



Electronic error-reporting systems: A case study into the impact on nurse reporting of medical errors

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ABSTRACT

Background: Underreporting of errors in hospitals persists despite the claims of technology companies that electronic systems will facilitate reporting. This study builds on previous analyses to examine error reporting by nurses in hospitals using electronic media.

Purpose: This research asks whether the electronic media creates additional barriers to error reporting, and, if so, what practical steps can all hospitals take to reduce these barriers.

Method: This is a mixed-method case study nurses' use of an error reporting system, RiskMan, in two hospitals. The case study involved one large private hospital and one large public hospital in Victoria, Australia, both of which use the RiskMan medical error reporting system.

Conclusion: Information technology-based error reporting systems have unique access problems and time demands and can encourage nurses to develop alternative reporting mechanisms. This research focuses on nurses and raises important findings for hospitals using such systems or considering installation. This article suggests organizational and technical responses that could reduce some of the identified barriers.

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The reduction of errors in hospitals is an important area of research and endeavor. Hospital managers depend on staff reporting errors and events via computer systems and see these systems as faster, more cost-efficient, and an easy way to audit error rates. Nurses, doctors, and other hospital staff simply stop at a computer in their ward, use specific software to enter incidents, and then go on with their work. Executives believe they receive high-quality information about errors in their institutions, are confident they can spot problem areas and system failures, and can move to fix

them quickly. But, do these systems really work? Why then have reporting rates not risen in recent years with these computer systems (Braithwaite, 2008; Pfeiffer, 2010)? Does the technology create barriers that lead staff to refrain from reporting?

This article examines these questions through a case study of RiskMan (incident reporting software, RiskMan International, Melbourne, Australia) from the perspective of nurses and nurse managers in two hospitals. RiskMan covers 80% of beds in the Australian public system and 65% of Australia's private hospitals.

Appendices to this article can be found at http://cis.unimelb.edu.au/people/staff.php?person_ID=5168.

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RiskMan is used by administrators to monitor near misses, sentinel events, and other incidents in hospitals. The results have implications for public safety in both the private and the public hospital systems.

Background

Hospitals worldwide have introduced information technology (IT) systems for medical staff to report adverse events that occur. However, the productivity paradox (Brynjolfsson, 1993) cautions about presuming that all computerization leads to benefits. One study of a computerized error reporting system found that, since implementation, 22.7% of 2185 subjects reported more incidents and 21.8% reported fewer. This is a very small improvement in the total reporting rate given the cost and effort involved (Braithwaite, 2008, p. 230). Despite widespread computerization, underreporting of medical errors by nurses and other medical staff persists (Pfeiffer, 2010).

Previous studies have examined barriers to reporting medical errors, mainly in paper-based systems (Evans et al., 2006; Sanghera, Franklin, & Dhillon, 2007; Ulanimo, O'Leary-Kelley, & Connolly, 2007; Vincent, 2007). There are several reasons behind a failure to report medical errors including fear, a belief that reporting will not result in improvements (Evans et al., 2006; Leape, 1999), and a lack of feedback from management (Evans et al., 2006; Kingston, Evans, Smith, & Berry, 2004; Sanghera et al., 2007; Walker & Lowe, 1998) linked to a lack of management support or pressure for reporting (Sanghera et al., 2007). Nurses fear appearing incompetent and being judged by peers and management (Chiang & Pepper, 2006; Mayo & Duncan, 2004; Sanghera et al., 2007; Schelbred & Nord, 2007; Ulanimo et al., 2007) and coworkers may be unsupportive (Evans et al., 2006). Nurses also fear disciplinary action (Sanghera et al., 2007); 18% (Evans et al., 2006), 16% (Ulanimo et al., 2007), and 20% (Mayo & Duncan, 2004) of nurses failed to report for fear they would be disciplined or their position terminated. Some were afraid that reports would damage their reputation (Kingston et al., 2004). There were also concerns about litigation resulting from reporting (Evans et al., 2006; Kingston et al., 2004). Evans et al. (2006) identified these attitudes as being stronger in nurses than in doctors.

A lack of knowledge of the advantages of incident reporting systems impacted on nurse incentive to report (Smetzer, Cohen, & Milazzo, 2000), especially where the systems were seen to be poorly designed (Karsh, Escoto, Beasley, & Holder, 2006). In some cases, discussing the incident with the person involved was believed to be adequate; thus, a report did not need to be made (Evans et al., 2006).

A lack of time is a barrier to reporting (Kingston et al., 2004; Sanghera et al., 2007; Ulanimo et al., 2007) because of complex reporting processes and forms

(Evans et al., 2006; Kingston et al., 2004; Sanghera et al., 2007) and because nurses may forget to report (Evans et al., 2006) or give reporting low priority because of their heavy workload (Smetzer et al., 2000).

There is also a lack of understanding and clear definitions of reportable errors (Karsh et al., 2006; Pfeiffer, 2010), including what to report and by whom an error should be reported (Kingston et al., 2004). Some nurses create their own criteria (Baker, 1997). Furthermore, there is a lack of awareness of the reporting process (Kingston et al., 2004; Sanghera et al., 2007) or in locating the reporting form (Evans et al., 2006).

Reporting has an emotional impact on nurses (Schelbred & Nord, 2007), deterring reporting (Sanghera et al., 2007). In addition, nurses thought there was no value in reporting near misses or incidents they found trivial (Evans et al., 2006). Some disliked reporting other's mistakes, fearing a negative impact on the other nurse (Sanghera et al., 2007), or thought it was not their responsibility to report the incident (Evans et al., 2006).

The benefits of features such as the ability to produce standardized reports, data analyses, and risk profiles (e.g., <http://www.riskman.net.au/>) are emphasized by vendors, but it is possible that persistent reports would aggravate nurses' fear of disciplinary action. Consequently, the management goals of computerized system implementation may be disconnected from nurses' goals.

Nurses are part of complex organizational environments and have responsibilities and relationships with patients, other nurses, doctors, medical staff, and management. Consequently, reporting systems may fit nurses in ways different from doctors or management. For example, a nurse's general identity might suggest a desire to report errors; however, the nurse's commitment to and fear for other members of the team and wariness of entrenched power structures in the hospital might lead to unexpected behaviors (Pfeiffer, 2010). Thus, our research question is the following: are there barriers specific to the fit of the technology with nursing practice that make nurses reluctant to report medical errors? If so, what can health institutions do to reduce these barriers?

Method

This article reports a case study of the RiskMan medical error reporting software in two Australian hospitals in a large Australian city. The first hospital was private with 130 beds. The second was a tertiary public hospital with 390 beds. RiskMan is the most widely used reporting software in Australia.

A case study approach was used with both quantitative and qualitative data collected. An interpretive approach was adopted for analyzing the qualitative data because it enabled the researchers to understand

the phenomenon from the perspective of participants (Cavaye, 1996). The interpretive approach is subjective, meaning the study must reflect meaning and understanding according to the actors in the setting (Cavaye, 1996). The study passed all quality assurance and ethics processes at the researchers' home university and the hospitals.

The case study involved three stages with the first two stages conducted in parallel. The first stage comprised meetings with senior nurses and hospital management in both hospitals. This first stage had two aims: (a) to explore the use of error reporting software in the case study setting and (b) to discuss issues emerging from the findings of the survey. The second stage involved a semistructured survey in the private hospital to confirm the findings of previous studies and to finalize the interview questions. In the third stage, in-depth interviews were conducted with nursing staff in both hospitals. Each is described later.

Meetings with Senior Hospital Staff and Analysis of the Setting

Two meetings of 2-hour durations were held with four senior nurses, a senior doctor, and a pharmacist in the private hospital (i.e., the director of nursing, the hospital's nurse educator, the nurse in charge of the cardiothoracic ward, the nurse in charge of pharmacy management for the hospital's parent organization, a department head, and the head pharmacist in the hospital). They were chosen because the director of nursing oversees the use and implementation of RiskMan for nurses, the nurse educator is in charge of training programs for nurses in using RiskMan, the senior doctor is a department head and has responsibility for errors in his department, and the head pharmacist reviews pharmacy-related errors in RiskMan; the nurses in charge of the cardiothoracic ward and of pharmacy management were chosen because they are often consulted by junior nurses on the use of RiskMan.

In the first meeting, attendees were asked how well they felt that data in RiskMan corresponded to the real error situation and why any discrepancy may have occurred. This meeting provided for open-ended discussion. In the second meeting, the results of the nurse survey were used to generate further discussion on the same subject.

To understand the context, the researchers toured the private hospital's cardiothoracic ward, performed a walk-through of RiskMan, collected screen shots of RiskMan menus for review, and viewed deidentified RiskMan reports and blank drug chart forms. A separate meeting was held with the deputy head of the public hospital's emergency department. The purpose was to understand the organization's culture and processes and how these impacted on reporting in RiskMan. A detailed site visit and shadowing of a senior nurse in the public hospital's emergency department was also

undertaken. Team members also had a walk-through of the public hospital's RiskMan system.

Nurse Survey

A survey was conducted at the private hospital to identify themes for the interviews. After the meetings with senior staff at both hospitals (see the next section), enough themes had emerged that it was believed that the survey to refine themes for the interviews could be conducted at either hospital or that the in-depth interviews would bring out any subtle differences. The survey questions were derived from a literature review (see Appendix 1 for survey questions and sources). Senior hospital staff helped refine the survey, which used a mixed approach, gathering mostly quantitative data but with space to expand on answers. The survey asked participants whether they agreed, disagreed, or were unsure about a list of reasons for not reporting in RiskMan. This approach was validated in previous studies examining barriers to reporting (Evans et al., 2006; Kingston et al., 2004; Ulanimo et al., 2007). Several new possible barriers relating to the new electronic medium were added to the survey. These new barriers were derived from the detailed discussions with the six senior hospital staff. This discussion assessed content validity, with the survey piloted on these staff. Test-retest reliability was determined using a kappa statistic.

The survey was distributed at the private hospital, with a locked drop box in the cardiothoracic ward. The survey had a description of the research signed and endorsed by six senior staff. Only the researchers saw the survey responses. A paper-based survey was chosen to make the survey as widely accessible as possible and allow nurses to complete the survey at home. Anonymity was chosen to increase the likelihood of honest answers.

The cardiothoracic ward was selected because (a) the ward had a mix of patients including acute and long-stay patients, (b) patients in the ward had received a range of therapies and treatments, and (c) in a typical week the ward used a mix of outsourced (agency) and permanent nurses. These features meant that a range of errors were likely to be reported in the cardiothoracic ward.

The survey instrument remained on the ward for 4 weeks. All nurses were encouraged to complete the survey. Specifically, the nurse educator briefed staff about the survey process at a regular meeting the week before distribution. Nurses were encouraged to take part in the survey whether or not they were frequent users of RiskMan. Thirty nurses completed the survey. Approximately 70 nurses work in the ward in a typical week.

Qualitative Data Collection: Interviews

Eighteen in-depth interviews were conducted with nurses: 8 at the private hospital and 10 at the public

hospital. The team also interviewed one occupational health and safety officer at the private hospital (a qualified nurse) and two doctors at the public hospital because doctors make their own entries in RiskMan at the public hospital. This provided roughly equal representation of both hospitals. Stratified sampling was used to select the nurses to interview to ensure a range of seniority and experience. The two doctors and one safety officer were interviewed to gain a fuller picture of software use. However, at the private hospital site, only nurses have access to RiskMan; thus, they formed the only participant group for this part of the study at the private hospital. In Australia, at private hospitals, doctors are not employed directly by the hospital, and, in this setting, must ask a nurse to record errors. For this reason, no doctors from the private hospital were asked to participate directly in the study. A senior doctor associated with both the private and the public hospital advised the research team.

All interviews were recorded and transcribed (See [Appendix 2](#) for interview questions). Three researchers then separately ascribed descriptive codes to parts of each interview's text. The coding of the transcripts meant that each researcher brought their own understandings to the interpretations made about the meaning of the text ([Alvesson & Sköldbberg, 2000](#)).

Coding was mostly at the sentence level, but at times at the multiple-sentence level. Codes were chosen to represent an understanding of what was happening in each transcript being coded. After separately coding, the coders met to discuss the codes. There were several actions taken. First, a need for a new code could be identified because the idea manifested in the transcript was not covered by existing codes. Second, codes were changed or removed to better represent the interview. Third, one or more of the coders withdrew a specific ascription of a code to the text fragment where it was agreed the ascription was not a reasonable interpretation of the meaning of the fragment of text. Fourth, a consolidated coding of the transcript was prepared that reflected the outcome of the meeting (See [Appendix 3](#) for list of codes).

The principles of [Klein and Myers \(1999\)](#) were used in the coding. For instance, an examination of the transcripts involved multiple iterations of the data (principle of the hermeneutic circle), in seeking to understand statements made by interviewees from different perspectives (principle of multiple interpretations). The goal was to refine the codes and thereby to reach a deeper understanding of the transcripts of the interviews. Occasionally, the coders returned to the transcripts coded earlier to check new understandings of a text being interpreted.

Results

Results from Meetings with Senior Staff

Senior staff at both hospitals suspected error-reporting rates did not reflect real error rates. At both hospitals, this was felt to result primarily from concern about blame, the effort involved in reporting, and the lack of feedback on reports. A distinguishing feature of the meeting with senior staff at the private hospital was that the hospital had undergone a major change in the previous 12 months to turn around a "blame culture" and to replace it with a "no blame" culture to promote free-reporting of medical errors. It had openly discussed the issue at staff meetings and provided education. The hospital's quality manager described the approach this way, "The head office cheers when the number of reported errors is high; it's not good when they are low. More reported events are good." However, senior staff reported that rates continued to be low in some wards. Hospital management estimated that about 45% of incidents in the cardiothoracic ward were reported based on a comparison with similar wards and hospitals operated by the owner. Management identified a nonsystematized approach to training in the use of RiskMan.

One factor identified as a possible cause of confounding reporting rates was that their hospitals did not clearly define a reportable error. In the words of the senior doctor, "I am not sure if this is easy to define as it is pitched at a variety of users of different backgrounds. Essentially we are keen to catch anything believed to be an incident." The public hospital had a broad definition in policy that was considered difficult to operationalize (see [Appendix 4](#) for the policy). RiskMan allows hospitals to define their own list of errors creating confusion for staff with prior experience with it elsewhere.

Survey Results

In this section, we discuss the survey results. We present mostly descriptive statistics of the 30 respondents to the survey. Of the 30 participants, 25 were ward nurses, three were senior nurses, and two declined to say. The dominance of junior-rank nurses in the cohort was reinforced by the age spread with 23 of the 30 in the 26- to 35-age group, whereas five were in the 36- to 45-age group and one each in the 46- to 50- and 50+ age groups. This skewing of demographic data precluded using these demographic facts to base groups for inferential statistical analysis. Apart from

Table 1 – Demographic Spread of Survey Participants

	N	Minimum	Maximum	Mean	Standard Deviation
Years of experience	30	.25	36.0	9.5	7.0
Years of employment at the hospital	30	.17	11.0	2.4	2.8

Table 2 – Level of Comfort with RiskMan

	n
Very comfortable with RiskMan	4
Comfortable with RiskMan	13
Indifferent about RiskMan	7
Uncomfortable with RiskMan	6
Very uncomfortable with RiskMan	0

age, the participants had the demographic spread shown in Table 1.

All but one of the participants was comfortable (19) or very comfortable (10) with using IT. One participant was indifferent. This contrasted sharply with the levels of comfort with RiskMan itself as shown in Table 2. The level of comfort with RiskMan is explained partly by the fact that only half of the participants had received training in RiskMan. Only 16 volunteered an answer about whether they had received training at the hospital: 13 had and 3 had not. All but one of the 13 that had received training in RiskMan did so within 3 months of arriving, with seven receiving the training in under a month of arrival.

Twenty-seven participants only knew of RiskMan for reporting. Two had used a different error-reporting software package from RiskMan, both of whom claimed they had used Medihale, an inhalation drug delivery method. One participant did not answer. Seventeen (n = 29) had used RiskMan to report, whereas 12 had not reported an error. Fourteen gave the number of reports they had submitted (Table 3).

One significant correlation was found in the data—a nurse’s number of years with the hospital was correlated with whether they had made a report using RiskMan. Specifically, the longer a nurse is with the hospital the more likely they are to have made a report. We divided the nurses into two groups, those who had made a report and those who had not, and used number of years employed in the hospital as the dependent variable and the correlation was significant (F[1, 28] = 7.839, p = .009).

Six participants (33%, n = 18) had received feedback from someone in the hospital in response to a report they had submitted. Eleven (44%, n = 25) had heard of a positive outcome from a report made by a nurse in the hospital. Encouragingly, only two (9%, n = 22) had heard of a negative outcome from a report. These findings are evidence that reporting tends to lead to positive outcomes in the hospital. Fifteen participants

Table 3 – Number of RiskMan Reports by Respondents

	n	Minimum	Maximum	Mean	Standard Deviation
Number of RiskMan reports made	14	1	50	7.2	12.7

Table 4 – Time Taken in Making a RiskMan Report

	n	Minimum	Maximum	Mean	Standard Deviation
Self-reported time taken to make a RiskMan report (min)	15	7.5	30	18.5	7.5

self-reported the time taken to complete a RiskMan report as shown in Table 4.

The top barriers to reporting errors identified from the survey were in descending order (a) lack of training in RiskMan (53%, N = 30), (b) too busy to enter errors (52%, n = 29), (c) lack of access to a computer (45%, n = 29), (d) fear of being “tracked down” (40%, n = 29), (e) never getting any feedback on what actions are taken as a result of the report being made (36%, n = 28), and (f) the reporting form requiring too much detail (32%, n = 28).

Interview Results

In this section, we discuss the results of interviews with 18 staff, referring to relevant results of the survey that relate to the barrier being discussed. We stopped with 18 interviews because, at that point, we felt we had reached saturation (Goulding, 2002), meaning nothing new was emerging on which we could base our findings. We also were gaining no new insights from the interviews. The barriers that emerged from the coding process are grouped into categories (Table 5) and are described in the following subsection.

Barrier Categories

Training and Education

The lack of understanding of how to use RiskMan from the lack of training was the most frequently identified barrier. In the survey, 53.3% of respondents (N = 30) felt they did not have enough RiskMan training. Five of 10 nurses at the public hospital interviewed had not received training. One of the five private hospital nurses who had received training described being “trained” on a paper printout from the system but not on the actual software. An assistant nurse unit manager attributed the reluctance to report incidents very clearly to the lack of training. Nurse 6 stated, “once people are educated to use it they’ll feel [it’s]... easier to just get on there and do it. And it will be quicker the more times that they have to do it.” Another participant nurse stated it would be valuable to have a training exercise in which example reportable incidents were used.

The lack of training led to a lack of understanding about what should be reported. In the survey, only 14.8% of nurses reported this barrier; a deeper probing of this

Table 5 – Barriers to Error Reporting

Barrier Category	Barrier
Training and education	Training in using RiskMan Knowledge of what to report
Technology acceptance	RiskMan interface/form design Attitude to information technology
Organizational structure and culture	Time Alternatives to RiskMan reporting Blame Failure to get feedback on action from the report
Access	Log-in to RiskMan Computer availability Privacy

question in the interviews showed that there was a range of definitions of reportable incidents, and some nurses were unclear what defined an incident. For example, nurse 4 stated RiskMan was “obviously” for reporting patient falls. To her, this was RiskMan’s role. When the question was reframed, she responded, “to be honest, I don’t really know what its capabilities are, what it’s for.” Nurse 7 reeled off several examples of reportable incidents and then admitted, “I don’t know... We just get told everything and anything...it’s not very specific is it?” Nurse 8 did not know if near misses should be entered in RiskMan. Nurse 1 did not believe near misses should be reported in RiskMan. Nurse 3 said, “Although a fall might be reported, an infection might not be, giving an example of a patient who developed an infected intravenous access site, which was not reported in RiskMan; instead, it was ‘just written up in the notes [patient records].’ The infection then turned into a serious bone infection “which was quite catastrophic.”

Nurse 11 understood that a medication error should be entered (e.g., wrong dose or wrong medication) but also defined an error worthy of entry to include things such as breaches of hospital protocol regarding restraints, “It was a breach of hospital protocol or hospital policy that I felt was severe, that had to be brought to somebody’s attention. So specifically it was a patient who was restrained, restrained...for a lengthy period of time, there was no documentation, there was no instructions on anybody’s behalf to take the restraints off the patients....”

The lack of clarity around reportable incidents was further supported by interviews with the hospital management. Neither the acting head of nursing, nor the nurse educator, nor the nurse in charge of the floor knew of any hospital definitions of what errors should or should not be reported.

Technology Acceptance

Some participants found the incident reporting form in RiskMan confusing or repetitive. Nurse 2 felt if she was confused about part of the form, she was likely to leave

things off. Nurses perceived the form required both a summary and detailed description, leading to information duplication. Nurse 3 estimated that 60% of report fields were redundant and 32.1% of survey respondents ($n = 29$) felt RiskMan’s form required too much detail. These issues led to technology acceptance problems for nurses. Nevertheless, some nurses felt paper-based forms were more time-consuming to complete and that nurses might have to copy the completed forms and send them to relevant people. One nurse felt that nurses did not like using computers and that paper was a better option. However, paper forms are likely to be lost because of the nature of the work environment.

Organizational Structure and Culture

A number of issues relating to organizational structure and culture were identified including time, alternative routes for error reporting, fear of blame, and failure to receive feedback from reports. Time issues arose in two ways: a lack of time to make RiskMan reports because of workloads and a perception that the RiskMan report was time-consuming. In the survey, 52% of nurses ($n = 29$) agreed they were too busy to enter errors in RiskMan. This was the second most highly identified cause of not reporting after lack of training. Nurses surveyed took from 10 to 30 minutes to report, with the average time being 20 minutes. Nurses’ responses in the open comments section of the survey reinforced this result. For example, survey nurse 29 stated, “RiskMan is very time-consuming, and questions on the [electronic] form are repetitive. When the ward is busy, there is just no time to sit down for the next 15-20-25 minutes and fill one out.” When asked on the survey about how long it took to complete a RiskMan report, survey nurse 3 replied succinctly, “Too long.” The interviewed nurses expressed similar views and described the error reporting process as “time-consuming.” Nurse 11 described her experience of it “feeling” much longer than it probably actually took. This was echoed in many of the interviews, “I would say to get on to RiskMan and out of it, it seems to take ages, that’s probably not that long and maybe 10 minutes, I suppose I would say...It’s just because you are so busy that it actually seems to take a long time.”

One issue arose in a number of interviews: there are informal ways of error reporting that are seen as replacements for RiskMan. Some nurses believed that verbally reporting an error to a nurse manager fulfilled their reporting obligation. Reporting an incident in the nursing notes was another alternative. Some also stated that if the error was corrected, such as later giving medication that had been missed, it did not need to be reported. Another was that education was sufficient for an observed error. One nurse told how she found chest drain devices used incorrectly and rectified the problem instead of reporting the error by showing how to use the device correctly.

Nurses had varying views on whether there was still a blame culture in place at either hospital. Most felt the hospitals were on the “no blame” end of a spectrum

between “blame” and “no blame.” One participant felt that before RiskMan was implemented the private hospital had a blame culture but had since shifted to a no blame culture with a focus on systems improvement. Two participants could not rate where the hospital sat on the “blame” spectrum because there was a mix of cultures; some managers had a punitive attitude, whereas others were interested in system improvement not blame. However, those nurses who felt the hospital was free of a blame culture were still cautious about reporting errors because the reports could be collated and tabulated with the possibility of a “black mark” against them. They suspected anonymous reports could be traced through log-ons. This was reflected in the survey; 27.6% ($n = 29$) wondered who else was “privy to the information that I disclose.”

Some nurses viewed reporting as an acknowledgment they have done something wrong. One nurse felt there was some shame in making a mistake; she should have asked for help but did not. Another was afraid others might no longer trust her, and she would have trouble facing them as a result. Foreign nurses on temporary visas ($n = 2$) thought blame was a significant issue and feared losing their working visas; this made reporting less likely.

The failure of the hospital system to provide feedback to nurses on action taken as a result of a report was a barrier. If they spent the time making an error report, nurses wanted a positive outcome, such as a system improvement; 36% of surveyed nurses said they never received feedback on what action was taken.

A surprising theme in the public hospital was that some staff used RiskMan as a defensive tool (for themselves), an offensive tool toward colleagues or other departments, and a complaint mechanism to senior management who they felt were not listening to them. Nurse 11 said she filed a RiskMan report “sometimes...when we feel short staffed, or the skill mix has been bad and I felt the department has been unsafe on my shift.” She described a situation in which there had been an error on her shift, “I just wanted to have that documented that I felt this shift was unsafe because of these reasons. So, I didn’t want to carry the responsibility. Now I don’t know if that’s the right avenue for reporting it but I think, as a nurse you feel very limited in how you can express yourself and I think RiskMan is one way that you can do it sometimes.” This was a view reflected in other interviews. This defensive approach was less about defending themselves against peers and more about defending themselves against decisions by senior management or by other wards in the hospital that impacted on their ability to care for patients.

Nurse 12 described RiskMan being used as “an aggressive tool” by staff to get back at other staff for not doing tasks and being “between departments.” She said RiskMan has, “...been used in a petty manner...it appears as an aggressive tool...its almost an acceptable practice now to put something on RiskMan (in order to put other staff on notice). So...it has changed a lot.”

The nurses in the public hospital spoke more frequently of using RiskMan to report other people’s errors, whereas in the private hospital the nurses primarily described reporting their own errors. Among the private hospital nurses, they almost never spoke of reporting others’ errors, and several seemed surprised when asked about it. It was clear that the two groups had quite different ideas on how RiskMan should be used—as an early intervention tool to stop other people’s mistakes versus a self-declaration tool to help management stay on top of risks.

Access

Four types of access barrier were identified: log-in issues, computer availability, privacy, and age-related lack of ease with technology. Each of these is examined.

Log-in issues resulted in the inability for nurses to access RiskMan to report (45%, $n = 29$). The interviewees indicated that some did not have log-ins because they were agency nurses, they worked nights/weekends, or they had never received one. One nurse told of how it took 18 months to get a log-in because she only worked two or three shifts a fortnight. Some nurses without log-ins used another nurse’s log-in to report their own errors, but some said this took too long. One nurse told of how a second nurse refused to log-in for her to make a report because the second nurse was worried the report would go against her name.

There are up to 12 nursing staff in each shift who must share the computer used for RiskMan entry with the ward clerk. During the day, nurses interrupt the clerk’s work. Senior staff members help more junior nurses to gain computer access during the day. Often, nurses return later to complete the report, resulting in forgotten details in reports.

Nurses had privacy concerns about the final report and about whether peers might see RiskMan data entries. The computer was at the front desk of each floor. Some nurses believed report rates would increase if RiskMan could be used in a private and confidential way.

The issue of whether there was a technology divide between younger and older nurses was also raised in the interviews. Nurse 3 stated, “the younger ones are probably more used to the technology so that (RiskMan) doesn’t faze them.”

Summary of Results

The results showed a mismatch between rates of error reporting and the occurrence of errors (management meetings) and uncovered the reasons why this was so (nurse survey). These results were extended in the interviews in which a lack of training, a hospital culture that limited nurse spare time, problems of computer access, and fear of retribution were all reinforced. The interviews showed that technology either exacerbated or failed to minimize problems that also existed with manual systems.

Discussion

This study supports earlier studies regarding the reluctance to report medical incidents but also reveals the impact of the computer-based reporting on nurse reporting behavior. Some of the technology barriers are specific to these hospitals, for example, the lack of access to computers and problems relating to where the computers are placed in the ward although such problems are widely reported elsewhere (Costa, Oliveira, Silva, Ribeiro, & Ribero, 2009; Jenkins, 2004; Lederman, 2004). Similarly, hospitals allocate different lengths of time and resources to training, and the hospitals studied here may fall short. However, this study shows problems common to both private and public hospitals.

Problems in giving IT-system log-on accounts apply in any hospital using temporary nursing staff and consultants. A lack of high-speed computers, which is common in underfunded systems, also means logging on and off is prohibitively slow and shows that all software installations need to include adequate hardware and support.

Hospitals adopt electronic incident reporting to save time, yet our results suggest that nurses consider these more time-consuming than paper. Furthermore, electronic systems support auditing and data collation/reporting requirements rather than the nursing staff inputting data. Consequently, the systems have compulsory data fields to partly fill out the form. This is useful for management but was a clear barrier for nurses making an electronic report.

The hospitals had two age clusters for nurses: nurses in their early 20s just out of training and nurses over 45 years of age. Hospitals should provide extra training specifically for any nurses uncomfortable with technology.

We found that nurses sometimes chose alternative reporting mechanisms from paper or RiskMan. Some reported verbally to the nurse manager, some reported in the nursing notes, and some reported to doctors on their rounds or to other nurses in training sessions. Nurses who did not use the official mechanism still reported errors.

Finally, nurses were concerned that electronic forms were, in fact, less anonymous than paper forms because they could be linked to user identifiers and be more widely distributed than paper despite the fact that paper forms contain handwriting leading to easy identification of the reporter.

The problem of nurses not knowing what to report was exacerbated by the use of IT. Paper forms could be discussed with other nurses because they could be easily walked around the ward. Without an electronic system in place, nurses felt they were more likely to report an incident verbally to the nurse manager or to a peer (such as the next nurse caring for a particular patient). This had a "verbal calibration" in which the

importance of an incident to be reported could be tested with a peer or superior. The staff member would discuss the incident's potential impact, risk, and circumstances; the other staff member would ask questions, probe, discount unimportant parts, and explore the significance and ramifications. Interviewed nurses said this occurred more often before RiskMan. With the introduction of systems such as RiskMan, this calibration can be lost because the staff member is alone with the computer, which is not transportable like a paper form. This problem is enhanced when the hospital does not provide clear definitions of reportable incidents. Furthermore, paper submission to a nurse manager can provide opportunities for feedback that is not as easy with an electronic submission. Tablet computers may help alleviate some of these problems.

Conclusions

Error reporting is one task among many tasks that nurses perform and causes nurses to reflect on their practice and that of their colleagues. It also forces them to choose which errors to report. It is interesting to reflect on these findings in the context of what we know about how nurses make decisions. Generally, nurses in specialist areas have more freedom and satisfaction in making decisions than others (Orme, 1993) but require time to critically reflect. Nurses also need hospital support to engage in decision making (McCaughan, 2002) and need codes of professional conduct that make action pathways clear (Orme, 1993).

Error reporting shows nurses' willingness to take responsibility for their actions, to solve or confront errors of judgment, and to consider the root cause of errors. This takes time, insight, and confidence. Systems without adequate feedback on reporting will not encourage reports or provide satisfaction for the nurse reporting. The lack of feedback on reporting found in this study confirmed previous studies of nonelectronic reporting. However, electronic reporting provides new opportunities for feedback and management. Requiring an action response to be given by a supervisor would give the reporting nurse satisfaction that the report had been read and signed off on. Electronic reporting also allows for faster feedback. Error reports could form the basis of organizational knowledge about errors. The decision to report would then be seen as a satisfying professional response.

We answered the first research question in identifying specific barriers to reporting provided by technologies such as RiskMan. In answering the second research question about what hospitals can do to reduce the barriers caused by technology, we need to consider how hospitals can use reporting systems in decision making and view the information gathered as knowledge assets to be used in improving error rates and reporting.

This study recommends the following policies for hospitals to adopt for electronic incident reporting systems:

1. Training sessions should explain clearly the answer to these two questions:
 - a. What is an incident?
 - b. When should it be reported?
2. Any reporting system must include an explicit drop-down list of possible incidents. However, an "open entry space" is also important where a nurse can enter events not covered in the existing list.
3. Compulsory data fields should be minimized, capturing the essential data for decision making.
4. Hospitals should use real-life examples to train staff and training should cater for older nurses.
5. Hospitals should make computer access easy, with universal log-ins and computer availability.
6. Hospitals should allow anonymity and privacy in reporting.
7. Systems should be selected so that data entry redundancy is eliminated.
8. Reporting errors should be viewed as paid time for nurses; if they have to do it outside work time, they are far less likely to participate.
9. Alternative routes for error reporting should be discouraged, but not eliminated.
10. Management should provide feedback on reported incidents. Feedback should be to nursing staff generally and to the reporting nurses specifically.

For electronic incident reporting to be successful, nurses need both time and feedback. Time allows for insightful situation assessment, and feedback contributes to nurses becoming partners in the problem solving.

The past decade has seen hospital health professionals face challenges of increasing information bombardment and real reductions in resources. More information is delivered via screens in hospitals than ever before. The expectation is that this will accelerate the capacity of staff to process information. The tendency has been to continually reduce time allotted for assessment and reporting of incidents. However, it is clear that the hidden cost may be the loss of time for critical reflection and, therefore, to report incidents in a meaningful fashion and consider systemic problems. This makes it harder for hospital management to know the situation on the ward.

Software systems, such as RiskMan, are only as useful as the data input. This study shows that without proper engagement, data entered will be incomplete and dirty. For hospitals, the policy solution is (a) remove barriers and (b) introduce incentives to support and to help nurses report.

Hospitals and other health facilities have embraced electronic reporting of incidents. At first glance, this change seemed to have no risks or downsides. If it is managed poorly, an electronic risk reporting system can be risky for hospitals. It may give senior management the mistaken belief they know what is happening on wards. The implications of this are management

may be completely unaware of systemic failure with potentially serious outcomes. Therefore, matching technology-based risk reporting technology to the hospital norms, behaviors, and expectations is critical and provides the following beneficial outcomes: (a) nurses will feel empowered to report; (b) nurses and managers will be able to tackle emerging and systemic problems; and (3) managers will be able to aggregate high-quality data efficiently, enabling them to spot patterns and trends in errors and incidents. Actions taken about these trends will lead to safer wards.

The results of this study have implications for public safety in hospitals. Worldwide, nurses are in short supply and, with increased professionalization, are expensive to employ. Thus, nurse time spent dealing with cumbersome systems is significant despite nurses' willingness to enter and learn from reported errors and further improve nursing practice. This study shows that computerized systems raise new barriers to reporting compared with manual reporting systems. Nurses are keen to reduce errors, but for hospitals to realize the benefits of computerized incident reporting systems, hospitals must overcome the new barriers. The systems must fit the work practices, enable a quick first response as well as a satisfying later response, and facilitate learning from errors at all levels in hospitals. However, this will only happen if the systems are designed to minimize time for entry, maximize data quality, fit nurse practice and professionalism, and discourage nurses from seeking alternative reporting mechanisms.

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**Appendix 1.
Survey**

1. What position do you hold:
 - Ward Nurse
 - Senior Nurse
 - Nurse in training
 - CNS/ANUM
 - Other
 2. Years experience as a nurse (give best estimate): _____
 3. Years at Melbourne Private (give best estimate): _____
 4. Age: (Circle one) Under 25 25-35 36-45 45-50 Over 50
 5. Ward : _____
 6. What shift/s did you normally work? (circle all that apply)
 - a. 0700-1930
 - c. 0700-1510
 - d. 1400-2200
 - e. 2130-0730
 - f. 1900-0730
 7. How comfortable are you with using computers? (circle one of the following)
 - Very Uncomfortable
 - Uncomfortable Indifferent
 - Comfortable
 - Very Comfortable
 8. How comfortable are you with using RiskMan? (circle one of the following)
 - Very Uncomfortable
 - Uncomfortable
 - Indifferent Comfortable
 - Very Comfortable
 9.
 - a. Have you been given RiskMan training? Yes No
 - b. If yes was your training provided by Melbourne Private? Yes No
 - c. If yes who provided you with training? _____
 - d. How long did you wait to receive RiskMan training? (Give best estimate in months) _____
 10. Have you had experience with other risk management software? Yes No
 - a. If so what was it called? _____
 - b. Did you prefer to use it over RiskMan? Yes No Indifferent
 - c. If so why? _____
 11. Have you completed a RiskMan entry? Yes No
- If yes how many RiskMan entries have you completed ? (give best estimate) _____
12. Have you received feedback on your RiskMan entries? Yes No
 - If Yes who has given you feedback? _____
 13. Can you think of any positive things that have occurred as a result of completing an incident report? Yes No
 - Comments _____
 14. Can you think of any negative things that have occurred as a result of completing an incident report? Yes No
 - Comments _____
 15. RiskMan: (please tick agree, disagree or unsure)

	Agree	Disagree	Unsure
Is easy to understand			
Has some ambiguous parts			
Has redundant sections			
Comments: _____			

16. If you were unsure when administrating medication did you have:

	Always	Sometimes	Never
Access to a senior nurse			
Adequate time from a senior nurse to explain things			
Access to MIMS online			
Access to MIMS hardcopy			

17. Was medication delivery/responsibilities included in your orientation? Yes No Unsure
18. Have you noticed any errors/incidents that you haven't reported? Yes No
19. About how long does it take you on average to make an entry into RiskMan?
-

20. I don't report some errors to RiskMan because: (please tick agree, disagree or unsure) (note sources are reference for the paper, they are not referenced in the actual survey)

	Agree	Disagree	Unsure
a. I never get any feedback on what action is taken (Evans et al., 2006)			
b. I am sometimes unsure of what constitutes a medical error (Ulanimo et al., 2007) (note question was "I am normally sure what constitutes a medical error")			
c. The incident was too trivial (Evans et al., 2006; Ulanimo et al., 2007)			
d. When the ward is busy I forget to make a report (Evans et al., 2006)			
e. When it is a near miss, I don't see any point in reporting it (Evans et al., 2006)			
f. The form is too complicated (Evans et al., 2006)			
g. The form requires too much detail (Evans et al., 2006)			
h. Junior staff are often blamed unfairly for adverse incidents (Evans et al., 2006)			
i. Adverse incident reporting is unlikely to lead to system changes (Evans et al., 2006)			
j. I wonder about who else is privy to the information that I disclose (Evans et al., 2006)			
k. If I discuss the case with staff members involved, nothing else needs to be done (Evans et al., 2006)			
l. I am worried about litigation (Evans et al., 2006)			
m. I am unsure if it is my responsibility to make a report (Evans et al., 2006)			
n. It's not my responsibility to report someone else's mistakes (Evans et al., 2006)			
o. I don't want to get into any trouble (Evans et al., 2006)			
p. Even if I don't give my details, I'm sure they'll track me down (Evans et al., 2006)			
q. I am worried about disciplinary action (Evans et al., 2006; Ulanimo et al., 2007)			
r. I am worried about losing my job			
s. I feel I haven't had enough training in how to use RiskMan			
t. I am worried about how managers will react (Ulanimo et al., 2007)			
u. I am worried about how co-workers will react (Ulanimo et al., 2007)			
v. I am not encouraged to report errors			
w. I find it hard to get access to a computer to enter details into RiskMan			
x. I feel I am too busy to enter errors			
Other (please specify): _____			

21. Please make any additional comments about RiskMan here. Write on the back of page for more space:

Appendix 2. Nurse Interview Questions

BACKGROUND—WARM UP

1. How long have you been nursing?
2. How long ago did you do your training?
3. Where do you do your nurse training?
4. Were you born overseas?
5. Staff or agency?
6. What is your position?

RISKMAN

1. How comfortable do you feel about reporting mistakes you have made? (Very comfortable, comfortable, moderately comfortable, not comfortable, uncomfortable)
2. Hospitals have different cultures, if you think of a scale of ten with one being strong blame culture and being free of blame where they're much more interested in trying to fix the problem. Where do you feel this hospital stands on that scale?
3. What percentage of minor errors do you think are reported on the ward?
Minor event - No interventions required, may be a documentation error

4. What percentage of moderate errors do you think are reported on the ward?
Moderate event - Requiring routine therapy available outside the ICU
5. What percentage of major errors do you think are reported on the ward?
Major event - Need for therapeutic interventions specific to the ICU or death
6. Are you aware of RiskMan?
7. Have you received RiskMan training? If so, what training did you receive?
8. Have you used RiskMan?
9. About how long does it take you to do an entry into RiskMan?
10. What do you think should be reported to RiskMan?
11. Should nurses report other nurses' errors using RiskMan?
12. Do you ever report documentation errors through RiskMan?
13. Do you feel that near misses should be reported?
14. Do you have any issues with using RiskMan? (ex: negative consequences, takes too long, access to computers etc.)
15. What are the issues?
16. Do you use any other reporting methods (i.e. informal reporting to the nurse in charge)?
- 16.1 Do you feel you use other methods of reporting more or less than RiskMan?
- 16.2 Which methods?
- 16.3 Why?
17. Have you experienced any other methods of incident reporting? (i.e. paper based reporting, other software based reporting)
18. Do you think it would make a difference if reporting were anonymous?
19. Do you think it would make a difference if RiskMan were based on a wireless handheld?
20. Is there value in reporting RiskMan incidents? What is the value?
21. Do you find that feedback and follow up to RiskMan reports is important or not important?
22. What kind of follow up is most important to you?
23. Have you seen any system improvements as a result of RiskMan reporting?

Appendix 3. Codes

Label: Training.

Definition: Nurses experiences with training and the impact.

Flag: Any comments where the participant mentions what training if any they had in the use of RiskMan and the impact it has had on their comfort level with reporting.

Qualifications: Only comments relating directly to training.

Example: "Because I haven't done training it took me half an hour because I didn't realize I only need to answer the yellow bits then its all the I answered also the white blanks I answered everything somebody showed me so they told me it was already late I was half way finished."

Label: What to report.

Definition: Any dialogue relating to beliefs of what should be reported.

Flag: An example would be thoughts as to what kind of incidents should be reported, what criteria is used to decide whether to report or not.

Qualifications: Comments relating to what a nurse feels should be reported, this can include nurses opinions of what they think others believe should be reported.

Example: "I've said if there's no harm done and it was a near miss that was corrected before it happening, it shouldn't really be reported. Maybe like you know if it's a one to one level you can advise the nurse that was involved and the next party. But if its major it should be reported."

Label: Responsibility to report.

Definition: Discussion relating to perceived responsibility for reporting errors.

Flag: Any comments where the participant mentions who they think should be reporting, this can include their opinion of others thoughts relating to responsibility to report.

Qualifications: Only comments relating directly to responsibility to report.

Example: "Some people like coming to work and doing their little bit and they don't want to look anywhere further outside that little patch and RiskMan is something outside that patch it's seen as someone else's responsibility."

Label: Log-in

Definition: Discussions relating to log-in access.

Flag: An example would be comments relating to the lack of log-ins and the impact this has on reporting.

Qualifications: Only comments relating to a lack of log-in in and/or the impact not having a log-in

Example: "I had a patient who fell on the floor who collapsed so what I did was I asked the nurse in charge because I don't have access to the computer so I've been asking everyone all the staff can you open the computers so I can do the RiskMan."

Label: Computer Availability.

Definition: Discussion relating to gaining physical access to a computer to report and the impact this has on reporting.

Flag: Any comments where the participant tells of access issues and the impact it has on reporting.

Qualifications: Only comments relating to physical access and the impact of lack of physical access on reporting.

Example: "There is only one computer in the NUM's office which is shut at weekends and no one gets in there during the week anyway. There's the one the receptionist uses so unless you're the team leader you can't get near that."

Label: Privacy.

Definition: Nurses have not received RiskMan training.

Flag: Any comments where nurses express concerns resulting from the lack of privacy and the impact it has on reporting.

Qualifications: Only comments relating to the impact of there being lack of privacy when reporting.

Example: "so some people might find it embarrassing to do it in front of everybody? Yeah, I guess it depends on the nature of the if its you that's done it if its because of you it depending on whatever it is you've done it would probably then be harder to do it."

Label: Form Design.

Definition: Nurses have not received RiskMan training.

Flag: An example would be comments relating to the length, content of the reporting form.

Qualifications: Only comments relating to the design of the form and the impact it has on reporting.

Example: "That sort of stuff the forms don't quite fit that the forms are designed for patient incidents rather than anything else that goes on in the ward."

Label: Attitude toward computers.

Definition: Discussion relating to attitudes towards computers.

Flag: Any comments where a participant mentions attitudes towards computers.

Qualifications: Any comment where a participant discusses their or others attitude towards computers.

Example: "People don't like computers and I don't like computers but you know just to do it on paper seems a lot easier."

Label: Alternatives to RiskMan reporting.

Definition: Discussion of other methods of handling medical errors.

Flag: Any comments where the participant mentions what they perceive to be alternatives to using RiskMan.

Qualifications: Any comment where a participant discusses actions to handle and error as an alternative to RiskMan.

Example: "I've said if there's no harm done and it was a near miss that was corrected before it happening, it shouldn't really be reported. Maybe like you know if it's a one to one level you can advise the nurse that was involved and the next party. But if its major it should be reported."

Label: Time.

Definition: Discussion of the impact available time has on reporting.

Flag: Any comments where the participant mentions a lack of time and/or the impact it has on reporting.

Qualifications: Only comments relating to time constraints.

Example: "Because its too time consuming, and if we do think we should then we forget and everything just snowballs if a patient gets worse then you just loose track of time and you forget really."

Label: Blame.

Definition: Discussion of perceived blame, judgment and impact on reporting.

Flag: Any comments where the participant mentions a fear of blame, judgment and what they believe to be the consequences.

Qualifications: Only comments related to blame and the impact of blame.

Example: "It's better if the names don't go on it, because it's always harmful for the nurse obviously."

Label: Reporting other nurses.

Definition: Discussion relating to the reporting other nurses.

Flag: Any comments relating to negative feelings towards reporting other nurses.

Qualifications: Any comment where a participant discusses issues with reporting other nurses.

Example: "We probably should report other nurses but we don't...because it's too time-consuming... I think that's another thing, you don't want to get someone else into trouble."

Appendix 4. Extract of the Risk Management Policy

2. Purpose and Scope

This procedure informs staff of the mechanism for reporting incidents. The importance of reporting incidents is highlighted in the analysis of incidents and incident data.

The objective of monitoring all incidents is to have a positive impact in improving patient care and staff support, focus the attention on the causes underlying the event and identify systems changes to reduce the probability of such an event in the future. This approach focuses on the system under which the incident occurred rather than the assignment of individual blame.

Every incident is worthy of investigation and attention, and information relating to all incidents must be treated as confidential. All consumers of health services and staff have the right to have all incidents handled in a prompt, effective and appropriate manner.

3. Definitions

Incident	Any event or circumstance which could have, or did lead to unintended and/or unnecessary harm to a person receiving care, visitor, staff member, volunteer or contractor of Melbourne Health.
Near Miss	An occurrence with the potential to result in harm to a person receiving care, visitor, staff member, volunteer or contractor, that was prevented from developing into an actual event as a result of change, prevention or mitigation.
Sentinel Event	Incidents of a clinical nature, that occur independently of a patient's condition commonly reflect hospital system and process deficiencies and result in unnecessary outcomes for patients.
Notifiable Incidents	For further details: <state government department> Sentinel Event Reporting Incidents that involve personal injury and/or environmental damage and are required by legislation to be reported to <statutory reporting agency>
Notifiable Death under Mental Health Act	Death of an involuntary consumer or the unexpected death of a registered consumer of the mental health service.

...

5. Procedure

When an incident has occurred, the staff member(s) involved is/are responsible for ensuring that the following steps occur:

- a. Initiate the relevant emergency response if required (fire/hazardous substance spill, security required) and immediate corrective action to minimize harm.
- b. Notify their direct line manager/supervisor that an event has occurred.
- c. Notify a medical officer to assess the patient (if involved) or provide first aid to the person/s involved.
- d. The direct line manager/supervisor of the ward/department must ensure the safety of the employee(s) and others in the area if there is imminent risk, and assist the employee to seek first aid or medical attention if required.
- e. Where the incident reflects a Notifiable Incident, the incident should be reported immediately to the <health region's> Occupational Health and Wellbeing Director (contacted via switchboard). If a fatality occurs, preservation of the scene of the accident must occur until the <statutory workplace safety organization> inspector arrives to investigate. The scene may be disturbed only to help someone who is injured, protect the health and safety of someone or to take essential action to make the site safe to prevent a further accident.
- f. Report the incident via the organizations incident reporting system by the end of the working day/shift.
- g. Forward the incident report to the direct line manager/supervisor.

5.2. The line manager/supervisor is responsible for ensuring that all relevant details have been completed appropriately/accurately in the incident report including the risk stratification.

- a. For low and medium rated incidents or near misses, the respective line manager/supervisor should review these events by the next working day.
- b. For incidents that are rated high and extreme, the line manager/supervisor must review the report by the end of the working day and provide an update to their manager on harm minimization strategies implemented and any outstanding review findings.
- c. For all high and extreme rated incidents occurring out of hours, the line manager/supervisor must contact the hospital bed manager whose role it is to liaise with the Executive on Call as appropriate.