

Development of an Online Incident-reporting System for Management of Medical Risks at Hospital

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(Received November 8, 2010; Accepted June 17, 2011; Published online June 27, 2011)

To minimize their occurrence, it is important to gather and analyze data regarding cases of not only medical accidents but also of incidents involving potential harm to patients. In gathering data, we have separated reporting between the details of such incidents and information about their occurrence. We have implemented a system involving a first report to achieve prompt notification and a second report to provide details. An online report input system has been established taking into consideration both ease of input and promptness of information sharing. We discuss the input of the first and second reports in a total of 951 cases over a period of 6 months. From the data regarding the timing of the first report, 307 and 789 cases were reported within 24 h and 48 h, respectively, indicating that the first report was input mostly without delay in accordance with the operational guidelines. On the other hand, it took 14 days to surpass a second report rate of 80%. Cases that took more than 2 weeks to be reported would likely have gone unreported had there not been a first report to indicate and confirm that an incident had even occurred. Investigation is needed, especially for problematic cases, so we assume that discovering important incidents *via* the first report has been successful. In addition, details of incidents can be input into this system in free-text, yielding information that cannot be acquired with multiple choice input as in standard reporting systems.

Key words—hospital incident reporting; patient safety; reporting system; medical error

INTRODUCTION

To reduce the number of medical accidents, hospitals in Japan providing advanced medical care have been required to organize internal safety management teams since April 2000.¹⁾ Safety management is based on the daily observation and analysis of medical practices implemented in each hospital. To ensure safety and improve the quality of medical care, it is necessary to observe, clarify, and analyze any problems that exist in daily medical practices. Furthermore, this sequence should be performed smoothly and continuously.

There are many causes of medical accidents. Issues related to hospital safety can be categorized as those that involve actual harm to patients (“accidents”) and those that involve potential harm to patients (“incidents”). It is important to gather and analyze data regarding cases of not only medical accidents but also of incidents with the potential to cause harm to a patient because for every accident there are likely to be many more less serious incidents (Heinrich’s law). Many incidents are caused by human error, which

means that they are preventable. If incidents occur frequently, they may develop into accidents. However, not all incidents result in accidents, and from this we gain insight into methods of preventing accidents (Byrd analysis). Therefore, how well a safety management system functions depends on the amounts of data gathered regarding incidents. The importance of such data gathering regarding incidents has recently begun to be recognized.²⁻⁷⁾ However, in reporting an incident, factual details and questions regarding responsibility must usually be examined by the person who discovered the incident (relevant personnel). Consequently, it becomes difficult and/or time-consuming to submit a report, and therefore a percentage of reports may not actually be submitted. It is desirable to know about such incidents immediately, but it usually takes time to uncover and report the relevant details.

To meet the contradicting demands of both prompt reporting and detailed understanding, we separated initial reporting from detailed reporting in each case by implementing a first report for prompt notification and a second report for describing cases in detail. The present system was developed based on this concept.

METHODS

In autumn 1999, we initiated the development of an online incident report system in which relevant personnel discovering an incident can report the incident easily and at their own discretion. This system was implemented on the hospital intranet to enable the sharing of information over the Web and by E-mail. We used TurboLinux Server 6.1 as the OS running the PostgreSQL database and Apache Web server. To build the system, the process of inputting cases was divided into a “first report” and a “second report.” Thus, reports are made twice to fulfill the contradicting demands of prompt reporting and detailed understanding. As the purpose of the first report is to achieve prompt incident reporting, it requires only minimal information to reduce the input time of the person discovering an incident. In the second report, the input items, which enable analysis of cause, are arranged with additional items describing the details of the case. Based on these conditions, the construction of an online incident report system proceeded from the first to the third phase. We evaluated the usefulness and the validity of this incident reporting system by analyzing the number of incident reports, and the amount of time required to send reports from the occurrence of incidents.

RESULTS

System Construction and Operation for Electronic Incident Reporting on the Intranet The purpose of the first phase of system construction (July 2001–March 2003) was to establish the basic operation of reporting twice by separating each case into first and second reports. After a trial period, the following input items were set for the first report: date of discovery; location; action caused by the incident; and incident level (Fig. 1). In accordance with the concept of anonymous reporting, the person discovering the incident (the reporter) was not asked to input their name. The first report was sent to the risk manager of the ward where the incident occurred. In addition, the same report was also E-mailed to the director of the hospital if the risk level of the case was close to that of an accident. Once system troubles were resolved and most personnel became familiar with using the present reporting system during the first half of the year, the reporting time for first reports was set to within 24 h of incident discovery (Fig. 2).

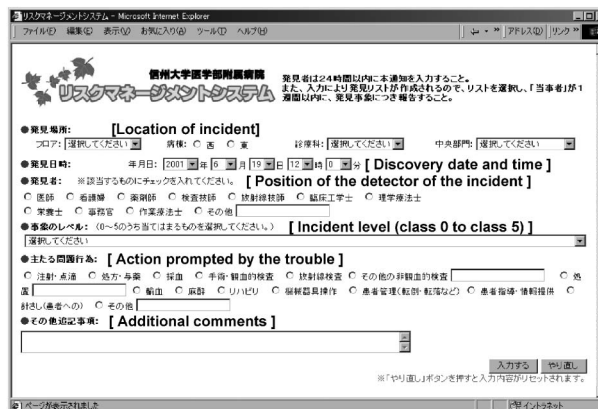


Fig. 1. First Report Input Screen

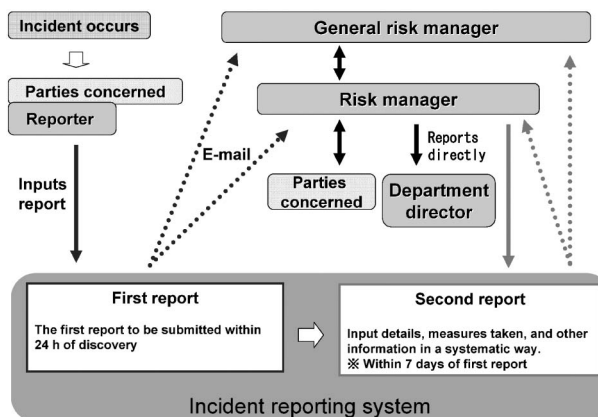


Fig. 2. Operational Flow of the Incident Reporting System

The risk manager has been placed by one person about 60 departments, the second report will be input from a password-protected site by the department’s risk manager the incident occurred. For the second report, the classification and coding of case details were fundamentally limited to some specific items (Table 1). To understand the correlations between different human factors during the occurrence of a case, these items were encoded for input as follows. The messaging route of operation was defined through the following stages: indicator, indicator-performer, performer, performer-patient, and patient. At each stage, the main cause of the incident was selected from the following options: missing instructions; lack of verification of instructions; unexpected reactions to medical treatment; and problems involving the patients themselves. Incidents were analyzed based on the above information. Encoding was not used for additional information, which was input as free-text to facilitate reporting of various informa-

Table 1. Notification Item List

Notification item	First report	Second report
Date it occurred	■	■
Discovery date	■	■
Incident level	■	■
Number of PHS (effect-level input if 3b above)	■	■
Party positions	■	■
Date of commencement of treatment		■
Years of experience in this hospital		■
Years of experience after obtaining license		■
Sex patient information		■
Patient Information Age		■
Clinics and departments where the floor discovered	■	■
Time reported to the Head of Dean		■
Reporter	■	■
Check the wristband		■
Type of problems	■	■
As you can see complete details of the accident (text input)	■	■
Task analysis of events issue—Stages		■
Task analysis of events issue—Options		■
Transitional problems (text input)		■
Responding to problems and progress (text input)		■
Measures not to repeat the same problem (text input)		■
Description and subsequent reactions to patients and others (text input)		■
Other important that you want (text input)		■

The items except “text input” are input from the choices listed in the pull-down menus or radio buttons.

tion that would not be possible with simplified encoding.

Taking the complexity into consideration, the detailed second reports were required to be submitted within 7 days. If the 7-day period was exceeded, a reminder was E-mailed automatically to the risk manager of the relevant department every day until the completed second report was submitted. The risk manager of the relevant department would find the anonymous reporter of the first report specify how was this achieved if the report was anonymous and ask them to submit the second report.

In addition, a tabulation function for statistical analysis was added to the Web page used by administrators, such as department risk managers, thus enabling the reporting of monthly figures to the Risk Management Committee and the Risk Managers Meeting held once every month. This made it possible to promptly gather data regarding cases of incidents and utilize them in prevention of medical accidents (Fig. 3).

In the second phase of system construction (April 2003–September 2005), we made improvements to analyze information promptly and effectively. This was difficult to implement in the first-phase system because technical knowledge regarding database management was required. In the previous system, it was necessary to control the server directly to process statistics. In the second phase, we were assisted in the

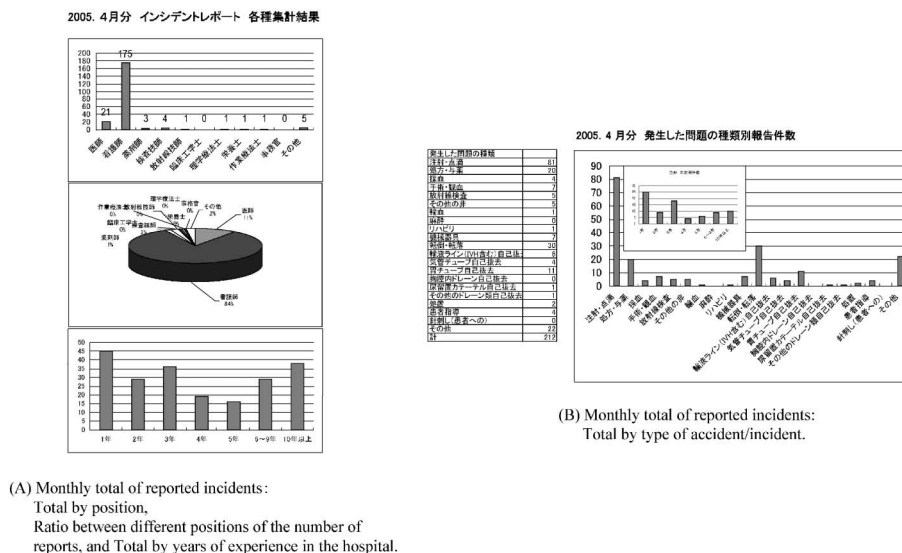


Fig. 3. Materials of the Safety Management Commission

(A) Monthly total of reported incidents: Total by position, ratio between different positions of the number of reports, and total by years of experience in the hospital (April, 2005). (B) Monthly total of reported incidents: Total by type of accident/incident (April, 2005).



Fig. 4. Screen Showing a Graph Counting All Types of Problem That Have Occurred (Second System)

processing of statistics by an information technology expert. Consequently, data processing functions were added to the system to allow the risk manager to process basic statistics whenever necessary, and graphical analyses were enabled at each department (Fig. 4). In addition, to promote the sharing of information, the numbers of incidents occurring in each department were made accessible to the risk managers through the Web page. This made it possible for managers to examine incidents that occurred in each department and to more easily improve their own operations.

As described above, for secondary use of information, only improvement of statistical functions was required and there was no need to change the procedures of the first and second reporting style. However, for the anonymous reporting of incidents, the Risk Management Committee suggested that we add the in-hospital Personal Handyphone System (PHS) numbers of personnel submitting the first report in cases of incidents graded level 3b or higher. This would make it possible to ascertain details by contacting the personnel *via* PHS in the case of the occurrence of a serious situation. Risk management generally uses anonymous reporting because the purpose is not to investigate individual responsibility but rather to improve operations. Nevertheless, in the case of a serious incident, it is necessary to understand the situation without having to wait for a second report. This was one aspect in which anonymous submission

caused problems, and we implemented measures to deal with crisis management during the occurrence of an accident while maintaining the principle of anonymity.

In the third phase of system construction (from October 2005), more advanced analysis functions were installed for the effective use of data. The execution of two-dimensional and three-dimensional tabulation by changing the analysis criteria was enabled on the Web page, such as “Type of problem”, “Incident level” and “Years of experience in this hospital”. Consequently, data required for statistics could be acquired at any time without requiring technical knowledge regarding database usage.

Acquired Effects The tabulated results of reported data are submitted to the Risk Management Committee and the Risk Managers Meeting held every month. These data are important for understanding any trends in the occurrence of incidents over the previous month. At the Risk Management Committee, we discussed and determined important factors for safety management both for each department and for the entire hospital. In 2001, the year in which this system was first implemented, the figures regarding the numbers of reports per month showed an increase in July and a decreasing trend during the following months. This pattern of increases and decreases in the number of reports was seen every year (Fig. 5).

In this operation, the first report was to be submitted within 24 h and the second report was to be sub-

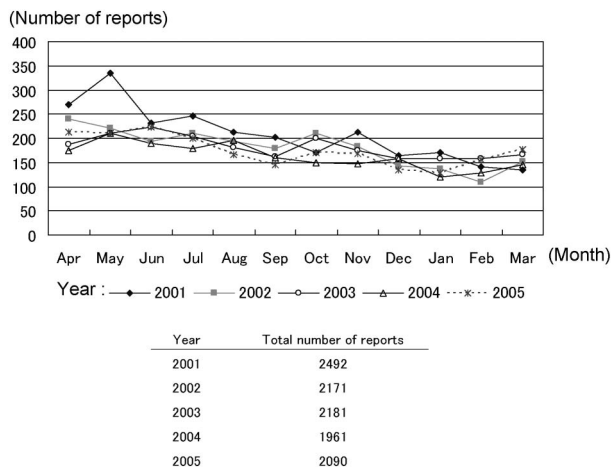


Fig. 5. Annual Changes in the Number of Reports

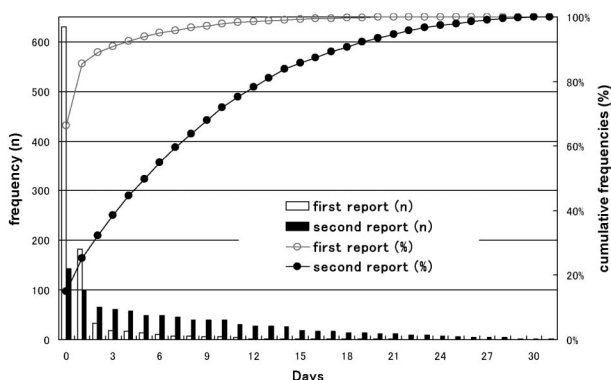


Fig. 6. Frequency and Relationship between Cumulative Frequency and the Number of Days between the Discovery and Reporting of an Incident

mitted within 7 days. The status of the first and second reports for a total of 951 cases for the months between October 2005 and March 2006 is described below. For the first reports, 307 cases (32.3%) were submitted within 24 h and 789 cases (83.0%) within 48 h, indicating that the first report was submitted mostly without delay in accordance with the operational guidelines (Fig. 6). For the second reports, 525 cases (55.2%) were submitted within 7 days, while 426 cases (44.8%) took more than 7 days. There were no specific periods where the rate of reporting increased dramatically, not even after 7 days, and it took 14 days to surpass 80%. On the other hand, the second report was submitted within 30 min after the first in 48 cases (5.0%).

DISCUSSION

The voluntary reporting of incidents by medical

workers is essential for preventing medical accidents and improving the quality of medical care.⁸⁻¹⁷⁾ Kishi *et al.* reported that installing an intranet reporting system increased the number of incidents reported and the sharing of information in comparison to paper-based reporting systems.¹⁸⁾ Web-based incident reporting is effective not only for tabulating and/or analyzing data but also for sharing practical information regarding patient safety within the hospital.^{16,19-23)} Nakajima *et al.* also reported the usefulness of sharing information between departments.³⁾ However, previous systems were based on the principal purposes of accuracy of input and analysis of data. There have been no previous reports of systems focusing on promptness and information sharing. The use of first and second reports in the system described here allowed the smooth reporting and transfer of information regarding the occurrence of incidents. This system appears to be highly useful for supporting safety management.

With regard to the numbers of reports per month, a pattern of an initial increase followed by a subsequent decrease in the number of reports was seen every year. This is believed to be a result of the fluctuating level of medical skills in the workplace when new personnel are employed or moved between departments in April. The basic pattern throughout the year was the same for each year, but the overall number of reports decreased gradually over time. The problem of skill levels remains an annual subject of concern, but we believe that the decreasing numbers indicate that the present system is becoming more effective in managing risk in this hospital.

While 80% of first report submissions were completed within 48 h, only 5% of second reports were submitted immediately after the first. The status of the second report indicates that if we did not provide a simple first report method, it would take up to 2 weeks for more than 80% of the cases to be reported and understood completely. The period required for reporting 80% of the incidents may be reduced from 2 weeks to 48 h using the present system. As the purpose of incident reporting is operational improvement rather than crisis management for the occurrence of accidents, a simple first report as in the present system may appear to be a waste of time with only a detailed report, such as the second report, appearing to be necessary. However, the observation that it takes up to 2 weeks to submit more than 80% of all cases rev-

ealed that it is not so to submit a detailed report, indicating that functions other than E-mailed reminders will be necessary in the future. Without a first report to indicate and confirm that an incident even occurred, it would be even more difficult to request detailed input. It is even possible that such cases would go unreported. Investigation is always necessary, especially for problematic cases. Our system makes it possible to gather data regarding problematic cases in which the details must be described. The development of a system that includes a first report is a significant step toward achieving promptness of reporting, while increasing the effectiveness of gathering information regarding incidents for risk management.

In addition, personnel who discover an incident can submit details freely at their own discretion using free-text input. This allows us to understand various aspects and/or ideas regarding accidents and incidents that may not have been acquired *via* multiple-choice input. The length of the each text field was limited to encourage reporters to summarize the details because long text fields almost invariably make details ambiguous and can complicate incident analysis. In general, free-text input is not suitable for statistical analysis, and is instead used to gain flexibility for input. Therefore, to analyze the details of incidents, a text-mining technique was used in the trial to identify keywords relevant to each type of incident. Currently, it is difficult to identify causal factors using the text-mining technique, but the possibility of exploring trends in each of the factors was discussed in the previous report by Ohkura *et al.*²⁴⁾ To utilize the gathered data regarding relevant cases more effectively, it will be necessary to develop tools to enable more detailed analysis of data from free-text input.

Acknowledgments I am extremely grateful to Dr. S. Murase, former Professor of Medical Informatics, Shinshu University Hospital.

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