International Journal for Quality in Health Care 2006; **Volume 18, Number 6:** pp. 452–457
Advance Access Publication: 19 October 2006
10.1093/intqhc/mzl054

Voluntary incident reporting by anaesthetic trainees in an Australian hospital

LIADAINE FREESTONE, STEPHEN N. BOLSIN, MARK COLSON, ANDREW PATRICK AND BERNIE CREATI

Department of Anaesthesia, The Geelong Hospital, Geelong, Victoria, Australia

Abstract

Objective. To assess the reporting of critical incidents by anaesthetic trainees using personal digital assistants. The project also identified the reporting of 'near miss' incidents by anaesthetic trainees.

Design. Comparison of electronic incident reporting with retrospective case note review of cases in which no incident was reported.

Setting. A 400-bed university teaching hospital in Victoria.

Participants. Fourteen accredited Australian and New Zealand College of Anaesthetists (ANZCA) registrars and their training supervisors.

Interventions. Registrars and supervisors underwent initial training for 1 hour and were provided with ongoing support. The cases and incidents reported to the database using the portable digital assistants were analysed.

Main outcome measures. These were the total number of anaesthetics reported to the database; the number of incidents reported to the database; the outcome severity of incidents reported; and the number of incidents detected in the case note review that were not reported to the database.

Results. An incident was reported for 156 (3.5%) of 4441 anaesthetic procedures reported to the database. Of these incidents, 72 (46.2%) were 'near misses'. One incident was identified in a review of 208 case notes, which had no incidents reported electronically, and was not reported to the database electronically. This gives a reporting rate of 99.52% [95% confidence interval (CI) 96.9–100%].

Conclusions. ANZCA trainees in routine anaesthetic practice can reliably use mobile computing technology to report critical incidents and 'near miss' incident data.

Keywords: adverse events, anaesthesia, critical incidents

Reliable critical incident reporting in health care has been notoriously hard to achieve [1–5]. Various authors have described different rates of incident reporting, but even limited adverse occurrence screening has achieved an estimated level of incident recording of around 50% [6,7]. The value of incident reporting and analysis has recently been emphasized by the Australian Incident Monitoring Study group [8]. In this article, Runciman [8] uses the usual definition of an adverse event as 'an unintended injury or harm to a patient, caused by health care management rather than a disease process, which led to hospitalization, prolongation of hospital stay, morbidity at discharge or death'.

In 2001, the Division of Perioperative Medicine, Anaesthesia & Pain Medicine in the Geelong Hospital introduced a personal professional monitoring programme based on personal digital assistants (PDAs) [9]. The programme facilitated critical incident reporting at the point of care and the production of performance charts for practical procedures in anaesthesia. The initial analysis reported a 2.5% critical incident reporting rate in 1690 anaesthetics provided to patients logged in the database [9]. The number of sites involved prevented a retrospective analysis of the case notes to identify critical incidents documented in the case notes that were not reported via the programme.

To identify the true critical incident reporting rate, it is necessary to identify adverse events reported in the case notes or by other routes (e.g. Morbidity & Mortality or Australian Incident Monitoring Study reports) that were not reported via the programme. This case note review was undertaken according to guidelines from previous studies, for one of the contributory hospitals (the Geelong Hospital), to attempt to identify retrospectively the level of voluntary incident reporting using the programme [3].

This article describes the results of the data collection with respect to the rate of critical incidents in the anaesthetic practice of a Victorian tertiary hospital. The study also evaluates

Address reprint requests to Stephen N. Bolsin, Department of Anaesthesia, The Geelong Hospital, Geelong, Victoria, Australia. E-mail: steveb@barwonhealth.org.au

the number of incidents that resulted in patient harm relative to those in which no patient harm occurred. This allows an estimate of the 'near miss' incident rate, which may be very valuable in reducing future adverse events. The relationship of these incident rates provides information on the applicability of the Heinrich ratio to current health care practice [9,10]. Finally, the study provides an estimate of the fraction of critical incidents occurring in this setting that are actually reported to the database.

Materials and methods

Both the Barwon Health Research and Ethics Committee and the Asoka Database Access Management Committee approved the data collection and analysis. The analysis was carried out in the Geelong hospital as previously described and extended from August 2001 to February 2004 [9].

Eight anaesthetic critical incident categories were provided to facilitate incident reporting. The categories were derived from the anaesthetic and safety literature and represented the best incident reporting categories available at the time the programme was written in 1999. Each category of incident when 'tapped' on the PDA screen displayed subcategories of incident that could then be reported. These are summarized in Table 1 along with the frequency of each type of incident and the outcome of the incident.

Each incident reported had to be categorized with one of four possible outcomes for the patient. Four outcomes were provided and these were death, major adverse outcome (increased length of hospital stay or permanent patient harm), minor adverse outcome (transient patient harm, no increased length of stay), and uneventful incident with no adverse outcome for the patient.

The 'near miss' critical incidents were defined as the 'uneventful' category of outcome for reported incidents.

The case note review was undertaken by one of the authors using criteria from published studies [3]. Before the case note review, two other authors (S.N.B. and M.C.) were also assigned to review incidents in which there was any doubt about the classification of the incident and the classification of the outcome. The case note review only revealed one adverse incident attributable to the anaesthetic procedure, and there was no disagreement between the authors about its classification.

Results

During the study period, the number of patients undergoing anaesthesia reported to the database was 4441 in the Geelong hospital. One hundred and fifty-six of these anaesthetics had a reported incident using the PDA programme. This represents a critical incident rate of 3.54%.

The number of incidents and 'near miss' incidents reported to the database are summarized in Table 2. Seventy-two of the 156 incidents reported represent 'near miss' incidents where no patient harm occurred, including any prolongation of in hospital stay or permanent patient damage. This gave a 'near miss' incident reporting rate in this study of 46.2%.

To calculate the percentage of actual critical incidents that were experienced by the registrars, it was necessary to examine the case records of those patients in which no critical incident had been reported. The sample size calculations were undertaken to establish a confidence interval (CI) that would be statistically significant.

The number of cases examined with no incident reported was 208. In this sample, only one incident was identified that could have given rise to a report in the database.

This incident occurred when a 5-year-old male undergoing elective day surgery grommets insertion had a general anaesthetic with laryngeal mask airway (LMA) and spontaneous respiration. At the end of the procedure, on removal of the LMA, bile-stained fluid was noted on the LMA but not in the hypopharynx. The child developed tachypnoea and arterial oxygen desaturation (measured by pulse oximetry) in the recovery area. This was attributed to aspiration of stomach contents and was treated with overnight admission and oxygen therapy via a facemask. The child was discharged well, the following day.

One incident detected in 208 case notes where no incident had been reported via the programme represents a false-negative incident reporting rate of 0.48% (95% CI 0–3.1%). Thus, the incident reporting rate of the trainee anaesthetists was 99.52% (95% CI 96.9–100%).

Using the case note review as the 'Gold standard' for detecting incidents that should have been reported, it can be extrapolated that one case in 208 not reported represents $4285 \times 1/208 = 20.5$ extra cases that should have been reported to the database.

This gives a sensitivity estimate for a report of 88.4% (95% CI 54.0–100%).

The specificity for a positive incident report is 100%.

Discussion

The data from this study indicate that accredited anaesthetic registrars will report critical incidents occurring in their anaesthetic practice at the rate of 3.54 per hundred cases undertaken. Furthermore, the rate of critical incidents reported is likely to be as high as 98% of the actual number of critical incidents that occur in their practice. This is the highest rate of critical incident reporting that has been reported in the medical or health care safety literature and represents a considerable advance on previous studies [3,7,11].

One of the weaknesses of this study is the lack of an accepted nomenclature for critical incidents in health care [8]. The adoption of a standardized classification of incidents in health care could easily be incorporated into this electronic incident reporting system. Despite the lack of clear definitions at the time the programme was authored, the definitions provided by the Patient Safety International website were adopted to guide the case note review [12].

Table 1 Categories and subclassification for incident reporting with numbers of incidents and outcomes

Incident type	Subclassification	No.	Outcome grade			
			Uneventful	Minor	Major	Death
Airway						
	Accidental extubation	1		1		
	Difficult intubation	40	23	17		
	Endo-bronchial intubation	0				
	Failed intubation	3	2		1	
	Non-ventilation	1	1			
	Obstruction—including vomit/spasm	17	7	10		
	Oesophageal intubation	3	2		1	
	Trauma	1		1		
	Other	2	1	1		
	Suboptimal assistance	0				
Cardiovascular						
	Anaemia—severe (<70 g/l)	4	1	3		
	Cardiac arrest	2				2
	Dysrhythmia requiring intervention	6	1	3	2	
	Hypertension—significant	4	2	2		
	Hypotension—significant	12	5	4	3	
	Myocardial ischaemia	5	1	3	1	
	Myocardial infarction	1		1		
	Pulmonary oedema	0				
	Other	0				
	Suboptimal assistance	0				
Respiratory						
	Aspiration	2		2		
	Bronchospasm	0				
	Desaturation (<90% >30 seconds)	7	3	4		
	Pneumothorax	0				
	Respiratory arrest	1	1			
	Unplanned post-op ventilation	0				
	Unplanned post-op ICU admit	1			1	
	Other	0				
	Suboptimal assistance	0				
Central nervous system						
	Awareness	0				
	Cerebrovascular accident	2	1		1	
	Delayed emergence	0				
	Hiccoughs	0				
	Seizure	0				
	Other	1		1		
	Suboptimal assistance	0				
Equipment						
	Anaesthetic machine	2	2			
	Circuit	1	1			
	Disconnection	5	3	2		
	Monitor	1		1		
	Other	2		2		
	Suboptimal assistance	0				

continued

Table 1 *continued*

Incident type	Subclassification	No.	Outcome grade			
			Uneventful	Minor	Major	Death
Pharmacological						
	Allergic phenomenon	2			2	
	Inappropriate drug	0				
	Interaction	0				
	Overdosage	3	1	2		
	Side effect	2	1	1		
	Wrong drug	1	1			
	Other	2		2		
	Suboptimal assistance	0				
Regional/ procedural						
	Dural tap	5	2	2	1	
	High block	0				
	Nerve damage	0				
	Paraesthesia	0				
	Trauma	0				
	Vascular injection	2	2			
	Other	12	9	3		
	Suboptimal assistance	0				
Temperature						
	Hyperthermia	0				
	Hypothermia (<35°C)	0				
	Suboptimal assistance	0				

Table 2 PDA reports by outcome of case note review: figures for negative PDA reports are an estimate based on an extrapolation from a subsample of one positive case note review from 208 negative PDA reports

PDA reports	Case note review		
	Positive	Negative	Total
Positive	156	0	156
Negative	20.5	4264.5	4285
Total	176.5	4264.5	4441

Sensitivity = 88.4% (confidence intervals 54.0–100%), specificity = 100%.

The fact that only one adverse event was described in the case notes made inter-rater and intra-rater analysis of the case note review particularly easy. However, it was clear from the first case note reviewer that only one incident was documented in the case notes. Some authors of articles on case note review have discussed the limitations of retrospective case note review to detect adverse incidents in health care [13,14]. In contrast this study used case note review to confirm that no incidents had been recorded in the patient record when no incident had been reported via a PDA-based incident reporting program.

The methodology may have contributed to the high apparent rate of voluntary incident reporting because it is possible that critical incidents were not recorded in the anaesthetic or recovery record. This is unlikely to have accounted for many adverse incidents and is not likely to have contributed to a large difference between the reported incident rate and the observed incident rate. The reason for this conclusion is that the registrars were prepared to report critical incidents with minor or no adverse outcomes for the patient and certainly routinely reported incidents that would not have been recorded in the case notes. These events are unlikely to have been detected by any morbidity or mortality surveillance or by case record review, and yet the registrars reported the incident. Furthermore, there was only one critical incident with a serious adverse outcome that was not reported. All serious adverse outcomes would have been documented in the case notes and would therefore be available for comparison with the PDA reporting programme. This confirms that the culture of incident reporting in registrars can be encouraged to a very high degree [15].

Vincent, Firth-Cozens, and Waring, in the UK, Barach, Gawande, and Shojania, in the US, and Kingston, in Australia, have recently identified professional and institutional reasons given by doctors and nurses for not reporting poor care in hospitals [4,5,16–21]. These considerations do not appear to have influenced the trainees in this organization during this study. Firth-Cozens identified lack of confidence or trust in organizational management as a significant barrier to reporting.

In our study, the registrars were informed that reported incidents were anonymous and would not be used to judge or discriminate against those reporting. In fact, incident reporting is seen as a valuable contribution to future patient safety and an activity that helps to prevent colleagues from suffering similar difficulties in the future [15]. This explanation is delivered by a well-known health care safety expert and whistle blower, who emphasizes the non-punitive nature of the data collection [22,23]. This explanation repeated over time, coupled with the publication record of the authors in the area of improving health care safety, has created an atmosphere of trust in incident reporting within the Division of Perioperative Medicine, Anaesthesia & Pain Management that has supported a high level of incident reporting [15,24,25].

Kingston *et al.* [5] identified the ability to undertake rapid incident reporting as being a requirement for incident reporting in both hospital nursing and medical staff. Incident reporting using the programme in this study takes <5 seconds. We can confirm that if a simple rapid and available method is provided to anaesthetic trainees, they will complete reliable incident reporting.

The observation that of the incidents reported 46.2% had no impact on patient outcome compared with 53.8% that had a serious outcome for the patient or death indicates that the Heinrich ratio described for US industrial accidents in 1931 may not apply to complex health care delivery in the 21st century [10]. This is hardly surprising given that the Heinrich ratio was derived from a 1926 study of over 5000 cases of industrial accident but relates to a theoretical 330 average accidents of the same kind *and involving the same person* (original italics) [10]. The Heinrich ratio of 1:29:300 concluded that there are 300 'no injury' and 29 'minor injury' accidents for every one major injury accident [10]. Furthermore, a subsequent study in 1969 by Frank Bird Jr reported an analysis of 1,753,498 accidents covering over 3 billion work hours and demonstrated that there are 600 'no injury or damage', 30 'property damage', and 10 'minor injury' accidents for every serious or disabling accident [26]. This led Petersen and Roos to conclude 'there are different ratios for different accident types, for different jobs, for different people etc.'. Thus, the finding, for a group of anaesthetic registrars, the ratio of 1 'no injury' to 1 major injury incident applies, may indicate the first detailed confirmation of the Heinrich ratio (46.2–64%) for this area of health care and is consistent with our earlier study [9,10].

The fact that 46.2% of the critical incidents reported by anaesthetic trainees had no adverse outcome indicates that in a supportive and blame-free environment, accredited anaesthetic registrars will report >96% of the critical incidents occurring in their practice is a striking and encouraging observation. In effect, the trainees are prepared to identify shortcomings in the ability to deliver the highest quality service to their patients, and this represents a form of whistle blowing on their own clinical practice [15]. We believe that this requires the juxtaposition of both the portable computing technology and the correct environment for reporting to occur and that both features will favourably transform the culture of the trainees in reporting critical incidents [27–30]. Both features are present in the Geelong Hospital Division of Perioperative Medicine, Anaesthesia & Pain Management, and this organizational culture and adoption of mobile computing technology are a likely explanation of the rate of incident reporting achieved [15]. This culture and the associated technology represent the highest standards of clinical governance available to the speciality and should be encouraged throughout Australia [25,31–33]. Other authors have recognized and documented the fact that honesty in patient management in the face of adverse events will lead to reduced legal costs over time and use of this technology to promote honest and open incident reporting is likely to reduce the costs of medical and systemic error in health care [34,35].

The ability to gather critical incident data to improve the safety of health care is well recognized [8]. The timely and efficient feedback of this information to clinical risk managers and safety staff should ensure a reduction in adverse occurrences in health care organizations in the future [7]. All the incidents reported via the programme in the Geelong hospital are automatically e-mailed to the Divisional Quality Manager for feedback to morbidity and mortality meetings and review. Incidents with serious outcomes (major adverse outcome or death) are automatically e-mailed to the hospital Risk Manager for immediate analysis [30].

References

1. Wilson RM, Runciman WB, Gibberd RW, Harrison BT, Newby L, Hamilton JD. The quality in Australian healthcare study. *Med J Aust* 1995; **163:** 458–471.
2. Wilson RM, Harrison BT, Gibberd RW, Hamilton JD. An analysis of the causes of adverse events from the Quality in Australian Health Care Study. *Med J Aust* 1999; **170:** 411–415.
3. Vincent C, Neale G, Woloshynowych M. Adverse events in British hospitals: preliminary retrospective record review. *Br Med J* 2001; **322:** 517–519.
4. Vincent C, Stanhope N, Crowley-Murphy M. Reasons for not reporting adverse incidents: an empirical study. *J Eval Clin Pract* 1999; **5:** 13–21.
5. Kingston MJ, Evans SM, Smith BJ, Berry JG. Attitudes of doctors and nurses towards incident reporting: a qualitative analysis. *Med J Aust* 2004; **181:** 36–39.
6. Wolff AM. Limited adverse occurrence screening: using medical record review to reduce hospital adverse patient events. *Med J Aust* 1996; **164:** 454–461.
7. Wolff AM, Bourke J, Campbell IA, Leembruggen DW. Detecting and reducing hospital adverse events: outcomes of the Wimmera clinical risk management program. *Med J Aust* 2001; **174:** 621–625.
8. Runciman WB. Lessons from the Australian Patient Safety Foundation: setting up a national patient safety surveillance system – is this the right model? *Qual Saf Health Care* 2002; **11:** 246–251.
9. Bent P, Creati B, Bolsin SN, Colson M, Patrick A. Professional monitoring and critical incident reporting using personal digital assistants. *Med J Aust* 2002; **177:** 496–499.

10. Heinrich HW, Petersen D, Roos N. *Industrial Accident Prevention*. New York: McGraw-Hill, 1980.

11. Runciman WB, Webb RK, Helps SC *et al*. A comparison of iatrogenic injury studies in Australia and the USA II. reviewer behaviour and quality of care. *Int J Qual Health Care* 2000; **12:** 379–388.

12. Glossary of Terms: Patient Safety International, 2004: http://www.patientsafetyint.com/Glossary.aspx Accessed August 2006.

13. Leape LL, Brennan TA, Laird N *et al*. The nature of adverse events in hospitalized patients. Results of the Harvard Medical Practice Study II. *N Engl J Med* 1991; **324:** 377–384.

14. Thomas EJ, Studdert DM, Burstin HR *et al*. Incidence and types of adverse events and negligent care in Utah and Colorado. *Med Care* 2000; **38:** 261–271.

15. Bolsin SN. Whistle blowing. *Med Educ* 2003; **37:** 294–296.

16. Shojania KG, Wald H, Gross R. Understanding medical error and improving patient safety in the inpatient setting. *Med Clin North Am* 2002; **86:** 847–867.

17. Gawande AA, Zinner MJ, Studdert DM, Brennan TA. Analysis of errors reported by surgeons at three teaching hospitals. *Surgery* 2003; **133:** 614–621.

18. Barach P, Small SD. Reporting and preventing medical mishaps: lessons from non-medical near miss reporting systems. *Br Med J* 2000; **320:** 759–763.

19. Firth-Cozens J, Firth RA, Booth S. Attitudes to and experiences of reporting poor care. *Clin Governance* 2004; **8:** 331–336.

20. Firth-Cozens J. Barriers to incident reporting. *Int J Qual Health Care* 2002; **11:** 7.

21. Waring JJ. A qualitative study of the intra-hospital variations in incident reporting. *Int J Qual Health Care* 2004; **16:** 347–352.

22. Smith R. All changed, changed utterly. British medicine will be transformed by the Bristol case. *Br Med J* 1998; **316:** 1917–1918.

23. Bolsin SN, Colson M. Making the case for personal professional monitoring in health care. *Int J Qual Health Care* 2003; **15:** 1–2.

24. Bolsin S, Colson M. The use of statistical process control methods in monitoring clinical performance. *Int J Qual Health Care* 2003; **15:** 445.

25. Bolsin SN, Solly R, Patrick A. The value of personal professional monitoring performance data and open disclosure policies in anaesthetic practice: a case report. *Int J Qual Health Care* 2003; **12:** 295–297.

26. Bird F. *Management Guide to Loss Control*. Atlanta: Institute Press, 1974.

27. Bolsin S, Faunce T, Oakley J. Practical virtue ethics: healthcare whistleblowing and portable digital technology. *J Med Ethics* 2005; **31:** 612–618.

28. Morton A. The use of statistical process control methods in monitoring clinical performance. *Int J Qual Health Care* 2003; **15:** 361–362.

29. Shortell SM. Physician involvement in quality improvement. Issues, challenges, and recommendations. In Blumenthal D, Scheck A, eds. *Improving Clinical Practice*. San Francisco: Jossey-Bass, 1995: 205–228.

30. Bolsin S, Patrick A, Creati B, Colson M, Freestone L. Electronic incident reporting and professional monitoring transforms culture. *Br Med J* 2004; **329:** 51–52.

31. Bolsin S, Patrick A, Colson M, Creatie B, Freestone L. New technology to enable personal monitoring and incident reporting can transform professional culture: the potential to favourably impact the future of health care. *J Eval Clin Pract* 2005; **11:** 499–506.

32. Bolsin SN, Faunce T, Colson M. Using portable digital technology for clinical care and critical incidents: a new model. *Aust Health Rev* 2005; **29:** 297–305.

33. Bolsin SN. League tables & professionalism. *Aust Health Rev* 2001; **24:** 1–4.

34. Kraman S, Hamm G. Risk Management: extreme honesty may be the best policy. *Ann Intern Med* 1999; **131:** 963–967.

35. Kraman S. A risk management program based on full disclosure and trust: Does everyone win? *Complimentary Ther* 2000; **27:** 253–257.

Accepted for publication 17 September 2006