

Medical Errors in a Hospital in Taiwan: Incidence, Aetiology and Proposed Solutions

*Chang-I Chen^{†‡}, Chien-Tsai Liu[†], Chieh-Feng Chen^{†‡},
Yu-Chuan Li^{†‡}, Chia-Cheng Chao^{‡\$*}*

[†] Graduate Institute of Medical Informatics, Taipei Medical University, [‡] Municipal Wan Fang Hospital, ^{\$} Department of Health Management, Taipei Medical University, ^{*} National Chen Chi University MIS Graduate School, Taiwan

ABSTRACT

Objective: To investigate the incidence and aetiology of medical errors in a hospital in Taiwan and to propose effective solutions for their prevention.

Design: Retrospective audit.

Setting: An 800 bed general hospital in Taiwan with a computerised physician order entry system and prescription delivery system.

Methods: We collected and analysed 1,462 filed incident reports covering the period 1 January 2001 to 31 December 2002. Errors were categorised into one of three types: medication, medical or administration errors. They were further analysed to see if they resulted in patient harm. Medication errors were also further analysed to identify the type of error.

Results: The number of medication, medical and administration errors were 254 (17.3%), 736 (50.4%) and 472 (32.3%), respectively. Based on the number of patients treated in the hospital and the number of prescriptions written, the calculated medical error rate was less than 0.1% and the medication error rate was less than 0.01%. 8% of incidents resulted in injury to patients. The most common medication errors were omitted drug, wrong drug and wrong dose.

Conclusions: Compared with other studies, the medical and medication error rates in this study are very low. This may be a reflection of the benefits of computerised physician order entry and prescription delivery, but may also be due to under-reporting.

INTRODUCTION

Medical errors are a major cause of concern as they affect both medical practitioners and patients. They were highlighted a decade ago by Brennan and colleagues¹ in a paper estimating the incidence of medication errors caused by medical professionals, management and healthcare systems. Subsequent studies

in the USA demonstrated that 3–4% of patients experience injury due to medical errors².

The subject of medical errors was brought to international prominence by the Institute of Medicine's publication, *To Err is Human*³. The report highlighted the scale of the problem by estimating that nearly 100,000 deaths each year in the USA are the result of medical errors. This makes it a leading cause of deaths in the USA. In fact in magnitude it almost equals the combined annual deaths from motor vehicle accidents (43,000), breast cancer (42,000) and AIDS (17,000). However, significantly, the report concluded that the majority of errors were not due to careless or incompetent doctors but the consequence of poorly designed, complex healthcare systems.

Little is known about medical errors in Taiwan. The current study was undertaken to investigate the incidence and aetiology of medical errors in a hospital in Taiwan and, based on the findings, to propose strategies for reducing them.

METHODS

The study was conducted by retrospectively reviewing filed incident reports for an 800 bed general hospital in Taipei for the period 1 January 2001 to 31 December 2002. At the time of the study the hospital had a computerised physician order entry system (without clinical decision support) and computerised prescription delivery system. In addition the laboratory information system and the radiology reporting system were computerised.

The incident reports were completed in response to adverse clinical outcomes or significant anomalies. Incidents were classified into one of three categories:

- Medication errors
- Medical errors
- Administration errors

Medication errors are related to the prescribing, dispensing and administering of drugs. For example, they would include the wrong drug or wrong dose being prescribed or a drug being administered to the wrong patient. Medication errors encompassed both in-patient and out-patient prescriptions. Medical errors refer to malpractice or mistakes in performing tests, examinations or procedures. Administration errors would encompass, for example, appropriate care not being provided due to a shortage of staff, inappropriate workflow systems or dangerous working environments.

Each incident report indicates into which of the three categories the incident falls. The incident forms are filled in by a nurse, administrator or pharmacist who is trained to identify the type of incident and possible causes of the incident. If the incident is urgent, i.e. an imminent threat to the patient, the nurse, administrator or pharmacist reports to his/her supervisor, and then reports to the Incident Task

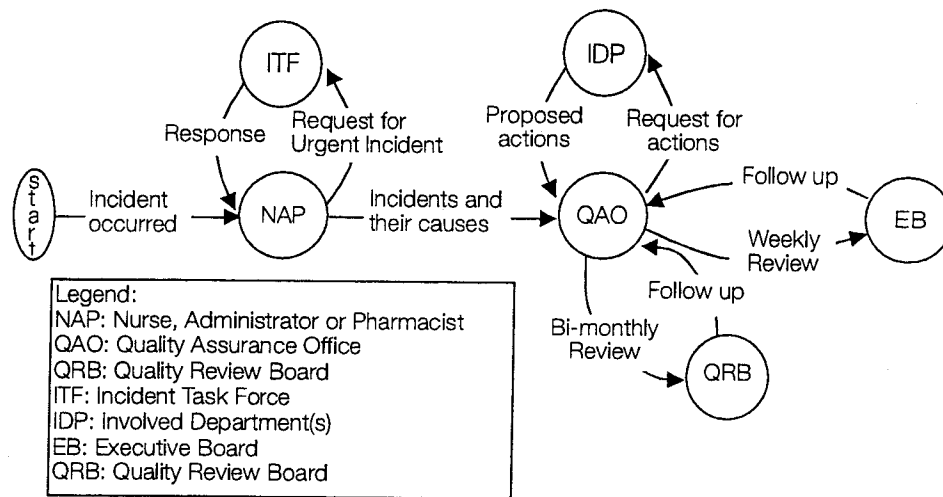


Figure 1. The workflow for processing incident reports

Force (ITF). This is a group of medical experts responsible for immediately responding to urgent incidents in the hospital. Ultimately, both urgent and non-urgent incidents must be reported to and reviewed by the Quality Assurance Office (QAQ). Members of this office are initially responsible for:

- Identifying the relevant department involved in the incident
- Dispatching the incident report to the department
- Asking the department for proposed actions to reduce or eliminate future similar incidents

The workflow for processing incident reports is shown in Figure 1. After completing the incident report, the QAQ compiles the causes and actions specified in the incident reports, and submits them on a weekly basis to the Executive Board (EB) for review and correction of any workflow processes. The QAQ also submits the compiled incident reports every month to the Quality Review Board (QRB) for further review. The review process includes identifying the root cause of the error, classifying the severity of injuries and evaluating the effectiveness of any proposed remedial action. The decisions of the EB and QRB are implemented and enforced by follow-up from the QAQ.

The classification of the severity of injuries is based on the guidelines proposed by the National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP)⁴. Based on these guidelines the severity of injuries is classified into the following nine levels.

Category A: Circumstances or events that have the capacity to cause error.

Category B: An error occurred, but the error did not reach the patient (note, however, that an 'error of omission' is regarded as having reached the patient).

Category C: An error occurred that reached the patient but did not cause patient harm.

Category D: An error occurred that reached the patient and required monitoring to confirm that it resulted in no harm to the patient and/or required intervention to preclude harm.

Category E: An error occurred that may have contributed to or resulted in temporary harm to the patient and required intervention.

Category F: An error occurred that may have contributed to or resulted in temporary harm to the patient and required initial or prolonged hospitalisation.

Category G: An error occurred that may have contributed to or resulted in permanent patient harm.

Category H: An error occurred that required intervention to sustain life.

Category I: An error occurred that may have contributed to or resulted in the patient's death.

RESULTS

As shown in Table 1, during the two-year period, there were a total of 1,462 incident reports. Their breakdown into medication, medical and administration errors were 254 (17.3%), 736 (50.4%) and 472 (32.3%), respectively.

The severity of injuries resulting from these errors was graded according to the NCC MERP guidelines. Strictly speaking these guidelines apply to medication

Table 1. *Breakdown of incident reports by category*

Category of error	Number of incidents	Percentage (%)
Medication error	254	17.3
Medical error	736	50.4
Administration error	472	32.3
Total	1,462	100

Table 2. *Breakdown of the severity of injuries based on the NCC MERP classification guidelines*

Injury level	Number of incidents	Percentage (%)
Level B	1,201	82.1
Level C	65	4.5
Level D	79	5.4
Level E	66	4.5
Level F	30	2.1
Level G	16	1.1
Level H	2	0.1
Level I	3	0.2

Table 3. Causes of medication errors

Error	Number of incidents	Percentage (%)
Omitted drug	62	24.4
Wrong drug	34	13.3
Wrong dose	34	13.4
Wrong route	4	1.6
Wrong patient	15	5.9
Wrong time	14	5.5
Wrong order	16	6.3
Package damage	26	10.2
Narcotic event	17	6.7
Missing label	6	2.4
Out of stock	4	1.6
Others	22	8.7
Total	254	100

errors. However, we have extrapolated them to also encompass medical and administration errors.

Based on the NCC MERP classification, as shown in Table 2, the vast majority of errors (82.1%) did not reach the patient (level B). Of the 17.9% that did reach the patients, just under half (8%) caused patient harm (levels E-I).

The 254 medication errors were analysed in greater detail. Errors were classified according to their cause as shown in Table 3.

The most common medication errors were omitted drug, wrong drug and wrong dose, which contributed 24.4%, 13.3% and 13.4% respectively to the errors. These errors may occur during the prescribing, dispensing or administering process and may be committed by physicians, nurses or pharmacists.

DISCUSSION

Preventing errors is a complex process. To help minimise accidents, high-risk industries, such as the airline industry, use incident reporting⁵. This same principle can be applied to reducing medical errors and consequently many hospitals have established quality assurance or performance improvement programmes. Our hospital has a Quality Assurance Office to deal with all reported incidents. The office is responsible for compiling causes and proposed solutions, and submitting weekly and monthly reports to the hospital's Executive Board and Quality Review Board respectively. The Quality Assurance Office is also responsible for implementing and following up the recommendations of these boards.

In this study the number of filed incident reports equates to approximately two per day or fifteen per week. The hospital's computer system recorded 1,600,000 patient visits and 7,000,000 prescriptions over the two years. This gives a calculated

incident event rate of 0.091% (1,462/1,600,000) and a medication error rate of 0.0036% (254/7,000,000).

These figures for medical errors and medication errors are far lower than other previously published studies². They may be a reflection of the success of the hospital's quality assurance programme and the fact that the hospital had a computerised physician order entry (CPOE) system at the time of the study. However, the possibility that the low figures are due to under-reporting of errors cannot be discounted. At the time of the study the hospital did not have a standardised incident reporting system, and did not implement or enforce reporting guidelines.

Even if it is accepted that errors are under-reported at the hospital, the low medication error data provides evidence of the benefits of the hospital's computerised physician order entry system and prescription delivery system. The benefits of CPOE in reducing medication errors has been previously demonstrated by several other studies⁶. At the time of the study, clinical decision support was not provided and implementation of this would be expected to provide further benefit by, for example, eliminating dose errors⁶.

Following the Institute of Medicine's report, attention world-wide has focused on improving patient safety. In this study approximately 115 patients (8%) suffered harm as a result of the reported errors. The aim should be to reduce this to zero, and in line with this the Taiwan Joint Commission Board of Hospital Accreditation has set seven goals for improving patient safety in hospital settings:

- 1) Improve the accuracy of patient identification
- 2) Improve the effectiveness of communication among caregivers
- 3) Improve the safety of using high-alert medications
- 4) Eliminate wrong-site, wrong-patient and wrong-procedure surgery
- 5) Improve the safety of using infusion pumps
- 6) Improve the effectiveness of clinical alarm systems
- 7) Reduce the risk of nosocomial infections.

Many of these goals may be met by establishing a hospital-wide information infrastructure that integrates data from a variety of sources, and that is connected to medical knowledge bases for on-line consultation, reminders and alerts on adverse events⁷. The information infrastructure should improve the clinical decision making process, and hence enhance patient safety. For example, CPOE systems integrated with other hospital information systems, such as medical record management systems, radiology information systems, laboratory information systems etc., will allow physicians to access relevant patient clinical data when needed, and to transmit physician orders or prescriptions to relevant departments in a correct and timely manner. Advanced CPOE systems can even support surveillance of adverse events⁸⁻¹⁰, and provide reminders and alerts when events meet predefined criteria¹¹⁻¹⁴.

Since the study, the hospital has implemented an electronic medical record system and picture archive and communication system (PACS). The hospital is

also in the process of developing alert and reminder functions and a surveillance system for adverse drug reactions. We expect that these improvements in the hospital's information system will further reduce the incidence of medical errors. They should also enable the detection of medication errors without relying solely on human reporting.

CONCLUSION

This study has demonstrated that reported incidents of medical errors and medication errors in a hospital in Taiwan are very low. This may be a reflection of the hospital's computerised physician order entry system, but may also be due to under-reporting. The hospital has upgraded its information system to further reduce the incidence of medical errors and is also planning to implement computerised surveillance to enable the detection of medication errors without relying solely on human reporting.

REFERENCES

- 1 Brennan TA, Leape LL, Laird NM, et al. Incidence of adverse events and negligence in hospitalized patients: results of the Harvard Medical Practice Study I. *N Eng J Med* 1991; 324: 370-76.
- 2 Phillips DP, Nicholas C, Glynn LM. Increase in US medication-error deaths between 1983 and 1993. *Lancet* 1998; 351: 643-44.
- 3 Kohn LT, Corrigan JM, Donaldson MS, eds. *To Err is Human: Building a Safer Health System*. Washington, D.C.: National Academy Press, 2000.
- 4 National Coordinating Council for Medication Error Reporting and Prevention. NCC MERP Index for Categorizing Medication Errors, 2001.
- 5 Barach P, Small S. Reporting and preventing medical mishaps: lessons from non-medical near miss reporting systems. *BMJ* 2000; 320: 759-63.
- 6 Kaushal R, Shojania KG, Bates DW. Effects of computerized physician order entry and clinical decision support systems on medication safety: a systematic review. *Arch Int Med* 2003; 163: 1409-16.
- 7 Stead WW, Miller RA, Musen MA, Hersh WR. Integration and beyond: linking information from disparate sources and into workflow. *J Am Med Inform Assoc* 2000; 7: 135-45.
- 8 Stolberg SG. Pushes for prescription drug guides. *New York Times* Jun 4 1999; A23.
- 9 Whipple J, Quebbeman E, Lewis K, Gaughan L, Gallup E, Ausman R. Identification of patient controlled analgesia overdoses in hospitalized patients: a computerized method of monitoring adverse events. *Ann Pharmacother* 1994; 28: 655-58.
- 10 Bates D, Makary M, Teich J, Pedraza L, Ma'luf N, Burstin H, et al. Asking residents about adverse events in a computer dialogue: how accurate are they? *Jt Comm J Qual Improv* 1998; 24: 197-202.
- 11 Jha A, GJ K, Teich J. Identifying adverse drug events: development of a computer-based monitor and comparison with chart review and stimulated voluntary report. *J Am Med Inform Assoc* 1998; 5: 305-14.

- 12 Naranjo C, Lanctot K. Recent developments in computer-assisted diagnosis of putative adverse drug reactions. *Drug Saf* 1991; 6: 315-22.
- 13 Classen D, Pestotnik S, Evans R, Burke J. Computerized surveillance of adverse drug events in hospital patients. *JAMA* 1991; 266: 2847-51.
- 14 Goughnour BR, Arkininstall WW, Stewart JH. Analgesic response to single and multiple doses of controlled-release and morphine oral solution in cancer patients. *Cancer* 1989; 63(11 Suppl): 2294-97.