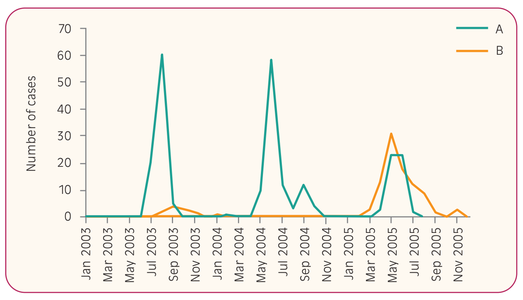


Figure 5. Monthly influenza data collected in the Philippines between January 2003 and December 2005.

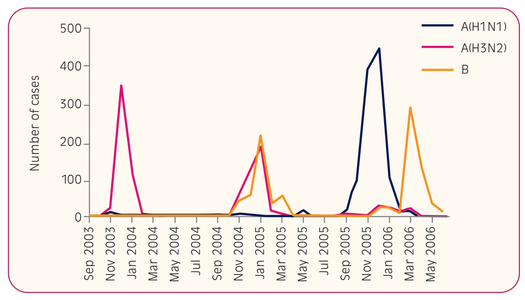


Figure 6. Monthly influenza data collected in northern China between September 2003 and June 2006.

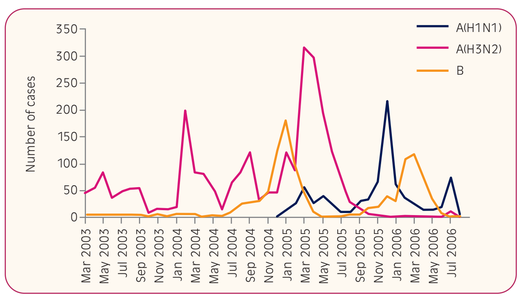


Figure 7. Monthly influenza data collected in southern China between March 2003 and August 2006.

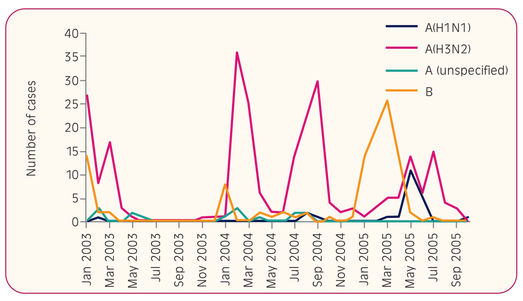


Figure 8. Monthly influenza data collected in Taiwan between January 2003 and October 2005.

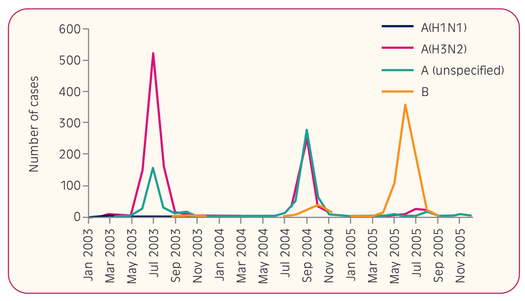


Figure 9. Monthly influenza data collected in New Zealand between January 2003 and December 2005. Data courtesy of the Institute of Environmental Science & Research Limited, Porirua, New Zealand.

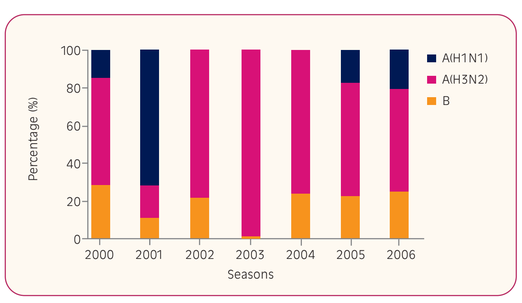


Figure 10. The seasonal proportion of influenza subtypes across the 2000 to 2006 seasons in Australia. Data for seasons from January to December of each year.

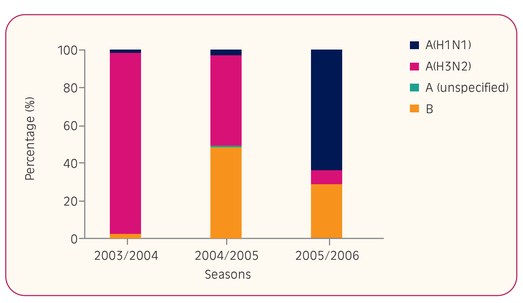


Figure 11. The seasonal proportion of influenza subtypes across three seasons in northern China. Data for the 2003/2004 season were from September 2003 to June 2004, while the data for the 2004/2005 and 2005/2006 seasons were from July to June of the following year.

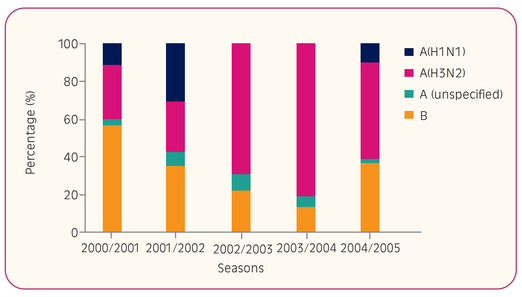


Figure 12. The seasonal proportion of influenza subtypes across five seasons in Taiwan. Data for seasons from July to June of the following year.

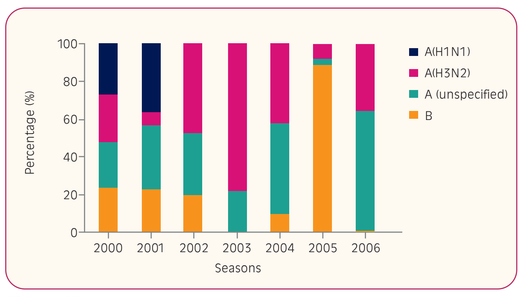


Figure 13. The seasonal proportion of influenza subtypes across the 2000 to 2006 seasons in New Zealand. Data for seasons from January to December of each year. Data courtesy of the Institute of Environmental Science & Research Limited, Porirua, New Zealand.

Conclusions

Every country in the Asia-Pacific region with established surveillance shows evidence of seasonal influenza activity, with almost year-round activity in tropical and subtropical zones and clear periodicity in temperate zones. The seasonality of influenza needs to be better understood in all countries to assist the development of appropriate health policies that identify the best timing of influenza vaccine administration with the most recent vaccine composition. It is hoped that the data presented will be beneficial in shaping influenza vaccination policy: awareness of influenza periodicity and seasonality in the Asia-Pacific region is an important step in tackling the disease burden of seasonal influenza.

References

1. Simonsen L. The global impact of influenza on morbidity and mortality. *Vaccine* 1999; 17 (Suppl 1): S3–10. **2.** Viboud C, Alonso WJ, Simonsen L. Influenza in tropical regions. *PLos Med* 2006; 3 (4): e89. **3.** Hampson AW. Epidemiological data on influenza in Asian countries. *Vaccine* 1999; 17 (Suppl 1): S19–23. **4.** Shek LP, Lee BW. Epidemiology and seasonality of respiratory tract virus infections in the tropics. *Paediatr Respir Rev* 2003; 4: 105–11. **5.** Simmerman JM, Thawatsupha P, Kingnate D, Fukuda K, Chaising A, Dowell SF. Influenza in Thailand: a case study for middle income countries. *Vaccine* 2004; 23: 182–7. **6.** Simmerman JM, Lertiendumrong J, Dowell SF *et al.* The cost of influenza in Thailand. *Vaccine* 2006; 24: 4417–26. **7.** Chiu SS, Lau YL, Chan KH, Wong WH, Peiris JS. Influenza-related hospitalizations among children in Hong Kong. *N Eng J Med* 2002; 347: 2097–103. **8.** Yap FH, Ho PL, Lam KF, Cheng YH, Peiris JS. Excess hospital admissions for pneumonia, chronic obstructive pulmonary disease, and heart failure during influenza seasons in Hong Kong. *J Med Virol* 2004; 73: 617–23. **9.** Wong CM, Yang L, Chan KP *et al.* Influenza associated weekly hospitalization in a subtropical city. *PLos Med* 2006; 3 (4): e121. **10.** Russell CA, Jones TC, Barr IG *et al.* The global circulation of seasonal influenza A (H3N2) viruses. *Science* 2008; 320: 340–6. **11.** World Health Organization. Global agenda on influenza – adopted version. Part I. *Wkly Epidemiol Rec* 2002; 77: 179–82. **12.** Stöhr K. The global agenda on influenza surveillance and control. *Vaccine* 2003; 21: 1744–8.

Acknowledgements

We are grateful to those who were involved in the collection of influenza data for this study. These include clinicians and public health and laboratory personnel across the Asia-Pacific region.