A multicentre evaluation of two intensive care unit triage protocols for use in an influenza pandemic

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The concept of triage can be used to allocate medical resources in mass casualty events, such as a natural disaster, where the volume of patients presenting for medical attention exceeds the capacity to provide effective health care. Triage systems to allocate critical care resources have not yet been used in an influenza pandemic.

The outbreak of pandemic (H1N1) 2009 influenza required the provision of critical care services to large numbers of patients in Australia and New Zealand. In New South Wales, there were 519 intensive care unit (ICU) beds available to service a population of 7.2 million people. Equipment stockpiles could increase statewide ventilation capacity in a pandemic, but only by an additional 70%.

Towards the end of the pandemic, in July 2009, the NSW Department of Health instituted a triage protocol to manage ICU resources during an influenza crisis when the surge in demand exceeded capacity by 50% (Box 1). The NSW triage protocol predominantly used criteria from a Minnesota protocol and added an element from a Canadian protocol, the Ontario Health Plan for an Influenza Pandemic (OHPIP; Box 2).

As the NSW triage protocol was instituted as a mandatory policy directive, our primary objective was to determine the increase in ICU bed availability that would result from its use. Our second objective was to compare this increase in bed availability with that from use of the OHPIP triage protocol.

Methods

Setting and patients

This prospective evaluation study was conducted in eight adult, general tertiary referral ICUs in NSW and Queensland, in the period after the 2009 influenza pandemic. Approval was obtained from the human research ethics committees of each institution, and the requirement for consent was waived.

All patients admitted to the ICUs were screened. Patients who had elective surgery were excluded, as it was expected that all elective surgery would be cancelled during an influenza pandemic. All remaining patients were evaluated by an ICU doctor using both the NSW and OHPIP triage protocols, to determine whether they qualified for admission to the ICU in a simulated pandemic situation. Patient admission and management were not actually altered by the study. The ICU experience of the assessing doctor varied between study centres, ranging from registrar to consultant level. After admission, the patients were re-evaluated using the NSW protocol at 12 and 72 hours, and the OHPIP protocol at 48 and 120 hours, to determine whether they should be discharged from the ICU.

Each ICU chose a continuous 6-week observation period. Data were collected between September 2009 and May 2010.

Triage protocols

The triage protocols are described in Box 1 and Box 2. In brief, the NSW triage protocol had three tiers, which could be activated in a stepwise, time-based fashion as demand for critical care services increased. Tier 1 excluded patients from ICU admission if they had significant multiple organ failure, and discharged patients after 12 or 72 hours if they failed to respond to treatment. Tier 2 excluded patients with clinical conditions perceived to be associated with a poor prognosis, in addition to patients already excluded by Tier 1. Tier 3 was designed to expand on Tier 2’s list of clinical exclusion criteria, but at the time of the policy’s introduction, only the Sequential Organ Failure Assessment (SOFA) scoring system from the OHPIP triage protocol had been incorporated.

The OHPIP triage protocol had one tier and differed from the NSW protocol in its patient selection criteria. It only admitted patients who required mechanical ventilation or haemo-
defined as the percentage of the total bed-days actually spent by patients in the ICU after the triage protocols had theoretically excluded them from admission or discharged them from the ICU. Increase in ICU bed availability was calculated at admission to the ICU and at each protocol’s re-evaluation time points.

**Data collection**

At ICU admission, data were collected on patients’ age, sex, APACHE II (Acute Physiology and Chronic Health Evaluation) score (higher scores indicate greater severity of illness), and diagnosis (as defined by the Australian and New Zealand Intensive Care Society Centre for Outcome and Resource Evaluation Adult Patient Database). Patients were followed up to discharge from or death in the ICU.

**Statistical analysis**

Descriptive statistics were calculated for all study variables. Continuous variables are reported as means and standard deviations. Increase in ICU bed availability was calculated as a percentage of the mean number of beds available per ICU per day (=standard error). Bed availability results were compared using Pearson’s χ² test. Statistical analysis was performed by an independent statistician using Excel 2003 (Microsoft, Redmond, Wash, USA), SPSS version 17.0 (IBM, Armonk, NY, USA) and Confidence Interval Analysis (CIA) version 1.2 (BMJ Publishing Group, London, UK).

**Results**

Of 1262 patients admitted to the ICUs during the study period, 457 (36.2%) were excluded because they were admitted after elective surgery. The remaining 805 patients (63.8%) were evaluated using the NSW and OHPIP triage protocols. Complete data were collected for all patients.

There were 135 beds available for use in the eight ICUs during the study period (mean, 16.9±5.2 beds per day per ICU). Demographic data of the patients are shown in Box 3. Patients had a mean length of stay in the ICU of 5.4±7.8 days and occupied 4350 bed-days (76.7% of 5670 total available bed-days). The overall ICU mortality rate was 11.7% (94 deaths).

Box 4 shows the cumulative increase in ICU bed availability resulting from evaluating patients using each tier of the NSW triage protocol at admission, 12 hours and 72 hours, and using the OHPIP protocol at admission, 48 hours and 120 hours. There were significant differences in the increase in ICU bed availability at admission between all tiers of the NSW triage protocol and the OHPIP protocol (P < 0.001).

Using the NSW triage protocol at admission, the increases in ICU bed availability using Tiers 1, 2 and 3 were 3.5%, 14.7% and 22.7%, respectively (P < 0.001). The incremental increases in ICU bed availability at 12 hours after admission using Tiers 1, 2 and 3 were 19.2%, 16.1% and 14.1%, respectively.
1. Assess whether the patient meets the inclusion criteria
   - If yes, proceed to step 2
   - If no, reassess patient later to determine whether clinical status has deteriorated
2. Assess whether the patient meets the exclusion criteria
   - If no, proceed to step 3
   - If yes, the patient is excluded from critical care
3. Proceed to prioritisation tool — initial assessment

### Exclusion criteria
The patient is excluded from admission or transfer to critical care if any of the following is present:
- A. Severe trauma
- B. Severe burns of patient with any two of the following: age > 60 years; > 40% of total body surface area affected; inhalational injury
- C. Cardiac arrest: unwitnessed cardiac arrest; witnessed cardiac arrest, not responsive to electrical therapy; recurrent cardiac arrest
- D. Severe baseline cognitive impairment
- E. Advanced untreatable neuromuscular disease
- F. Metastatic malignant disease
- G. Advanced and irreversible immunocompromise
- H. Severe and irreversible neurological event or condition

### Inclusion criteria
The patient must have one of the following:
- A. Requirement for invasive ventilatory support
- B. Hypotension with clinical evidence of shock refractory to fluid resuscitation, and requiring vasopressor or inotrope support

### Triage protocols
2. Ontario Health Plan for an Influenza Pandemic triage protocol*

#### Initial (admission) assessment
- Exclusion criteria met or SOFA score > 11
- SOFA score < 7 or single organ failure
- SOFA score 8–11

**Criteria**  
**Action or priority**

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<th>48-hour assessment</th>
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| Exclusion criteria met or SOFA score > 11 | Discharge from critical care
| SOFA score < 11 and decreasing | Highest priority for access to critical care resources
| SOFA score stable at < 8 with no change | Intermediate priority for access to critical care resources
| No longer dependent on ventilator | Discharge from critical care

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<th>120-hour assessment</th>
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| Exclusion criteria met or SOFA score > 11 | Discharge from critical care
| SOFA score < 8 with no change | Highest priority for access to critical care resources
| SOFA score > 11 and decreasing progressively | Intermediate priority for access to critical care resources
| SOFA score < 8 with minimal decrease (< 3-point decrease in past 72 hours) | Discharge from critical care
| No longer dependent on ventilator | Discharge from critical care

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NYHA = New York Heart Association. COPD = chronic obstructive pulmonary disease. FEV1 = forced expiratory volume in 1 second. PaO2 = partial pressure of arterial oxygen. VC = vital capacity. TLC = total lung capacity. SOFA = Sequential Organ Failure Assessment. ICU = intensive care unit.

* Reproduced with permission. The triage protocol applies to all patients undergoing assessment for possible critical care and not only those with influenza-like symptoms. Patients excluded from admission to or discharged from critical care should have non-ICU-level medical treatment continued and be given palliative care if required. Also used in Tier 3 of the New South Wales triage protocol (see Box 1).
patients excluded or discharged from the ICU. The NSW protocol focused on excluding patients with significant organ failures or comorbidities at admission. Fewer patients fulfilled the NSW exclusion criteria, resulting in smaller bed availability savings. The OHPIP protocol made more beds available early in the triage process by excluding the large proportion of patients admitted to the ICU being mechanically ventilated.

The justification for excluding patients with high predicted mortality rates from ICU care in a triage protocol is that they are less likely to survive, and therefore less likely to have outcomes improved by ICU care. However, selective application of triage criteria may be considered ethically unjust if patients with similar ICU mortality rates are treated differently. It is therefore important that mortality rates for patients excluded by triage protocols are accurately determined.

Future studies should evaluate influenza pandemic triage protocols in real pandemic situations and determine whether they can be improved. Complex computerised simulation may represent an alternative, although less rigorous, evaluation method. Future studies should evaluate these protocols in different medical jurisdictions. Research also needs to determine whether such restrictive measures are acceptable to the communities in which they will be used in a public health crisis.

In conclusion, when tested in a non-pandemic setting, both the NSW and OHPIP triage protocols provided increases in ICU bed availability, but the OHPIP protocol provided the greatest increase overall. Using the NSW triage protocol, ICU bed availability increased as the protocol was escalated.