

## ORIGINAL ARTICLE

# Medical record review of deaths, unexpected intensive care unit admissions, and clinician referrals: detection of adverse events and insight into the system

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**Aims and Methods:** To determine whether a programme of continuous medical record review of deaths, unexpected intensive care unit (ICU) admissions, and admissions referred by medical and nursing staff for specific review, would provide a range of adverse events from which to gain insight into the healthcare system of a large paediatric referral hospital. A quality assurance programme was commenced in 1996. **Results:** Over a six year period there were 103 255 admissions; 1612 (1.6%) records were reviewed, from which 325 adverse events were detected. Events were associated with operations, procedures and anaesthesia (56.5%), diagnosis and therapy (24%), drug and fluid management (12.6%), and system issues (7%). Medical records were reviewed from 23 of the 28 clinical units. Review of the records and analysis of the adverse events triggered many system changes.

**Conclusions:** The findings suggest that continuous medical record review may be a valuable method for the detection of adverse events and identifying system issues in children's hospitals.

The rate of adverse events for hospitalised children is estimated to be between 1% and 11% based on medical record review,<sup>1,2</sup> and may be as high as 48% using more comprehensive data collection.<sup>3</sup> Adverse events are associated with prolonged length of stay, disability, and death.<sup>1,2</sup> They are a source of anxiety for patients and families and increase the cost of health care.

Analysis of adverse events can provide an understanding of the system in which the event occurred<sup>4</sup> and help to guide strategies for system improvement.<sup>5,6</sup> Adverse events may be detected by a variety of methods. Voluntary incident reporting is used in many hospitals. A review of incident reports at our hospital found that reports are mostly completed by nursing staff and describe events such as medication error, falls, and equipment failure, and rarely events related to misdiagnosis or delayed therapy. Events associated with misdiagnosis or delayed therapy were detected by medical record review in the Harvard<sup>1</sup> and Australian<sup>2</sup> epidemiological studies, and were associated with a poor outcome.

In 1996 we began a quality assurance programme using medical record review of selected admissions to identify adverse events. The aim was to capture a broad range of adverse events including those associated with diagnosis and therapy. In this paper we present the findings from the first six years of the programme, with a focus on: (a) the occurrence of adverse events detected by this method; (b) the insight into the system that the review process and analysis of events provided; and (c) the system changes implemented as a result of the programme.

## METHODS

The hospital is a 250 bed stand alone paediatric hospital with an inpatient population of 25 000 per year, 50 000 emergency department visits per year, and 270 000 outpatient visits per year. The hospital provides the full range of sub-specialty care for the state of Victoria, and receives referrals for quaternary care from neighbouring states and international patients.

There is no obstetric service; admissions to the neonatal intensive care unit are primarily neonates with complex medical or surgical problems rather than specific problems of prematurity.

A programme for reviewing medical records for adverse events was established in 1996 under the auspices of the hospital's quality assurance body, now known as the Patient Safety Committee (PSC), and under the provision of Section 139 of the Victorian Health Services Act 1988 with statutory immunity. As a quality assurance programme, patient consent for review of medical records is not required. Ethics committee approval was obtained for analysis of the database.

Drawing on previous studies<sup>1,2,7</sup> and an in-house pilot study, detailed medical record review was undertaken of admissions in which the patient (i) died, (ii) was unexpectedly admitted to the intensive care unit, (iii) had an unplanned return to the operating theatre, or (iv) a prolonged length of stay (greater than 10 days), or (v) the admission was referred by doctors and occasionally nurses or allied health staff (collectively called "clinicians") for detailed review. We were notified of deaths and prolonged length of stay on a monthly basis from the hospital administration discharge coding database, and return to theatre from theatre lists. Intensive care admissions were obtained initially by reviewing the ICU admission logbook and subsequently by electronic notification from the manager of the ICU database. There were no predetermined criteria for when clinicians should refer an admission. An open door philosophy was adopted to listen to any concerns. The criteria for medical record review were reduced to three (unexpected transfers to the intensive care unit, death, and clinician notification) as the number of patients returning to theatre was low, with a low yield of events, and patients with a prolonged length of stay were often detected by an

**Abbreviations:** CQS, Clinical Quality and Safety Unit; ICU, intensive care unit; PSC, Patient Safety Committee

**Table 1** Admission details

	Year group			Patient characteristics			
	1997-98 (% all admissions)	1999-2000 (% all admissions)	2001-02 (% all admissions)	Total (% all admissions)	Length of stay (median days)	Gender (male)	Age (median months)
All admissions	35773	33617	33865	103255	2	58%	57.04
Medical record reviewed	518 (1.5%)	554 (1.6%)	540 (1.6%)	1612 (1.6%)*	7 (p<0.001†)	56% (p=0.17‡)	13.5 (p<0.001†)
Adverse events detected	146	113	66	271§ (0.3%)	11 (p<0.001¶)	53.5% (p=0.33**)	13.5 (p=0.13¶)

\*1612 admissions of 1564 patients; 36 patients were reviewed on two separate admissions, 6 patients on three separate admissions.

†Random sample of 51 410 admissions v medical record reviewed, Mann-Whitney U test.

‡All admissions v medical record reviewed,  $\chi^2$  test.

§271 admissions affecting 268 patients with a total of 325 adverse events detected.

¶Medical record review v adverse event detected, Mann-Whitney U test.

unexpected admission to the intensive care unit. All patients who suffer a respiratory or cardiac arrest are admitted to the intensive care unit and are detected by "unexpected admission to ICU" criteria.

The records were obtained for review as soon as practical after notification was received. It sometimes took many weeks from the time of death or ICU admission for the record to be obtained and reviewed. Clinician notifications were reviewed within one to two weeks. The medical records were reviewed for adverse events as defined by Wilson and colleagues<sup>2</sup> as an unintended injury or complication which results in disability, death, or prolonged hospital stay and is caused by healthcare management rather than the disease process. Records were reviewed by one of three paediatricians working in what is now known as the Clinical Quality and Safety Unit (CQS). While there was guidance on what constituted an adverse event, owing to the heterogeneous nature of events, judgement on whether an adverse event occurred was made implicitly and by consensus among the physicians. Clinical standards were benchmarked against the hospital's clinical practice guidelines and policies. Further clarification of adverse events was often sought from the treating clinical team. These events were those in which an error was described in the medical record, there was a suggestion in the record that care may have been compromised, or there had been similar events without an overt error but there was an opportunity for system improvement. Clarification was aimed at gathering the facts and not to attribute blame. The medical doctor in charge of the patient was asked to expand on what happened either in writing or in a one-on-one conversation with a physician from the CQS.

We regarded all events as teaching tools, whether preventable or not. Events in this report have not been classified by degree of preventability.

De-identified case reports of adverse events were presented at a monthly meeting of the Patient Safety Committee (PSC). The PSC consists of 12-14 senior clinicians (medical, nursing, and pharmacy) who receive the "story" of the case and who focus on systems issues and make recommendations for improvement. The PSC is charged with reviewing the implementation of such recommendations.

## RESULTS

### The screening process

From 1 January 1997 to 31 December 2002, there were 103 255 admissions (excluding day-stay admissions); 1811 admissions met criteria for detailed review, of which 1612 records were obtained for review (89%) (table 1).

The criteria for record review over the six year period consisted 800 deaths, 1066 unexpected admissions to the ICU, and 43 clinician referrals; some admissions met more than one criteria.

Patients whose records were reviewed were significantly younger and had a longer length of stay than the average patient (table 1). Records were reviewed from 23 of 28 clinical units (82%), with 844 (52.4%) records from general and subspecialty medical units (median age 29.3 mth); 346 (21.5%) from cardiac services consisting of cardiac surgery and cardiology (median age 2.2 mth); 229 (14.2%) from general and other subspecialty surgical units (median age 66.3 mth); and 193 (12%) from neonatology (median age 1 day).

### Adverse events

A total of 325 adverse events were detected during 271 admissions (16.8% of admissions reviewed; 0.26% of total admissions). Patients experiencing an adverse event were of similar age to those reviewed but stayed four days longer (table 1).

Fifty seven per cent of events were related to operations, procedures, or anaesthesia (table 2). While most operative and procedural events occurred in the surgical units, procedural events were also seen among medical units, and drug/fluid events were also seen among surgical units. Drug and fluid events were more prominent among clinician referrals, representing 24% of events in this group.

An adverse event was detected among 68.6% (n = 24) of admissions that met only clinician referral criteria; 20.4% (n = 159) of transfers to the ICU and no death; 16.6% (n = 48) transfer to ICU and death +/- clinician referral; and 7.8% (n = 40) of death and no transfer to ICU.

### Interventions

From detailed analysis of individual and collective adverse events presented to the Patient Safety Committee a number of initiatives were implemented over the six years (box 1).

## DISCUSSION

Medical record review for the identification of adverse events is well established but is often described as a one-off strategy to provide epidemiological data. We have used medical record review of selected admissions since 1996 to detect a broad range of adverse events. Review of the records and analysis of the adverse events triggered many system changes

In our study the criteria for record review was deliberately narrow and involved only 1.6% of all admissions. The number of adverse events is clearly not a true incidence of hospital-wide adverse events. The medical records of patients *expected* to arrive in the intensive care unit (for example, post-surgery or transfer directly to the ICU from outside hospitals) and patients in the neonatal unit, where intensive care is also provided, would have not been reviewed unless the patient died or the admission was notified by a clinician. The intensive care area is associated with a high number of errors that could lead to serious adverse outcome.<sup>9</sup> However, we

**Table 2** Categories of adverse events (AE) in surgical and medical units

AE category*	Surgical unit† (% category total)	Medical unit‡ (% category total)	Category total (% of AE total)
Operative	87 (93%)	7 (7%)	94 (29%)
Procedural	44 (62%)	27 (38%)	71 (22%)
Anaesthesia	14 (78%)	4 (22%)	18 (6%)
Diagnostic	21 (52%)	19 (48%)	40 (12%)
Therapeutic	8 (22%)	29 (78%)	37 (11%)
Drug and intravenous fluid	23 (56%)	18 (44%)	41 (13%)
System issue	14 (58%)	10 (42%)	24 (7%)
Total	211	114	325 (100%)

\*AE category definitions:<sup>2</sup>

*Operative:* an adverse event in relation to an operation.

*Procedural:* an adverse event in relation to a procedure such as insertion of a central venous line, nasogastric tube, cardiac catheterisation, etc.

*Diagnostic:* an adverse event arising from a delayed or wrong diagnosis.

*Therapeutic:* an adverse event arising when a correct diagnosis was made but there was incorrect therapy or a delay in treatment.

*Drug/intravenous fluid:* an adverse event arising from the incorrect administration of a drug or intravenous fluid.

*System issue:* an adverse event in relation to problems with hospital processes such as nosocomial infection or equipment malfunction.

†Surgical units = general and subspecialty surgical units and cardiac services (cardiac surgery and cardiology).

‡Medical units = general and subspecialty medical units and neonatology.

### Box 1: Interventions that took place directly as a result of the screening programme

#### Hardware

- Removal of potentially hazardous products from clinical areas
- Standardisation of drug storage areas on the wards
- Standardisation of equipment
- Reduction in the number of medication charts
- Revision of fluid balance charts

#### Education and training

- Education and training for all staff on patient safety concepts
- Rotation of a paediatric trainee to the Clinical Quality and Safety Unit
- Training in consent and procedural issues for physician staff and drug and fluid management for surgical staff
- Training in certain procedures and conditions, e.g. recognition of septic shock
- Increased requirement for supervision of procedures
- Acute paediatric life support (APLS) training for clinical staff

#### Guidelines and processes

- Introduction of a Medical Emergency Team (September 2002)<sup>8</sup>
- Modification of existing clinical practice guidelines
- Introduction of new clinical practice guidelines, e.g. intravenous fluid guidelines
- Review of hospital processes, e.g. access to after-hours operating theatre

#### Staffing

- Employment of an additional night medical registrar

reviewed the care provided in these areas in the many admissions that met other criteria. A more extensive record review process may be possible with a fully integrated electronic medical record. Such a system could flag potential adverse events from abnormal pathology results, medication errors,<sup>10</sup> deviations in vital signs, key words in clinical narratives,<sup>11, 12</sup> and discharge codes.<sup>13</sup>

Medical record review for the detection of heterogeneous adverse events has been challenged as a reliably reproducible method.<sup>14</sup> We did not set the programme up as a research strategy and the drop in adverse events over time cannot be attributed to the interventions made, even though it may appear compelling to draw this conclusion. We have not presented data that clearly show benefit from a programme such as ours. Surrogate indicators for the benefit of the programme include the extensive use of new and amended clinical practice guidelines, the introduction of the medical emergency team, the number of clinicians regularly attending the Patient Safety Committee meetings, and the allocation of a paediatric trainee (registrar) to the CQS for a three month rotation.

Our programme was led by physicians in contrast to most nursing led quality improvement programmes which may affect the acceptance of such a programme in other settings.<sup>15, 16</sup>

Our study focused on patients with a more severe outcome, including death, with an adverse event rate of 0.26% total admissions. Previous studies using more extensive criteria have reported figures of 2.1%<sup>1</sup> to 10.8%<sup>2</sup> for those under 15 years of age. The range of adverse events reported is similar to our study, with over half the adverse events we identified due to operations and procedures, and 23% (77 events) associated with diagnosis or therapy. In these latter cases it can be difficult to determine whether an adverse event occurred or whether the outcome was due to the disease process. We sought to learn from the case review whether or not an adverse event occurred and whether or not it was preventable. For example, analysis of unexpected ICU admissions of children who had deteriorated on the ward resulted in initiatives such as the medical emergency team.<sup>8</sup> Importantly, lessons were also learnt from averted adverse events and the many situations where good medical care was delivered.

Patient safety indicators based on discharge coding have been proposed to identify children at risk for an adverse event.<sup>13</sup> The three criteria we employed should be considered

### What is already known on this topic

- Adverse events affect 1–11% of hospitalised children
- Improving the system is a key strategy to achieving long term patient safety benefit

as additional candidates. We believe that all child deaths should be reviewed irrespective of the prior risk assessment. This is not only feasible because of the small numbers but mandatory in many jurisdictions. We found the greatest number of adverse events among unexpected ICU admissions. Not unexpectedly the highest yield came from clinician referrals.

Many clinical units have historically undertaken morbidity and mortality review of some sort. While these have merit, our programme involved an additional review by the CQS physician. The advantages were an outsider's viewpoint of what happened, the opportunity to ask questions that may not have been considered, to place events in the context of previous events, and to generalise learnings that arise across the organisation.

Younger patients and those with complex medical needs have been identified as particularly vulnerable to adverse events<sup>13–17</sup> although no case-control studies have been reported. In our study, younger patients were more likely to have their admission reviewed but were not more likely to have experienced an adverse event. We found children experiencing an adverse event had a longer length of stay. We did not adjust for severity of illness, but the impact of adverse events in the time spent away from home and healthcare expenditure may be significant.

Research into adverse events, particularly non-medication events, within health care is at an early stage. There are significant barriers to sophisticated research study design. The perceived threat to physician reputation or from medico-legal action should not be underestimated. In addition, success of this research is dependent on the acceptance and participation of organisations, professional groups, and individuals who may be at varying stages of readiness for investigation in this area. Notwithstanding the limits of descriptive studies, they are revealing both important challenges that will need to be overcome for future research to succeed and opportunities for system intervention. We have shown that continuous medical record review to identify adverse events can be a useful strategy in a quality improvement programme in a large paediatric centre.

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### What this study adds

- A method for the detection of a range of adverse events in paediatric hospitals
- Analysis of admissions can provide insight into the system and lead to system change, even in the absence of an overt adverse event or error

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