

Commentary

Not *if* but *when*; no longer *why* but *how*

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See related research by Zanier *et al.*, <http://ccforum.com/content/11/1/R7>

Abstract

There is accruing evidence that information technology can improve patient health care, with several trials of technology showing smaller numbers of medication errors, or can provide earlier detection of adverse events. Critics of this type of research point out that better resolution of events is of no value unless their direct management influences clinical outcome. Nevertheless, indirect evidence is available, such as reports indicating the importance of providing specialist neuro-critical care in the management of patients with traumatic brain injury. These studies do not indicate which aspects of critical care management are crucial, but management aimed at the earlier detection and treatment of adverse events must be partly responsible. We continue to hope for definitive controlled trial evidence that information technology-led management yields improved patient outcome, but our experience so far of funding and conducting such studies has been poor. There is no question that we need better monitoring and event detection technology for health care and that we need more research into optimising that technology, but should their adoption depend on large-scale clinical trials? Perhaps now the questions we need to focus upon are no longer *if* but *when*, and no longer *why* but *how*.

In this issue, Zanier and colleagues [1] conducted a study showing that although computer-monitored end-hour data is accurately reflected by the nurses' chart value, more complex summary measures (such as the detection of an intracranial pressure (ICP) of more than 20 mmHg) are less accurate. Their finding that at least one-third of secondary insults for raised ICP are not identified from the nursing chart is similar to that reported by Corrie and colleagues [2], who also found a similar detection error rate for other signals such as blood pressure, particularly the events of shorter duration. Importantly, Zanier's paper has further shown that when data are categorised in terms of percentage of time spent with raised ICP, the patients exhibiting instability in ICP were most prone to underestimation of ICP insults. The data sampling rate may be pertinent here: Zanier's study sampled at 600 samples per minute, whereas other studies used 1 sample per minute [2] or as few as 4 samples per hour [3].

There is accruing evidence that information technology can improve patient health care. The article by Bates and Gawande [4] describes several trials of technology that have reduced medication errors, decreased errors of omission from poor handoffs between clinicians and provided earlier detection of adverse events. For example, Kupermann and colleagues [5], in a randomized controlled trial of technology for the early detection of adverse events, showed an 11% reduction in time to treatment and a 29% reduction in the duration of dangerous conditions to patients. Rosenfield and colleagues [6] conducted a study of information technology-based remote monitoring of a 10-bed intensive care unit and reported a reduction in mortality of more than 40% and a reduced length of stay of 30% in comparison with historical controls.

Critics of this type of research point out that better resolution of events is of no value unless their direct management influences clinical outcome. Single-centre studies with small numbers of patients are not suited to answer such questions, and multi-centre randomised controlled trials validating information technology-driven management are neither readily funded nor easily justified as a research priority. Paradoxically, the patient populations that may benefit most from better information technology-based event detection, such as patients with brain injury, are the most challenging in which to conduct a controlled management trial because of a continuing inter-centre management variation [7,8] fostered in large part by a lack of evidence for any type of effective therapy [9].

Nevertheless, indirect evidence is available and continues to come forward. There are increasing numbers of reports indicating the importance of providing specialist neuro-critical care in the management of patients with traumatic brain injury [10-12]. For example, the report by Patel and colleagues [10] on 2,300 patients treated in non-neurosurgical hospitals showed a 2.15-fold increase in the odds of death compared with those treated in a neurosurgical centre. These studies do

ICP = intracranial pressure.

not indicate which aspects of critical care management are crucial, but management (whether surgically or medically focused) aimed at the earlier detection and treatment of adverse events must be partly responsible. In support of this, and at the risk of annoying enthusiasts of evidence-based medicine, neurointensive care centres with a track record in the aggressive management of secondary insults continue to report improvements in outcome statistics of patients compared with historical controls [13].

The Brain Monitoring with Information Technology (BrainIT) group have been strong proponents for the adoption of information technology methods for the early detection and management of secondary insults in patients with brain injury [14]. Analyses in progress by this group on 200 head-injured patients' minute-by-minute physiological data obtained from 22 neurointensive care centres across Europe also may indicate that more complex summary measures, such as the Pressure–Time Index [15], relate better to clinical outcome than do simple measures such as the mean or the median.

We continue to hope for definitive controlled trial evidence that information technology-led management yields improved patient outcome, but our experience so far of funding and conducting such studies has been poor. Surely our research time and funds are better spent on trialling new forms of management without the need to conduct controlled trials of new health care support systems as well? I am inclined to agree with the sentiments of Socrates as portrayed in the 'letter of dissent' [16], when arguing against 'Enthusiasticus' (for evidence-based medicine), that perhaps the loudest supporters of evidence-based medicine are the hospital accountants keen to keep health care costs down. There is no question that we need better monitoring and event detection technology for health care and that we need more research into optimising that technology, but should their adoption depend upon large-scale clinical trials? Perhaps now the questions we need to focus upon are no longer *if* but *when*, and no longer *why* but *how*.

Competing interests

The author declares that they have no competing interests.

References

1. Zanier E, Ortolano F, Ghisoni L, Colombo A, Losappio S, Stocchetti N: **Intracranial pressure monitoring in intensive care: clinical advantages of computerised monitoring over manual recording.** *Crit Care* 2007, **11**:R7.
2. Corrie J, Piper I, Housely A, Tocher J, Anderson S, Midgley S, Slattery J, Dearden N, Miller J: **Microcomputer based data recording improves identification of secondary insults in head injured patients.** *Br J Intensive Care* 1993, **May/June**:226-233.
3. Venkatesh B, Garrett P, Fraenkel DJ, Purdie D: **Indices to quantify changes in intracranial and cerebral perfusion pressure by assessing agreement between hourly and semi-continuous recordings.** *Intensive Care Med* 2004, **30**:510-513.
4. Bates D, Gawande A: **Improving safety with information technology.** *N Engl J Med* 2003, **348**:2526-2534.
5. Kuperman GJ, Teich JM, Tanasijevic MJ: **Improving response to critical laboratory values with automation: results of a randomised controlled trial.** *J Am Med Assoc* 1999, **6**:512-522.
6. Rosenfield BA, Dorman T, Breslow MJ, Pronovost P, Jenckes M, Zhang N, Anderson G, Rubin H: **Intensive care unit telemedicine; alternative paradigm for providing continuous intensive care.** *Crit Care Med* 2000, **28**:3925-3931.
7. Stocchetti N, Penny K, Dearden M, Braakman R, Cochaon F, Iannotti F, Lapierre F, Karimi A, Maas A, Murray G, *et al.*: **Intensive care management of head-injured patients in Europe: a survey from the European Brain Injury Consortium.** *Intensive Care Med* 2001, **27**:400-406.
8. Bulger E, Nathens A, Avery B, Rivara F, Moore M, Mackenzie E, Jurkovich G: **Management of severe head injury: institutional variations in care and effect on outcome.** *Critical Care Med* 2002, **30**:1870-1876.
9. Narayan R, Michel M and the Clinical Trials in Head Injury Study Group: **Clinical trials in head injury.** *J Neurotrauma* 2002, **19**:503-557.
10. Patel H, Bouamra O, Woodford M, King A, Yates D, Lecky F: **Trends in head injury outcome from 1989 to 2003 and the effect of neurosurgical care: an observational study.** *Lancet* 2005, **366**:1538-1544.
11. Varelas PM, Eastwood D, Yun H, Spanaki M, Haccin B, Kessaris C, Gennarelli T: **Impact of a neurointensivist on outcomes in patients with head trauma treated in a neurosciences intensive care unit.** *J Neurosurg* 2006, **104**:713-719.
12. Clayton T, Nielson R, Manara A: **Reduction in mortality from severe head injury following introduction of a protocol for intensive care management.** *Br J Anaesthes* 2004, **93**:761-767.
13. Elf K, Nilsson P, Enblad P: **Outcome after traumatic brain injury improved by an organised secondary insult program and standardised care.** *Crit Care Med* 2002, **30**:2129-2134.
14. **Neuro-Intensive Care Monitoring Research Group** [<http://www.brainit.org>]
15. Chambers I, Jones P, Milly L, Forsyth R, Fulton B, Andrews P, Mendelow D, Mins R: **Critical thresholds of intracranial pressure and cerebral perfusion pressure related to age in paediatric head injury.** *J Neurol Neurosurg Psychiatry* 2006, **77**:234-240.
16. Smith, D: **Evidence based medicine: Socratic dissent.** *BMJ* 1995, **310**:1126-1127.