Impact of pandemic (H1N1) 2009 on Australasian critical care units

Kelly Drennan, Peter Hicks and Graeme Hart

ABSTRACT

Objective: To identify the resource usage by patients with influenza A H1N1 admitted to Australian and New Zealand intensive care units during the first wave of the pandemic in June, July and August 2009.

Design, setting and participants: Data were collected in two separate surveys: the 2007–08 resource and activity survey and the 2009 influenza pandemic survey. Participants comprised 143 of the 189 Australian and New Zealand critical care units identified by the Australian and New Zealand Intensive Care Society Centre for Outcome and Resource Evaluation (ANZICS CORE). Mean length of stay (LOS) and ventilation data for H1N1 patients were reported by the ANZIC Influenza Investigators study from the same units over the same time period. Mean LOS for all ICU admissions was obtained from the ANZICS CORE adult patient database 10-year study.

Main outcome measures: H1N1 patient admissions as a proportion of all ICU admissions; H1N1 patient bed-days as a proportion of total bed-days; ventilation resource usage by H1N1 patients; changes in ICU admissions for elective surgery during the H1N1 pandemic.

Results: Over the period June–August 2009, among 30 222 ICU admissions to 133 ICUs contributing data, 704 patients (2.3%) had H1N1 influenza A. Twenty-eight units had no H1N1 patient admissions. The peak of the pandemic in Australia and New Zealand occurred in July 2009, when H1N1 patients represented 3.7% of all ICU admissions for July and 53.5% of all H1N1 patient admissions in the period June–August 2009. We estimate that H1N1 cases required approximately 12.4% of the ventilator resources and used 8.1% of total patient bed-days. During the pandemic, there was a 3.2 percentage-point reduction in elective admissions to public hospitals (from 32.5% to 29.3%).

Conclusion: Low rates of admission of H1N1 patients to ICUs during the 2009 pandemic enabled the intensive care system to cope with the large demand when analysed at a jurisdictional level.

Crit Care Resusc 2010; 12: 223–229

In April 2009, the H1N1 influenza A virus infected Australia and New Zealand. This pandemic was the first to occur since the advent of critical care with the ability for prolonged ventilation support. The aim of our study was to measure the effect of the H1N1 pandemic on the provision of critical care services in Australia and New Zealand during the first wave of the pandemic, in June, July and August 2009.

Methods

Survey design

We conducted a two-part survey using an established methodology within the ANZICS CORE (Australian and New Zealand Intensive Care Society Centre for Outcome and Resource Evaluation) that has achieved a 95% response rate in previous studies.[1,2] Part I, the "resource and activity survey", was a retrospective paper-based survey of intensive care units covering the financial year period 1 July 2007 to 30 June 2008. Part II, the "pandemic survey", was a prospective observational study focusing on influenza and pandemic data. Part II was divided into four sections: Section 1 addressed the unit's surge capacity, ICU environment and policy; Sections 2–4 addressed activity and clinical practice in June, July and August 2009, respectively. Case definitions for influenza A and H1N1 were the same as those used by the ANZIC Influenza Investigators in an earlier report.[3] All 189 ICUs in Australia and New Zealand were invited to participate. Parts I and II of the survey were administrated separately, with distribution and follow-up conducted via email, telephone and fax.

Because of the impending clinical load and information requests, it was considered too difficult to measure total patient hours/days and H1N1-related patient hours/days for each month.

Ventilation

The estimated total number of ventilation hours for H1N1 patients was calculated using the number of patients ventilated multiplied by the average ventilation duration reported by the ANZIC Influenza Investigators.[3] An estimate of the usual number of ventilation hours for all patients was made using the ventilation hours reported in the financial year 2007–08.

Patient bed-days

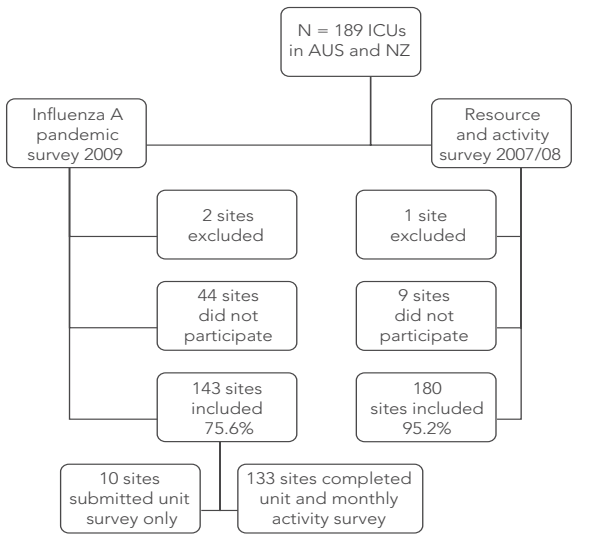
To estimate the number of patient bed-days for H1N1 patients, the mean H1N1 patient length of stay (LOS) reported by the ANZIC Influenza Investigators was multiplied by the number of H1N1 patients.[3] ANZICS CORE provided the mean LOS for all patients admitted to ICUs between 1993 and

2003, which was used to calculate bed-days for all non-H1N1 patients admitted to Australian and New Zealand ICUs.[4]

Considerations

All proportions were calculated as percentages of available data, and results were reported by country/jurisdiction and public/private sector. No assumptions were made for missing data. However, for two hospitals that could not provide 2007–08 admission data, information from the previous year was subsequently used. Data from the Australian Capital Territory and Tasmania were combined to prevent identification. As there are only two public units located in the Northern Territory and neither of these was able to submit data, the Northern Territory is not represented in our analysis.

Figure 1. Response rate of completed 2007–08 resource and activity survey and 2009 pandemic survey



AUS = Australia. NZ = New Zealand.

Data management

The resource and activity survey for the 2007–08 financial year was distributed in October 2008, and the database closed in May 2009. Aggregate unit level data collection is endorsed by the jurisdictional health authorities and did not require specific institutional ethical approval. Information was also provided by the Australian and New Zealand Intensive Care (ANZIC) Research Centre, which conducted an inception cohort investigation on influenza A H1N1 in all Australian and New Zealand ICUs during the same time period.[3]

We report our findings according to STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines for observational studies.[5]

Results

Response rates to the surveys are shown in Figure 1. The response rate to the resource and activity survey was 181/189 (95.8%), of which 180 sites met the minimum survey criteria. The response rate to the pandemic survey was 76.7%, representing 143 hospitals: 103/129 public hospitals (79.8%) and 40/60 private hospitals (66.7%). The units not responding were equally distributed across the tertiary

Table 1. ICU admissions, H1N1 and non-H1N1 admissions, June to August 2009, by jurisdiction

		All ICU admissions				ICU admissions for influenza A H1N1				ICU admissions for influenza A (non-H1N1 or not subtyped)			
Sector/state	Number of ICUs	Jun	Jul	Aug	Total admissions	Jun	Jul	Aug	Total influenza A H1N1	Jun	Jul	Aug	Total influenza A non-H1N1
Public													
NSW	24	2 057	1 910	1 969	5 936	20	110	30	160	7	38	9	54
NZ	21	1 365	1 330	1 336	4 031	13	61	11	85	12	28	3	43
QLD	19	1 382	1 500	1 415	4 297	9	79	78	166	6	10	11	27
SA	6	623	594	598	1 815	7	27	35	69	0	1	3	4
TAS + ACT	4	259	309	293	861	0	15	10	25	1	3	4	8
VIC	22	1 678	1 745	1 768	5 191	43	38	16	97	12	18	6	36
WA	4	450	457	446	1 353	1	30	34	65	0	3	11	14
Total	100	7 814	7 845	7 825	23 484	93	360	214	667	38	101	47	186
Private (total)	33	2 258	2 276	2 204	6 738	1	17	19	37	4	14	9	27
AUS + NZ (total)	133	10 072	10 121	10 029	30 222	94	377	233	704	42	115	56	213

ACT = Australian Capital Territory. AUS = Australia. ICU = intensive care unit. NSW = New South Wales. NZ = New Zealand. QLD = Queensland. SA = South Australia. TAS = Tasmania. VIC = Victoria. WA = Western Australia.

to rural spectrum and, based on 2007–08 survey data, showed no bias for elective surgery or ventilated patients.

Available beds

The 180 ICUs in Australia and New Zealand responding to the 2007–08 survey had 2108 physical beds and 1821 "available" beds (ie, physical beds that were fully staffed and funded). At 1 June 2009, during the first wave of the H1N1 pandemic, the 129 sites that contributed to both the 2007–08 survey and the 2009 pandemic influenza survey were operating at 106% of their average available bed count (1449 v 1359 beds). Reported available beds were 91.2% of total physical capacity (1449/1588).

Patient admissions

Total patient admissions, H1N1 admissions and non-H1N1 influenza A admissions are shown by month and jurisdiction in Table 1 and by ICU classification in Table 2. Over the period June–August 2009, the public sector admitted a total of 23 484 patients, of whom 667 (2.8%) had confirmed influenza A H1N1 (94.7% of a total of 704 patients admitted for H1N1). The private sector admitted 6738 ICU patients over the same period, of whom 37 (0.5%) were confirmed to have influenza A H1N1. The overall admission rate for H1N1 patients was 2.3%. The number of patients presenting with influenza A H1N1 was highest in July 2009. There was an uneven temporal load across jurisdictions.

In public hospitals, the proportion of admissions that were H1N1 admissions was 2.7% in tertiary units (313/11 525), 3.8% in metropolitan units (179/4685), 2.1% in rural/regional units (119/5653) and 3.4% in paediatric units (56/1621).

Twenty-eight units had no H1N1 admissions. For the remaining 105 contributing units, with a cumulative total of 315 months during which an H1N1 patient could be admitted, there were 202 months (64%) with H1N1 admissions and 113 months (36%) with no H1N1 admissions. The highest monthly proportion of H1N1 patients for a unit was 19.4%, and the median was 3.2%.

Interhospital transfers of H1N1 patients

Ninety-four H1N1 patients were transferred to another hospital (82 from public hospitals and 12 from private hospitals). There were 15, 54 and 25 transfers in June, July and August, respectively. This represented 13.3% of all H1N1 admissions and 0.3% of all admissions to the units. Fifty-seven per cent of all transfers occurred in July, the busiest month.

We were not able to follow individual patients or match admissions between hospitals, and it is likely that the 94 transferred patients were double-counted in the total patient admissions. Thus the 704 H1N1 admissions may represent 610 individual patients.

Elective admissions

Elective admission details for June–August 2009 were provided by 129 sites. Over this period, there were 6858 elective admissions to public hospitals and 4826 to private hospitals. Ninety-six units contributed elective admission data to both the 2007–08 survey and the 2009 3-month pandemic survey. During the pandemic there was a 3.2 percentage-point reduction in elective admissions to public hospitals (from 32.5% to 29.3%) and a 3.8 percentage-point reduction in elective admissions to private hospitals (from 77.1% to 73.3%) compared with 2007–08 (Table 3).

July had the highest number of H1N1 admissions. The differences in percentages for each public unit between elective admissions in July 2009 and the 2007–08 year ranged from –29% to 53% (median difference, 3.9% [interquartile range (IQR), –3.0% to 14.5%]).

Ventilation requirements of H1N1 patients

All 105 units that reported at least one H1N1 admission were able to provide ventilation information. Of 704 H1N1 patients, 368 received invasive ventilation only, and 121 received both invasive and non-invasive ventilation. Over two-thirds of all H1N1 patients (69.4%) required some form of mechanical ventilation during their ICU stay. Additionally, 127 H1N1 patients received non-invasive ventilation only.

Table 2. Public hospital ICU admissions, H1N1 and non-H1N1 admissions, June to August 2009, by ICU classification

		ICU admissions				Admissions for influenza A H1N1				Admissions for influenza A (non-H1N1 or not subtyped)			
ICU classification	Number of ICUs	Jun	Jul	Aug	Total admissions	Jun	Jul	Aug	Total influenza A H1N1	Jun	Jul	Aug	Total influenza A non-H1N1
Tertiary	29	3785	3890	3850	11 525	25	181	107	313	9	40	12	61
Metropolitan	29	1605	1502	1578	4 685	34	85	60	179	13	30	21	64
Rural/regional	35	1883	1893	1877	5 653	24	63	32	119	12	25	14	51
PICU	7	541	560	520	1 621	10	31	15	56	4	6	0	10

ICU = intensive care unit. PICU = paediatric ICU.

Table 3. CORE pandemic common sites: proportion of elective patients*

Sector/state	Number of ICUs reporting	2007–08 Admissions	2007–08 Elective admissions	2007–08 % Elective admissions	Pandemic (June to August 2009) Monthly admissions	Pandemic (June to August 2009) Monthly elective admissions	Pandemic (June to August 2009) % Elective admissions
Public							
NSW	15	14 214	3 812	26.8%	3 851	893	23.1%
NZ	15	12 969	3 246	25.0%	3 152	948	30.0%
QLD	15	12 683	5 384	42.5%	3 688	1431	38.8%
SA	4	4 421	1 554	35.2%	1 132	291	25.7%
TAS + ACT	3	2 212	823	37.2%	605	239	39.5%
VIC	17	16 391	5 025	30.7%	4 434	1303	29.3%
WA	4	5 466	2 379	43.5%	1 353	241	18.4%
Total	73	68 356	22 223	32.5%	18 215	5354	29.3%
Private (total)	23	16 501	12 730	77.1%	4 530	3318	73.3%
AUS + NZ (total)	96	84 857	34 953	41.1%	22 745	8672	38.1%

ACT = Australian Capital Territory. AUS = Australia. CORE = Centre for Outcome and Resource Evaluation. ICU = intensive care unit. NSW = New South Wales. NZ = New Zealand. QLD = Queensland. SA = South Australia. TAS = Tasmania. VIC = Victoria. WA = Western Australia. * Based on 96 sites that (i) contributed to the pandemic survey and (ii) provided elective admission details in the 2007–08 survey.

Ventilation data from both the 2007–08 resource and activity survey and the pandemic survey were available from 120 units (Table 4). A total of 134 283.6 ventilation days were provided by these units in the 2007–08 year. Assuming a uniform distribution of ventilation throughout the year, we estimated that the number of invasive ventilation days for this group over a 3-month period would be about 33 570. After removing all transferred patients from the analysis to prevent possible double-counting, there were, conservatively, 606 confirmed H1N1 cases in these 120 units. A minimum of 362 H1N1 patients (59.7%) received invasive ventilation or a combination of both invasive and non-invasive ventilation. The mean duration of mechanical ventilation for influenza A H1N1 patients reported by the ANZIC Influenza Investigators was 11.5 days.[3] Extrapolating from this figure, the 362 ventilated H1N1 influenza patients

Table 4. Predicted ventilation resource usage by patients with H1N1 influenza A, by jurisdiction*

Sector/state	Number of ICUs	Number of H1N1 patients invasively ventilated, Jun–Aug 2009	Estimated invasive ventiation days for H1N1 patients, Jun–Aug 2009	Estimated invasive ventilation days over a 3-month period, 2007–08†	Estimated H1N1 patient ventilation days as % of 2007–08 ventilation days
Public					
NSW	21	70	805	6 958.8	11.6%
NZ	19	37	425.5	4 227.4	10.1%
QLD	19	103	1184.5	6 450.9	18.4%
SA	6	25	287.5	1 921.6	15.0%
TAS + ACT	4	20	230	1 769.4	13.0%
VIC	21	55	632.5	7 516.4	8.4%
WA	3	36	414	2 167.3	19.1%
Total	93	346	3979	31 011.8	12.8%
Private (total)	27	16	184	2 559.1	7.2%
AUS + NZ (total)	120	362	4163	33 570.9	12.4%

ACT = Australian Capital Territory. AUS = Australia. ICU = intensive care unit. NSW = New South Wales. NZ = New Zealand. QLD = Queensland. SA = South Australia. TAS = Tasmania. VIC = Victoria. WA = Western Australia. * These figures are derived from all ICUs that responded with details of invasive ventilation and H1N1 admissions in the 2009 monthly pandemic survey and invasive ventilation data in the 2007–08 resource and activity survey. Transferred patients and patients with seasonal non-H1N1 influenza A were not included in this analysis. † One quarter of total invasive ventilation days for the year 2007–08.

would have used 4163 days of ventilation, or 12.4% of all ventilation days provided.

The same methodology was used to calculate the proportion of ventilation days in July 2009, when the highest number of ventilated H1N1 patients was recorded. Excluding transfers, 53 public units ventilated H1N1 patients and also reported their ventilation days in the 2007–08 survey. The median proportion of ventilation days for individual public units in July was 27% (IQR, 19.1% to 50.3%). There was an estimated total of 2070 ventilation days for H1N1 patients in public ICUs, or 24% of the estimated 8577 ventilation days for the month.

Bed occupancy requirements of H1N1 patients

In a 2009 study by the ANZIC Influenza Investigators, H1N1 patients had a median LOS in the ICU of 7.4 days and a mean of 15.3 days.[3] This compares with a median of 1.8 days and mean of 3.6 days for all patient admissions in Australia and New Zealand over the period 1993–2003.[4] All 133 units contributing to the monthly pandemic surveys were able to provide patient admission numbers. Total patient bed-days were estimated by multiplying the mean LOS by patient admission numbers (Table 5). H1N1 patients represented 2% of patients but required 8.1% of patient bed-days.

The highest occupancy for an individual unit occurred in July, with H1N1 patients comprising 19% of patient admissions and estimated to occupy 50% of the bed-days. For all units in July, the mean and median proportions of H1N1 patient admissions were 3.1% and 1.8%, respectively, and the mean and median proportions of H1N1 patient bed-days were 10.6% and 7.4%, respectively.

Nursing response

Questions regarding absenteeism and overtime during the pandemic were asked, but the responses were variable and could not be adequately standardised. We are only able to report that 96 units (71%) reported shifts that had been affected by absenteeism, and 92 (69%) reported having to run overtime shifts in the ICU. Thirty-three ICUs (26%) reported having to change nursing ratios to extend care as needed.

Discussion

Our study evaluated the effect of the H1N1 pandemic on the critical care system in Australia and New Zealand. This was an unprecedented event for critical care and was predicted to have a significant impact on intensive care capacity.[6] Previous planning for pandemics predicted that resources could be overwhelmed.[7,8]

There were 704 H1N1 admissions to ICUs in addition to a seasonal influenza load of 213 patients. This seasonal influenza load on ICUs has never been documented before, and it is unclear how the number of cases would have altered if H1N1 cases had not been present. The number of

Table 5. Estimated ICU resource usage based on mean length of stay (LOS), June to August 2009, by jurisdiction*

		Total admissions Jun–Aug (excluding H1N1 and transferred patients)		H1N1 patient admissions Jun–Aug			
Sector/state	Number of ICUs	Number of patients	Total bed-days based on mean LOS of 3.6 days	Number of patients	Total bed-days based on mean LOS of 15.3 days	H1N1 patient admissions as % of total admissions	H1N1 patient bed-days as % of total predicted bed-days
Public							
NSW	24	5 756	20 721.6	140	2142.0	2.4%	9.4%
NZ	21	3 923	14 122.8	62	948.6	1.6%	6.3%
QLD	19	4 119	14 828.4	154	2356.2	3.6%	13.7%
SA	6	1 743	6 274.8	66	1009.8	3.6%	13.9%
TAS + ACT	4	833	2 998.8	22	336.6	2.6%	8.9%
VIC	22	5 074	18 266.4	77	1178.1	1.5%	6.1%
WA	4	1 287	4 633.2	64	979.2	4.7%	17.4%
Total	100	22 735	81 846.0	585	8950.5	2.5%	9.9%
Private (total)	33	6 689	24 080.4	25	382.5	0.4%	1.6%
AUS + NZ (total)	133	29 424	105 926.4	610	9333.0	2.0%	8.1%

ACT = Australian Capital Territory. AUS = Australia. ICU = intensive care unit. NSW = New South Wales. NZ = New Zealand. QLD = Queensland. SA = South Australia. TAS = Tasmania. VIC = Victoria. WA = Western Australia. * Data were included for all patients admitted during the pandemic period except for 94 transferred patients.

H1N1 admissions does not match the number reported in the ANZIC Influenza Investigators study, as several large units were unable to respond to our survey.

H1N1 patients represented 2.3% of patients admitted to the ICU during the study period and occupied 8.1% of total patient bed-days. While the admission numbers are smaller than expected and suggest a manageable impact overall, our study reveals a patchy and variable intensity impact on ICUs that is obscured in jurisdictional level reporting.

The double-counting of transferred patients would not have affected the validity of measuring the number of admissions or the changes in elective admissions, but it would influence the strength of assessing the percentage of ventilation days and patient bed-days. Therefore, a conservative approach was taken of removing all transferred patients from the ventilation and LOS calculations presented in Table 4 and Table 5. Transfers out were not uniformly distributed across the units, with metropolitan units most affected.

The clinical characteristics of the illness included significant respiratory failure, with 69.4% of affected patients requiring mechanical ventilation — almost double the proportion of patients invasively ventilated in Australia during the 2006–07 financial year (35.1%).[9] We estimate that 12.4% of the ventilator days would have been used by H1N1 patients, although they represented only 2.3% of admissions (Table 4). This is a substantial workload for staff, particularly given the severity of the respiratory disease, the requirement for isolation nursing care and need for extracorporeal membrane oxygenation.[10]

We postulated that if H1N1 patient admissions exceeded a unit's capacity, there would be a significant reduction in elective admissions. Overall, there was a 3.2 percentage-point reduction in public hospital elective admissions and a 3.8 percentage-point reduction in private hospital elective admissions. Reasons for this small overall effect include the fact that only 78% of units had any H1N1 patient admissions, and that the study period was 3 months while the pandemic wave was typically 6 weeks, with a 2-week residual effect. Assessment of individual units during July 2009 showed a much larger effect for some units. However, the purpose of our study was to assess the impact on the whole system.

About 69% of ICUs ran overtime shifts, and 26% of ICUs broke their normal nursing ratios to provide care within the unit. This may indicate that additional beds were used to help manage elective and H1N1 admissions. It may also have been due to absenteeism, but anecdotal reports suggest there was a low incidence of staff infection from seasonal influenza.

The ability of the units to cope was assisted by the mild nature of the disease. In Victoria, prospective assessment of the initial 10-week pandemic period by the Victorian Department of Human Services identified a 5% gross attack rate and 0.3% hospitalisation rate, with ICU admissions being 20% of hospital admissions. The majority of cases in the community were subclinical or minimally symptomatic and did not require admission to the hospital or ICU.[11]

There was still scope within the system to respond to increased demand above the burden created by the H1N1 pandemic at a jurisdictional level. Additional capacity can be created by cancelling more elective surgery.

Conclusion

Patients with influenza A H1N1 represented only a small proportion of admissions during the June–August 2009 pandemic period. However, their heavy resource requirements created a major impact on the activity within critical care units. At a jurisdictional level, ICUs in Australia and New Zealand accommodated the surge in service demand without any apparent adverse affect on elective activity.

Acknowledgements

We thank all the Australian state and territory departments of health and the New Zealand Ministry of Health for their ongoing assistance with ANZICS CORE funding and activity. We acknowledge the tremendous assistance of the ANZIC Research Centre, in particular the efforts of Michael Bailey. The hard work of the medical, nursing and research staff in ICUs throughout Australia and New Zealand is highly appreciated and recognised. We thank them for collecting, collating and submitting data.

Author details

Kelly Drennan, Senior Research Officer[1,2]
Peter Hicks, Director, ANZICS CORE Critical Care Resources,[1] and Medical Director[3]
Graeme K Hart, Chair,[1] and Director[4]

1 Australian and New Zealand Intensive Care Society Centre for Outcome and Resource Evaluation (ANZICS CORE), Melbourne, VIC.
2 Department of Epidemiology and Preventive Medicine, Monash University, Melbourne, VIC.
3 Intensive Care Unit, Wellington Hospital, Wellington, New Zealand.
4 Department of Intensive Care, Austin Health, Melbourne, VIC.
Correspondence: Kelly.Drennan@anzics.com.au

References

1 Martin JM, Hart GK, Hicks P. A unique snapshot of intensive care resources in Australia and New Zealand. *Anaesth Intensive Care* 2010; 38: 149-58.
2 Drennan K, Hart GK, Hicks P. Intensive care resources and activity: Australia and New Zealand 2007/2008. Melbourne: ANZICS, 2010. http://www.anzics.com.au/core/reports (accessed Apr 2010).

3 ANZIC Influenza Investigators. Critical care services and 2009 H1N1 influenza in Australia and New Zealand. *N Engl J Med* 2009; 361: 1925-34.

4 Moran JL, Bristow P, Solomon P, et al. Mortality and length-of-stay outcomes, 1993–2003, in the binational Australian and New Zealand intensive care adult patient database. *Crit Care Med* 2008; 36: 46-61.

5 von Elm E, Altman DG, Egger M, et al. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. *J Clin Epidemiol* 2008; 61: 344-9.

6 Moreno RP, Rhodes A, Chiche JD. The ongoing H1N1 flu pandemic and the intensive care community: challenges, opportunities, and the duties of scientific societies and intensivists. *Intensive Care Med* 2009; 35: 2005-8.

7 Anderson TA, Hart GK, Kainer M. Pandemic influenza — implications for critical care resources in Australia and New Zealand. *J Crit Care* 2003; 18: 173-80.

8 Menon DK, Taylor BL, Ridley SA. Modelling the impact of an influenza pandemic on critical care services in England. *Anaesthesia* 2005; 60: 952-4.

9 Drennan K, Hart GK, Hicks P. Intensive care resources and activity: Australia and New Zealand 2006/2007. Melbourne: ANZICS, 2008.

10 Davies A, Jones D, Bailey M, et al. Extracorporeal membrane oxygenation for 2009 influenza A (H1N1) acute respiratory distress syndrome. *JAMA* 2009; 302: 1888-95.

11 Lum ME, McMillan AJ, Brook CW, et al. Impact of pandemic (H1N1) 2009 influenza on critical care capacity in Victoria. *Med J Aust* 2009; 191: 502-6. ❑