Anaesth Intens Care 1996; **24:** 314-319

The Australian Incident Monitoring Study in Intensive Care: AIMS-ICU. The Development and Evaluation of an Incident Reporting System in Intensive Care

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Intensive Care Units participating in the AIMS-ICU project#

SUMMARY

Intensive care units are complex, dynamic patient management environments. Incidents and accidents can be caused by human error, by problems inherent in complex systems, or by a combination of these. Study objectives were to develop and evaluate an incident reporting system. A report form was designed eliciting a description of the incident, contextual information and contributing factors. Staff group sessions using open-ended questions, observations in the workplace and a review of earlier narratives were used to develop the report form. Three intensive care units participated in a two-month evaluation study. Feedback questionnaires were used to assess staff attitudes and understanding, project design and organization. These demonstrated a positive attitude and good understanding by more than 90% participants. Errors in communication, technique, problem recognition and charting were the predisposing factors most commonly chosen in the 128 incidents reported. It was concluded that incident monitoring may be a suitable technique for improving patient safety in intensive care.

Key Words: INTENSIVE CARE: incident monitoring, quality assurance, patient safety

Intensive care units (ICUs) are complex patient management environments. The clinical skills of the care-givers are supplemented by sophisticated monitoring devices, life support systems and multiple drug administrations. Quality of Care (QOC) has become a major aspect of medical and other health care provision. What constitutes QOC and how it can be measured and improved are topics widely discussed in the literature[1-6]. One way of finding out what deficiencies in QOC exist is to examine adverse events and incidents. Adverse incidents can be caused by human error, by problems inherent in complex systems and most commonly by combinations of these. Error researchers typically find that at least 80% of serious incidents in complex systems where humans and machines interact involve human error[7,8]. If the frequency of error is to be decreased, a clearer understanding of the underlying processes is needed. Understanding the cognitive psychology of error[8] and the use of techniques such as incident monitoring[9,10] allow a contextual analysis of errors in the ICU setting. Developing and implementing a voluntary, anonymous incident reporting system in the ICU setting is a first step in the quest to improve QOC, as this may, in a cost-effective manner, identify adverse or potentially adverse events and try to elucidate the underlying causes and contributing factors. Specific investigations into those problem areas identified by incident monitoring are then required, allowing the

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Accepted for publication on January 4, 1996.

development and implementation of appropriate interventions. Follow-up of these interventions may link incident monitoring to changes in QOC.

The aim of this project was to develop and evaluate a tool to systematically identify and analyse adverse events in the intensive care environment. The incident reporting system had to be non-threatening to ICU staff, encourage team involvement, focus on deficits in the system rather than the individual and be ethically and legally appropriate. It was decided to trial it in three ICUs, before inviting the participation of more units across Australia.

MATERIALS AND METHODS

Definitions of an Incident

An incident was defined as any event or outcome which could have reduced, or did reduce the safety margin for the patient. It may or may not have been preventable and may or may not have involved an error on the part of the health care team.

Study Setting

The study included three Australian ICUs: the John Hunter Hospital (JHH), Newcastle; the Austin Hospital (AH), Heidelberg; and the Royal Adelaide Hospital (RAH). Information about an incident was gathered via an Incident Report (IR) form. Forms were completed anonymously by ICU staff members involved in an incident. The reporter was asked to describe the incident and then indicate his/her opinion with regard to contextual information about the incident.

A resource manual called *Quality of Care Concepts Applied to the Intensive Care Setting* was designed by the chief investigator (UB) as a tool to introduce the concepts of QOC and incident monitoring to ICU staff. The objectives were to familiarize the ICU staff with the concepts of QOC, involve them in the application of these principles in their ICU setting, indicate that QOC relies on a team approach, describe how a program of voluntary anonymous incident reporting can be a step in QOC evaluation and improvement and to enlist the member's help in designing this reporting system, implementing it and evaluating its effectiveness.

Development of the Incident Report Form

In deciding on the format for the IR form, the experiences of other error researchers were taken into account, particularly those of the Australian Incident Monitoring Study in Anaesthesia[11-18]. The IR form was designed to include a narrative section to elicit a description of the incident in the reporter's own words and a Multiple Choice Section (MCS) to elicit contextual details about the incident regarding "what happened", "why it happened", "when and where it happened", "to whom it happened", and patient outcome as a consequence of the incident. To allow evaluation of the incident in light of a theory of the psychological basis of human error[8] the MCS was structured into the following key areas: type of incident, predisposing and limiting factors, staff and patient factors, patient outcome and suggested corrective strategies.

As suggested by Streiner and Norman[19], four sources were utilized for devising new items for the IR form specific to the intensive care environment. These included clinical observation, theory, research and expert opinion. A multi-disciplinary team approach to define these key areas was felt to be essential. Therefore, a team of coordinators was assembled to oversee the development, evaluation and introduction of the incident reporting system at the JHH ICU, which included three nurses, one staff specialist and the chief investigator. Staff members at the JHH were introduced to the concepts of QOC and incident monitoring via a presentation at the ICU Grand Round and later tutorial/interview sessions.

The tutor's manual was used during these introductory sessions. All ICU staff members were invited to take part in group interviews. Six group interviews were conducted in which a total of 29 staff members participated. Each session was chaired by the chief investigator, using excerpts from the tutor's manual. The participants were asked, in an open-ended fashion, what type of incidents they would like to report in an incident monitoring study and which specific factors they would include in the MCS. Tape recordings and written notes of the open-ended question portion of these sessions were made by a second coordinator. Verbal permission for these procedures was obtained from the participants at the beginning of each session. The five coordinators also carried out informal observations on incident occurrence during the shifts they worked in the ICU over a one-month period. A notebook was kept on the key points identified. No information identifying staff members or patients was obtained. Both the published literature, as well as the incident report form of the AIMS in anaesthesia study[16] were used to select possible items for this report form, as were samples of narratives from the incidents reported in previous pilot studies at the AH and the RAH. All data obtained was reviewed by the chief investigator and items grouped into the predetermined areas.

Development of the Evaluation Questionnaire

A questionnaire was designed to assess staff attitudes to the study, staff understanding of the study aims and to identify problems in the project design and organization (Table 1). Between three and seven questions were included for each area of assessment. The questions for each specific area were scattered throughout the questionnaire, and some were worded negatively, some positively. A direct estimation method was used to scale the responses, consisting of a six-point scale which ranged from "strongly agree" to "strongly disagree".

TABLE 1

Items included in the questionnaire evaluation form

Attitude
"I am keen to take part in this project."
"I felt comfortable filling out this form."
"I am concerned about confidentiality."
"I felt coerced to fill out this form".
Understanding of Study
"This study aims to make our ICU a safer place."
"Incident monitoring aims to examine the SYSTEM rather than me personally."
"Incident monitoring is a first step towards improving patient safety."
Study Design
"The form was too detailed."
"The form was too tedious."
"The form was too confusing."
"The introduction and instructions were clear."
"The sequence of the sections was easy to follow."
"I could find appropriate items for any incident in each section."
Study Organization
"AIMS forms were readily available."
"The deposit box was inappropriately located."
"I could get help to fill out this form if necessary."
"Time was a limiting factor."

Pilot Study

Three intensive care units took part in the two-month pilot study in May and June 1993: JHH, AH and RAH. An evaluation questionnaire was attached to each incident report form, as was an instruction sheet. These combined forms were located within the ICU at points easily accessible to staff members. Forms were completed anonymously by ICU staff members involved in an incident. Reporters were advised to seek assistance from a local coordinator in filling out a report form, if required. The reporter was encouraged to complete the evaluation questionnaire after using the report form to describe an incident. The completed forms were then placed in a locked deposit box. This box was accessed only by the local coordinator, who would forward them to the chief investigator.

The chief investigator (UB) reviewed all incident report forms submitted. The narrative and multiple choice selections of the report forms were entered into a database, using codes to indicate missing data. All precoded items of the evaluation questionnaire were entered as ordinal data. Descriptive analyses were undertaken of both the incident and questionnaire data.

Ethical and Legal Implications

Patient and staff confidentiality was ensured by excluding personal identification information from the report forms. This study was not intended to compete with the established hospital compulsory reporting of incidents. Staff members' choice to participate in this study, by reporting incidents on the report form, was taken to imply consent. This study was declared a specific Quality Assurance Activity under the Health Insurance (Quality Assurance Confidentiality) Amendment Act 1992.

RESULTS

Questionnaire Evaluation

One hundred and twenty-nine incidents were reported in the three ICUs and for 116 (87%) of these an evaluation questionnaire was completed, giving a questionnaire response rate of 88%. Some participants indicated that they did not fill in multiple questionnaires if they reported more than one incident during the pilot study period. More than 90% of participants showed a positive attitude and good understanding of the incident monitoring study.

Four questions were included in the questionnaire to assess staff attitudes to the study (Table 1). A median of 1 ("strongly agree"), indicating a very positive attitude to the study, was found in three questions and a median of 2 ("agree") in one question. Three questions were used to assess the understanding of participating ICU staff members of the overall aims of this study. The median of 1 in all three questions indicated a good understanding by the participants. The questionnaires included six questions to attempt to identify problems with the study design. Two items had a median of 1, and three a median of 2. The item "I could find appropriate items for my incident in each section" identified a major problem area in the report form design, as evidenced by a median of 3. Four items were used to assess aspects of study organization. The item "time was a limiting factor" indicated this to be a potential concern for staff members. This was evident from a median of 3 for this item versus a median of 1 for each of the other three items.

Incident Reports

Allocations of incident types, by five major categories, for the three intensive care units taking part in the pilot study are given in Table 2. Comparisons of types of incident reported across the participating ICUs indicated that each unit varied in the distribution among these five incident groups. In 52 (27%) instances the reporter had difficulty finding an appropriate sub-category for the incident type chosen, indicating this by choosing "other".

TABLE 2
Incident categories

ICU	Airway	Drugs	Proc.	Envir.	Manage.	Total
1	12 (16)	15 (20)	13 (18)	22 (30)	12 (16)	74
2	9 (31)	6 (21)	5 (17)	7 (24)	2 (7)	29
3	6 (21)	12 (41)	10 (34)	1 (3)	0 (0)	29
Total	27 (20.5)	33 (25)	28 (21.2)	30 (22.7)	14 (10.6)	132

Airway = Airway/Ventilation
Drugs = Drugs/Therapeutics
Proc. = Procedures/Lines/Equipment systems
Envir. = Patient management/Environment
Manage. = Unit management
( ) = Percentages

Concerning patient factors, 97% of patients were more than 14 years of age at the time of the incident, 3% were 1 to 14 years of age. Forty-six per cent of patients were classified by the reporter as "stable ICU", 49% "unstable ICU" and 3% "high dependency". In 85% of incidents no harm came to the patient, in 15% harm did occur—13% minor in nature, 2% major, but all harm was of short duration only. None of the incidents resulted in major, longterm harm to the patient.

The incident was reported by nursing staff in 74% of reports, medical staff in 22%, and by other health professionals in 4%. In over 85% of reports the nurse reporting was also the nurse detecting the incidents, but only 70% of reports detected by medical staff were actually reported by them. In 41 reports (32%) accurate data on the timing of the incident was not given. Of those reported, 79% occurred during "routine care", 5% during "major procedures" and 8% during "handover". In 94% the incident occurred within the ICU, in 3% during transport within hospital and in 2% during retrievals.

Of the 50 "contributing factor" options available for selection, 64% of participants selected more than one factor and 11 options accounted for 73% of all selections. Those most frequently chosen were errors of communication, technique, problem recognition and charting. The effect of the incident was limited by "routine check" in 29% of reports, "incidental finding" in 28%, "supervision/skilled assistance" in 16% and by "prior experience/training" in 12%. Most participants indicated that the best way to prevent the incident in the future was to eliminate the precipitating factors. No new information was gained by this section.

DISCUSSION

Incidents can be identified in various ways: by direct observational studies of staff members working in the ICU, simulation studies, compulsory incident reporting, and by anonymous incident reporting. Direct observation studies may provide much information and an estimate of error frequency, but is labour-intensive and intrusive, and the reason for some of the errors may be difficult to assess. Simulation studies have similar advantages and disadvantages, and are also costly and time-consuming.

Compulsory incident reporting tends to be limited to obvious, witnessed events, and rarely contains a frank account of the true context of the problem. The advantages of a structured anonymous incident reporting system include the ability to elicit contextual details about contributing factors, human error, factors minimizing adverse outcome and suggested corrective strategies. Anonymity and medicolegal safety are key factors in gathering this information. Staff members are more inclined to describe the episode frankly when the report is anonymous and no effort is made to apportion blame. The "system" is assessed, not individual staff members. In this study, most incidents reported caused either no harm or minimal harm only: therefore, outcome bias should be less prominent than in accident investigations[8].

The major disadvantage of anonymous incident monitoring is that it does not provide a numerator or denominator, so that the incidence of a problem cannot be assessed. It is likely that only a small fraction of all incidents is reported. However, the more incidents reported, the more complete a picture emerges of the range of incidents encountered in the ICU setting.

The AIMS-ICU study is a descriptive study. Qualitative research techniques appear to be particularly useful when problems are "complex, contextual and influenced by the interaction of physical, psychological and social factors"[20,21]. The intensive care environment is such a complex system. Incident monitoring can be used as a tool to find out "what is going on". It is hypothesis-generating research. Quantitative research can build on these findings, and resources allocated to study those problem areas that

have been identified by staff members working in this area of health care.

The JHH ICU was chosen for the first stage of the study as it is the work place of the chief investigator. The report form was piloted in three ICUs, chosen because of their interest in incident monitoring. The study has now been extended to include all ICUs in Australia and New Zealand wishing to participate in this ongoing project. As more units take part, a more complete picture will result.

The information provided on the report form represents the opinion of the reporter regarding the contextual factors of the incident: opinions about contributing factors do not necessarily prove a cause-and-effect relationship. The AIMS-ICU data represents the spectrum of incidents which individual staff members working in the ICU setting felt motivated to report. However, it is probable that participants are more likely to report unusual, interesting or particularly dangerous incidents than mundane events. This reporting bias is more likely to occur when there is a delay between incident occurrence and reporting[9]. In this study participants were encouraged to report incidents as soon as possible after detection. The possibility of volunteer bias or selection bias needs to be considered for both the ICUs electing to join the study as well as for individual staff members choosing to participate.

During the pilot study valuable information was gained from both the evaluation questionnaires as well as the actual reported incidents. A reasonable response rate for the completion of the evaluation questionnaire was achieved. It was encouraging that more than 90% of participants showed a positive attitude and good understanding of the study. These participants, however, are not necessarily representative of all staff members working in an ICU.

In light of the findings from both the evaluation questionnaire and the incidents, the report form was redesigned for use in the ongoing national study. It became clear that the actual description of the incident given in the "narrative" was the real essence of the report, and that the MCS should contain only information not usually given in the narrative, as staff members are more likely to respond when the report form is easy to complete. During the pilot study much effort was wasted by the participants struggling to assign correct key words to their incident. The chief purpose of these key words is to allow retrieval of the incident at a later date. Therefore, this coding needs to be done uniformly and correctly. This task is now performed by the national coordinating team.

The results reported here are summaries only. These are of limited use when aiming to alter QOC, or decrease the occurrence of specific types of incidents. A framework is required for apportioning the various contributing factors (latent errors), behavioural factors (active errors) and chance to each category of problem. The incident reports received during the pilot study were included in the ongoing national study for further analysis, as it was felt that the information would be valuable for future review of specific categories of incidents.

This pilot study has now been developed into an ongoing national incident monitoring project. The findings of the first year of incident reporting in seven units are given elsewhere in this journal[22]. The AIMS-ICU database was set up so that sets of data can be cross-correlated. A knowledge of the relative frequencies of occurrence of the most important contributing factors and of the potential impact of each problem will allow appropriate preventive strategies to be devised, and will facilitate the setting of priorities. Once preventive strategies have been devised for a particular problem it may be necessary to carry out explicit risk-benefit analysis to justify the arguments for obtaining the necessary resources to solve the problem[16]. Follow-up of incidents and preventive strategies will then be needed to link incident monitoring to improvements in Quality of Care in the Intensive Care environment.

ACKNOWLEDGEMENTS

The study was endorsed by the Australian and New Zealand Intensive Care Society (ANZICS) and the Australian Patient Safety Foundation. Financial assistance was received in the form of a grant from the Professional Indemnity Review of the Commonwealth Department of Human Services and Health.

We would like to thank the staff members of the Intensive Care Units at the John Hunter Hospital, the Austin Hospital and the Royal Adelaide Hospital for their enthusiastic participation in this project. We also would like to thank Ms Gemma Grant for the skilful preparation of this manuscript.

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