Introduction of a Prehospital Critical Incident Monitoring System—Final Results

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Abstract

Background: Incident monitoring has been shown to improve patient care and has been adopted widely in the hospital care setting. There are limited data on incident monitoring in the prehospital setting.

Hypothesis: A high-yield, systems-oriented, incident monitoring process can be implemented successfully in a prehospital setting.

Methods: This prospective, descriptive study outlines the implementation of an incident monitoring process in a regional prehospital setting. Both trauma care and non-trauma care were monitored by a system of anonymous reporting and chart review with debriefing for trauma cases that met major trauma criteria. A committee reviewed all identified cases and coded and logged all incidents and provider recommendations.

Results: There were 454 incidents identified from 230 cases (mean = 2.0; 95% CI 1.8–2.1 per case). Anonymous reporting resulted in the identification of 113 incidents from 69 cases (1.61 per case 95% CI = 1.4–1.9 per case). Major trauma cases generated 266 incidents from 134 cases (mean = 2.0; 95% CI = 1.8–2.2 per case), and there were 74 incidents from 26 combined cases (mean = 2.9; 95% CI = 2.2–3.5 per case). One incident was uncategorized. There were 315 (69.4%) incidents categorized as management problems and 123 (27.1%) were system problems. Prolonged scene time was the most common incident in both management and system categories; 56 (17.8%) and 18 (14.6%) respectively. Mitigating circumstances were found in 111 (24.4%) incidents. The most common incident-related patient outcome was none/near miss (127 (28%)). Incident monitoring most commonly led to generalized feedback (105 (23.1%)) or specific trend analysis (140 (30.8%)). Reports to higher or external bodies occurred in 18 incidents (4.0%).

Conclusions: The project has been implemented successfully in a regional prehospital settling. The methodology, utilizing a number of incident detection techniques, results in a high yield of incidents over a broad range of error types. The large proportion of "near miss" type incidents allows for incident assessment without demonstrable patient harm. Many incidents were mitigated and the majority represented management-type issues.

Introduction

In-hospital error and critical incident monitoring processes are well-established and are an important component of clinical governance.[1-5] New technologies and approaches are assisting with these processes, and serious, preventable morbidity and mortality outcomes have been well-documented.[6-11] A critical incident can be defined as any incident that has resulted or has the potential to result in an adverse consequence to a person, equipment, or institution.

Research examining prehospital systems for critical incidents and adverse events is limited.[12] The Victorian Consultative Committee on Road Traffic Fatalities (CCRTF) identified deficiencies in prehospital care that contributed to preventable fatalities in Victorian road traffic crashes.[13-22] Assessment was

by a multidisciplinary committee and was retrospective, but it did not attempt to examine non-fatal incidents, non-trauma incidents, or undocumented incidents. This methodology inherently under reports the number and nature of incidents in the prehospital setting. Other prehospital reports are similar and tend to report on small patient subsets or specific types of critical incidents.[23–27]

In 2002, the Centre for Ambulance and Paramedic Studies at Monash University, Victoria conducted a literature review and national workshop on critical incident monitoring in the prehospital setting.[28] It reported that incident monitoring in this setting was "haphazard at best". It recommended the implementation of a critical incident monitoring process.

The "Critical Incident Monitoring and Audit in a Prehospital Setting Project" was established to implement and evaluate a critical incident monitoring process in a rural/regional setting. The Project had a primary focus on trauma care because of the high risk nature of this area, but had the scope to examine all aspects of prehospital care. The Project was funded by the then Victorian Trauma Foundation, which was superseded by the Trauma Accident Commission Health Research Group.

Prior to this Project, no formal and transparent process was in place.

The purpose of this paper is to outline the implementation process and describe the nature of incidents identified during the project.

Methods
This is a prospective, descriptive study of the implementation of a critical incident monitoring process in a regional prehospital setting. It was a 36-month project with an initial six-months pilot feasibility phase. The Project ran from 01 July 2005 to 30 June 2008. Pilot data were acquired from 06 September to 06 December 2005 and full data acquisition ran from 01 January 2006 to 30 June 2008. The pilot data are reported in a separate paper.[29] The implementation of the process began with focus groups of key stakeholders to determine the broad outline of the project. Intensive education sessions of ambulance personnel and emergency department staff were undertaken, and then, the pilot phase was initiated. Then, the project was refined further using the data and experience obtained from the pilot project.

Setting
This project was a collaboration between the (then) Rural Ambulance Victoria (RAV, now under the umbrella of "Ambulance Victoria") and Barwon Health through the Geelong Hospital Emergency Department. It was conducted in the RAV ambulance Area 1 (Barwon South West Region). This area covers approximately 10,600 square kilometres in South Western Victoria and serves a population of >240,000. It manages 18,000–20,000 cases per year with 112 operational RAV personnel serving the region. The Geelong Hospital is a tertiary, regional center with an adult and pediatric case mix, and is the only public tertiary hospital in the region. It serves all specialties except neurosurgery (cases are transferred to metropolitan neurosurgical centers). The emergency department manages >45,000 patients per annum.

The Critical Incident Monitoring System
The process of incident monitoring was designed to facilitate a non-threatening, systems-oriented overview of critical incidents. Anonymous reporting combined with chart review has been validated in previous hospital settings as a comprehensive way to detect critical incidents.[30] Formal education about the project and its processes were undertaken for both RAV and emergency department personnel. Additional sessions were provided at intervals to reinforce the process.

In this study, critical incident monitoring occurred on several simultaneous levels. Anonymous reporting was available to ambulance staff via a Web-based reporting system in addition to a paper-based version. This also was available to emergency department staff. Complaints received from outside either service were fed into the system through this mechanism by Project staff. The forms were modeled on an existing emergency department, anonymous reporting form, and all reports were confidential, anonymous, and voluntary. Reporting was encouraged for trauma and non-trauma cases. All incidents were logged, investigated, and included in the study data regardless of outcome.

In addition, all major trauma cases as defined by Department of Human Services (DHS) criteria, were subject to a chart review of ambulance and, when necessary, hospital records. Major trauma cases were identified by existing Geelong hospital databases or during routine patient care record audit by the RAV staff when cases were fatal at the scene or transported elsewhere. A predefined template was used to collate relevant facts from the chart review when issues arose.

A further mechanism of "hot debrief" was offered to participants involved in selected major trauma cases. A senior ambulance representative and a consultant emergency physician interviewed ambulance staff involved to elucidate detail or undocumented incidents. This mechanism was employed in cases in which ambulance staff may have raised particular concerns, where significant critical incidents were identified on chart review, or for cases predisposed to error (for example, multi-casualty events). Hot debriefs also could be requested by ambulance staff in non-trauma cases. The hot debriefs also served as an opportunity to provide positive feedback, and were conducted in a non-threatening fashion. All hot debriefs were to be conducted within 14 days of the event.

The Project Management Committee examined all incidents identified at regular intervals (monthly or bimonthly depending on demand). The Committee was composed of senior ambulance personnel and consultant emergency physicians in addition to the research staff. All cases were examined for incidents, and, if identified, these were further classified and categorized using a structured format. Incidents initially were classified into Critical Incident Monitoring System (CIMS) Incident types specifically developed for the study. In addition, they were further classified based on the system employed by the CCRTF study.[20] Incidents also were assessed for the risk from adverse outcome using a frequency and severity of outcome matrix. Any mitigating circumstances were identified and recorded against the incident. A strategy to resolve the

Major Trauma Cases	n	%
Not requiring debrief	126	78.8
Debriefed	22	13.8
Debriefed but >2/52	5	3.1
Failed to debrief	7	4.4
Total	160	100.00

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Table 1—Trauma debrief analysis

Incident Types	Total	%
Communications	101	22.2
Prolonged times	93	20.5
Resources	20	4.4
Equipment	15	3.3
Resuscitation	41	9.0
Other treatment problem	104	22.9
Deviation from CPG*	19	4.2
Diagnostic error	9	2.0
Interference	9	2.0
Injury	1	0.2
Other	42	9.3
Totals	454	100.0

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Table 2—Breakdown of incidents per CIMS incident types

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Figure 1—Trauma incidents by category

Category	n	%	Mitigated	%
System Inadequacy	123	27.1	46	37.4
Management problem	315	69.4	61	19.4
Technique	7	1.5	4	57.1
Diagnosis delay	0	0.0	0	0.0
Diagnosis error	8	1.8	0	0.0
Unknown	1	0.2	0	0.0
Total	454	100.0	111	24.4

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Table 3—Incidents by CCRTF categories

incident was determined and action(s) put into place. All decisions of the Committee were arrived at by consensus.

The coding of incidents and the management that ensued were recorded on a specifically designed Microsoft Access database. Data were processed using Jandel Scientific Sigmastat 2000 Statistical Software and Microsoft Excel.

Ethical and Legal Matters

The Barwon Health Research and Ethics Committee and the RAV Medical Standards Committee both approved the conduct of the study. Written consent was obtained from all participants for the research aspects of the project. Minutes from all meetings and hot debriefs were kept in a secure database and all data were de-identified. Once codified and collated, hard copies were destroyed for confidentiality reasons.
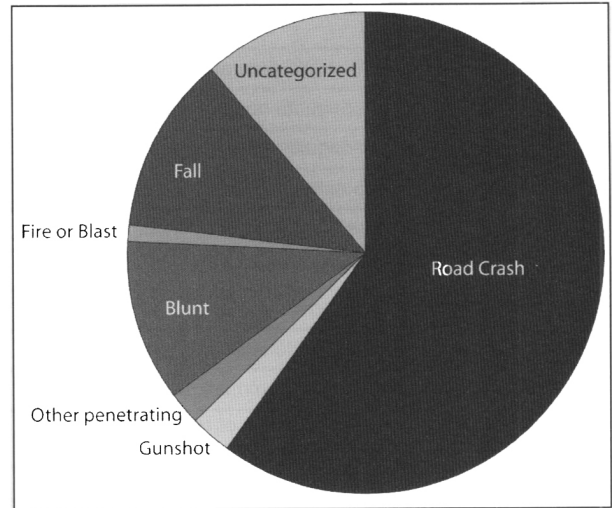
Results

Demographics

During the 2.5 years of data collection, there were 56,883 ambulance responses in the area. There were 230 cases examined of which 69 cases came from anonymous reports, 134 met trauma review criteria, 26 were both anonymous and trauma review cases, and one was not categorized. A breakdown of all trauma analysis is in Table 1.

Incident Analysis

There were 454 incidents identified. There was a mean of 2.0 (95% CI = 1.8–2.1) incidents per case. Anonymous cases resulted in 113 incidents (1.6 incidents per case; 95% CI = 1.4–1.9), while combined cases had 74 incidents (2.9 per case; 95% CI = 2.2–3.5) and trauma cases alone had 266 incidents (2.0 per case; 95% CI = 1.8–2.2). Of the 22 cases successfully debriefed, there were 85 incidents (2.9 per case; 95% = CI 3.0–4.8). The majority of trauma-associated incidents were related to road crashes (Figure 1). The incidents were categorized by CIMS incident type (Table 2).

Other treatment problems and communications issues dominated the categories. One example of a treatment problem was the failure to apply cervical spine precautions to an intoxicated patient involved in a high speed car crash. Inadequate documentation was a common communication problem. Classification of incidents by CCRTF coding categories is presented in Table 3.

Management problems predominated followed by system inadequacies. The top five categories in each type of incident are in Table 4. Scene times featured frequently in both categories. System-related, prolonged scene times often related to multi-casualty episodes that required crews to await the arrival of other crews to assist in processing patients, and hence, were considered mitigated. An example of mitigated, management-related, prolonged scene time was difficult access to a large man with a difficult airway who required

Type of Incident	Category	n	% of Category	n Mitigated	% Mitigated
Management	Prolonged time at scene	56	17.8	24	42.9
	Inadequate documentation	47	14.9	3	6.4
	Inadequate observations	25	7.9	5	20.0
	Inapprop spineboard/no spine board	25	7.9	4	16.0
	Inadequate oxygen monitoring	23	7.3	2	8.7
System	Communication with other services	18	14.6	4	22.2
	Prolonged time at scene	18	14.6	16	88.9
	Other system delivery problems	16	13.0	6	37.5
	Dispatch, communication problems	12	9.8	4	33.3
	Delay in arrival of helicopter/not available	10	8.1	1	10.0

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Table 4—Most common categories of incident by Consultative Committee on Road Traffic Fatalities coding
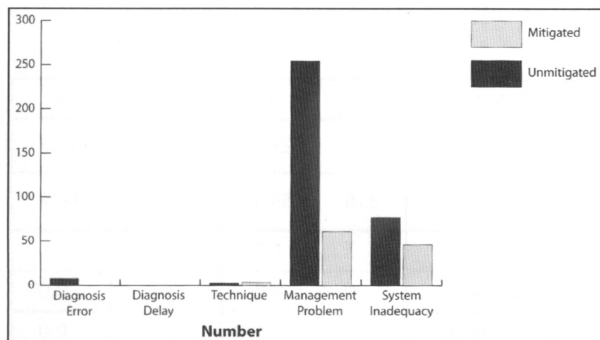
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Figure 2—Mitigated versus unmitigated incidents by category*
*1 case category is unknown

Outcome	n	%
None/Near miss	127	28.0
Minor	124	27.3
Moderate	88	19.4
Major	33	7.3
Death	12	2.6
Unknown	70	15.4
Total	454	100.0

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Table 5—Patient outcomes by incident

intubation. (Access was difficult because of his size and the confined space.) Inadequate documentation was common and only rarely mitigated. Issues in Communication with other services included communication difficulties with the State Emergency (SES), the Country Fire Authority (CFA), Police, and hospital services with safety issues for patients and ambulance staff commonly resulting. An example of mitigated circumstances in this category was a car crash with 11 injured occupants in a chaotic scene with live electricity wires down around the site. No single leader amongst the SES was available to coordinate the safe extrication of patients.

There were 111 mitigated incidents in all (24.4% 95%). The distribution across categories can be seen in Figure 2.

Outcomes
The range of patient outcomes can be seen in Table 5. There were 12 incidents where the outcome of five patients was death. (All categories represent incidents only, not individual patient outcomes. There was no assessment as to whether the incidents contributed to any patient outcome).

Committee Actions
The management committee responses to identified incidents can be seen in Table 6.

The general observation and feedback response consisted of periodic regional RAV Intranet, e-mail, and poster updates of observed study trends. Reports to higher or external bodies included the Medical Standards Committee of RAV, hospital emergency department staff, and other bodies such as Parks Victoria and DHS. The report to Parks Victoria was in response to a mitigated extrication problem of a patient from the mountain bike trails of the You Yangs National Park because of the difficulty in localizing a patient. This resulted in successful collaboration between the various services and the installation of Global Positioning System markers along the trails to more accurately localize any sites of further incidents. Communication in collaboration with the emergency department of Geelong Hospital and DHS resulted in tighter controls over the conditions in which mass sporting events could be organized and run with particular attention to weather conditions and minimum standards of medical care.

Discussion
This study has described the successful implementation of a critical incident monitoring process for a regional prehospital system. At the time of its inception, there was little literature describing incident monitoring in this setting.[12,28] Its design incorporated current successful emergency department process-

Committee Responses	n	%
General observation/feedback	105	23.1
Specific trend analysis	140	30.8
Specific issue RAV-wide education	36	7.9
Feedback to crew	62	13.7
Remedial education	42	9.3
Remedial case review	29	6.4
Report to higher/external body	18	4.0
Other	22	4.8
Total	454	100.0

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Table 6—Responses to identified incidents
(RAV = Rural Ambulance Victoria)

es and others derived from literature review. These were incorporated to compliment existing audit and less formal monitoring systems already in place within the service.

Multifaceted incident detecting approaches have been shown to improve the capture rate and breadth of critical incidents detected.[28,30] The ability to identify incidents via anonymous processes is an important adjunct to chart review and "debrief" processes. It helps overcome barriers of embarrassment and fear (of reprisal, litigation, or censure).[31-33] Web-based reporting methods, chart review, and interview processes, such as debriefing, have all been shown to improve the breadth of incident detection.[28,30,34]

A previously published paper has outlined the initial pilot data results prior to the commencement of the main study.[29] Overall, the number of incidents logged was in keeping with expectations, though overall there was a tapering of the number of anonymous incidents logged over time. System problems predominated in the pilot data (collected over a three-month period), while the main data (collected over a 2.5-year period) showed a predominance of management problems. This may have resulted from initial enthusiasm regarding the project and an avenue for highlighting sometimes frustrating system problems that later dissipated. Whether or not it reflects system improvement is beyond the scope of the study.

The distribution of trauma cases in this study is similar to the pilot data and likely reflects the balance of trauma in Australia with a low incidence of penetrating and fire or blast injury compared to blunt categories of injury mechanism. This profile more closely relates to the United Kingdom pattern of trauma than the United States pattern of trauma.[35]

Different classification styles and a paucity of data make direct comparisons with other incident monitoring processes difficult.[12,25,36-39] In the intensive care unit setting of intrahospital transfers, Beckman identified 61% of incidents as patient/staff management issues.[25] Communication/liaison problems were prominent, with prolonged scene time the most common issue. Other ambulance-based studies have highlighted individual technique- or equipment-related issues such as airway management, chest tubes and cardiopulmonary resuscitation. These types of issues did not figure prominently in this data set.[12,23,24,27]

A qualitative study of emergency service providers in the US highlighted a large proportion of "near-miss" events (44%) in keeping with nearly 30% demonstrated in this quantitative study.[37] "Near miss" events provide an ideal point to examine system processes before a serious adverse event or outcome has occurred. Outcome-based studies (e.g., CCRTF) do not capture near-miss events, and may be at risk of attributing greater importance to an incident because of a poor outcome (outcome bias).[2,3,18,31-33]

This study has several limitations. The process was particularly labor intensive and utilized significant resources (particularly in staff hours, many by staff outside of working hours). The debrief process posed problems because of multiple staff members on roster schedules that conflicted and considerable organization was required. Teleconferencing provided some flexibility as did debriefing smaller groups and individuals. A more selective approach to debriefing cases might have been employed, but debriefs did have a high yield of incidents. The total incidence of error is not able to be established using this methodology because many incidents, in likelihood, remain undetected. A "complete" detection system was beyond the scope and resources of the project. The preventability of incidents was not assessed formally nor was there an attempt to measure the impact of the system on overall outcomes, as this also was beyond the capabilities of the project. There is limited literature on the impact of incident monitoring systems on overall patient outcomes, and it often is difficult to link cause and effect in the complex setting of health care.[4,40-42] All incident systems have a tendency by their nature to focus on the negative aspects of care with no attention given to excellent work practices. An attempt to address this was made during the debriefing process and positive work was acknowledged actively in order to cultivate a productive environment.

The findings of this study and of other papers highlight the ongoing need for further detailed studies into incident and error monitoring systems in the prehospital setting.[12,28,37] The fragmented nature of prehospital services, differences in training and persisting cultural barriers still present widespread difficulties to achieving this.[12,37] Although this study was conducted in a regional/rural setting, the simplicity of its design is translatable to other systems, including an urban setting.

Conclusions

This study describes the successful implementation of an incident monitoring system in a regional prehospital setting. A combination of incident detection techniques proved successful in identifying a broad range of trauma and non-trauma related incidents. A large number of near-miss incidents and minor cases provides the opportunity to examine cases with no or minimal patient harm. The majority of incidents were management in origin and many incidents were mitigated by circumstances.

References
1. Hart GK, Baldwin I, Gutteridge G, Ford J: Adverse incident reporting in intensive care. *Anaesth Intensive Care* 1994;22(5):556–561.
2. Runciman WB, Edmonds MJ, Pradhan M: Setting priorities for patient safety. *Qual Saf Health Care* 2002;11(3):224–229.
3. Runciman WB, Sellen A, Webb RK, Williamson JA, *et al*: The Australian Incident Monitoring Study. Errors, incidents and accidents in anaesthetic practice. *Anaesth Intensive Care* 1993;21(5):506–519.
4. Spigelman AD, Swan J: Review of the Australian incident monitoring system. *A N Z J Surg* 2005;75(8):657–661.
5. Vinen J: Incident monitoring in emergency departments: An Australian model. *Acad Emerg Med* 2000;7(11):1290–1297.
6. Bolsin S, Patrick A, Colson M, *et al*: 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(5):499–506.
7. Brennan TA, Leape LL, Laird NM, *et al*: Incidence of adverse events and negligence in hospitalized patients. Results of the Harvard Medical Practice Study I. *N Engl J Med* 1991;324(6):370–376.
8. Leape LL: Reporting of adverse events. *N Engl J Med* 2002;347(20):1633–1638.
9. Localio AR, Lawthers AG, Brennan TA, *et al*: Relation between malpractice claims and adverse events due to negligence. Results of the Harvard Medical Practice Study III. *N Engl J Med* 1991;325(4):245–251.
10. 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(3):261–271.
11. Wilson RM, Runciman WB, Gibberd RW, *et al*: The Quality in Australian Health Care Study. *Med J Aust* 1995;163(9):458–471.
12. O'Connor RE, Slovis CM, Hunt RC, *et al*: Eliminating errors in emergency medical services: Realities and recommendations. *Prehosp Emerg Care* 2002;6(1):107–113.
13. McDermott FT, Cordner, SM, Tremayne AB: Evaluation of the Emergency and Clinical Management of Road Traffic Fatalities in Victoria 1992–1993. Melbourne: Consultative Committee on Road Traffic Fatalities in Victoria; 31 March 1994.
14. McDermott FT, Cordner SM, Tremayne AB: Evaluation of the Emergency and CLinical Management of Road Traffic Fatalities in Victoria 1993–1994. Melbourne: Consultative Committee on Road Traffic Fatalities in Victoria; 31 March 1995.
15. McDermott FT, Cordner SM, Tremayne AB: Evaluation fo the Emergency adn Clinical Mangement of Road Traffic Fatalities in Victoria January–March 1996. Melbourne: Consultative Committee on Road Traffic Fatalities in Victoria; 30 September 1996.
16. McDermott FT, Cordner SM, Tremayne AB: Evaluation of the Emergency and Clinical Management of Road Traffic Fatalities in Victoria 1996–1997. Melbourne: Consultative Committee on Road Traffic Fatalities in Victoria; 30 September 1997.
17. McDermott FT, Cordner SM, Tremayne AB: A "before and after" assessment of the influence of the new Victorian trauma care system (1997–1998 vs 2001–2003) on the emergency and clinical management of road traffic fatalities in Victoria. Report of the consultative committee on road traffic fatalities in Victoria. Melbourne: CCRTF; 31 December 2003.
18. McDermott FT, Cooper GJ, Hogan PL, *et al*: Evaluation of the Prehospital Management of Road Traffic Fatalities in Victoria, Australia. *Prehosp Disaster Med* 2005;20(4):219–227.
19. McDermott FT, Cordner SM, Cooper DJ, *et al*: Management deficiencies and death preventability of road traffic fatalities before and after a new trauma care system in Victoria, Australia. *Journal of Trauma-Injury Infection & Critical Care* 2007;63(2):331–338.
20. McDermott FT, Cordner SM, Tremayne AB: Evaluation of the medical management and preventability of death in 137 road traffic fatalities in Victoria, Australia: An overview. Consultative Committee on Road Traffic Fatalities in Victoria. *J Trauma* 1996;40(4):520–533; Discussion 533–535.
21. McDermott FT, Cordner SM, Tremayne AB: Consultative Committee on Road Traffic Fatalities: Trauma audit methodology. *Aust N Z J Surg* 2000;70(10):710–721.
22. McDermott FT, Cordner SM, Tremayne AB: Road traffic fatalities in Victoria, Australia and changes to the trauma care system. *Br J Surg* 2001;88(8):1099–1104.
23. Aufderheide TP, Pirrallo RG, Yannopoulos D, *et al*: Incomplete chest wall decompression: A clinical evaluation of CPR performance by EMS personnel and assessment of alternative manual chest compression-decompression techniques. *Resuscitation* 2005;64(3):353–362.
24. Bair AE, Smith D, Lichty L: Intubation confirmation techniques associated with unrecognized non-tracheal intubations by pre-hospital providers. *J Emerg Med* 2005;28(4):403–407.
25. Beckmann U, Gillies DM, Berenholtz SM, *et al*: Incidents relating to the intra-hospital transfer of critically ill patients. An analysis of the reports submitted to the Australian Incident Monitoring Study in Intensive Care.[see comment]. *Intensive Care Medicine* 2004;30(8):1579–1585.
26. Moss SJ, Embleton ND, Fenton AC: Towards safer neonatal transfer: the importance of critical incident review. *Arch Dis Child* 2005;90(7):729–732.
27. Rittenberger JC, Beck PW, Paris PM: Errors of omission in the treatment of prehospital chest pain patients. *Prehosp Emerg Care* 2005;9(1):2–7.
28. Boyle M, Archer F, Macdonald R: Incident monitoring: A review of the literature and development of a pre-hospital model. Melbourne: Monash University; May 2002.
29. Stella J, Davis A, Jennings P, Bartley B: Introduction of a prehospital critical incident monitoring system—Pilot project results. *Prehosp Disaster Med* 2008;23(2):154–160.
30. Beckmann U, Bohringer C, Carless R, *et al*: Evaluation of two methods for quality improvement in intensive care: Facilitated incident monitoring and retrospective medical chart review. *Crit Care Med* 2003;31(4):1006–1011.
31. Barach P, Small SD: How the NHS can improve safety and learning. By learning free lessons from near mistakes. *BMJ* 2000;320(7251):1683–1684.
32. Barach P, Small SD: Reporting and preventing medical mishaps: Lessons from non-medical near miss reporting systems. *BMJ* 2000;320(7237):759–763.
33. Lawton R, Parker D: Barriers to incident reporting in a healthcare system. *Qual Saf Health Care* 2002;11(1):15–18.
34. Nakajima K, Kurata Y, Takeda H: A web-based incident reporting system and multidisciplinary collaborative projects for patient safety in a Japanese hospital. *Qual Saf Health Care* 2005;14(2):123–129.
35. Boyle MJ, Smith EC, Archer FL: Trauma incidents attended by emergency medical services in Victoria, Australia. *Prehosp Disaster Med* 2008;23(1):20–28.
36. Donald M, Paterson B: Introduction of an electronic debrief and governance tool in prehospital care. *Emerg Med J* 2007;24(5):363–366.
37. Fairbanks RJ, Crittenden CN, O'Gara KG, *et al*: Emergency medical services provider perceptions of the nature of adverse events and near-misses in out-of-hospital care: An ethnographic view. *Acad Emerg Med* 2008;15(7):633–640.
38. Beckmann U, Runciman WB: The role of incident reporting in continuous quality improvement in the intensive care setting. *Anaesth Intensive Care* 1996;24(3):311–313.
39. Beckmann U, West LF, Groombridge GJ, *et al*: The Australian Incident Monitoring Study in Intensive Care: AIMS-ICU. The development and evaluation of an incident reporting system in intensive care. *Anaesth Intensive Care* 1996;24(3):314–319.
40. Hayward RA, Hofer TP: Estimating hospital deaths due to medical errors: Preventability is in the eye of the reviewer. *JAMA* 2001;286(4):415–420.
41. Semmens JB, Aitken RJ, Sanfilippo FM, *et al*: The Western Australian Audit of Surgical Mortality: advancing surgical accountability. *Med J Aust* 2005;183(10):504–508.
42. Wolff AM, Bourke J: Detecting and reducing adverse events in an Australian rural base hospital emergency department using medical record screening and review. *Emerg Med J* 2002;19(1):35–40.