Learning from error: identifying contributory causes of medication errors in an Australian hospital

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ABSTRACT

Objective: To study the clinical contexts contributing to harmful medication errors.

Design, setting and participants: A qualitative study using semi-structured interviews was conducted between March and August 2005 at Fremantle Hospital, a 450-bed metropolitan teaching hospital. Twenty-six of 46 staff members (57%) identified by pharmacy staff as having contributed to a significant medication error were interviewed. Interviews were recorded and transcribed for thematic analysis.

Results: Most errors were due to slips in attention that occurred during routine prescribing, dispensing or drug administration. Knowledge-based mistakes (eg, failure to follow a protocol) also contributed to prescribing errors. Errors were more likely to occur during tasks being carried out after hours by busy, distracted staff, often in relation to unfamiliar patients. Communication problems with senior staff and difficulty accessing appropriate drug dosing information contributed to knowledge-based prescribing errors. Several medical staff were unaware they had committed an error until their involvement with our study.

Conclusions: Contextual factors that contributed to slips, lapses and knowledge-based mistakes in our sample are likely to be widespread in hospitals, and their impact on medication error may be substantial. Staff need training in how to recognise and deal with error-prone clinical situations. Safe prescribing practices (eg, the absolute requirement to acquire information before prescribing unfamiliar drugs) must be emphasised. Improved access to drug information at the point of prescribing, attention to communication barriers, and increasing staffing levels in particular areas are other potential strategies for reducing error.

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Adverse drug events (ADEs) are associated with 2.4%–3.6% of admissions to Australian hospitals.[1,2] Preventable errors in the dispensing, prescribing or administering of drugs in hospitals make up roughly a quarter of ADEs.[2,3] In a United Kingdom study, 1.5% of medication orders had identifiable errors, of which 0.4% were judged potentially serious.[4]

Three types of error are common: errors due to lapses of memory or slips in attention; errors of judgement in planning (rule-based errors); and errors due to lack of knowledge (knowledge-based errors).[5] The systems approach to human error distinguishes between active failures/mistakes committed by staff and latent (system-related) conditions that make errors more likely, such as busy workloads and fatigue.[5,6] Medication-related tasks in hospitals usually occur within a busy and potentially distracting environment, a situation seemingly ripe with latent conditions that may predispose to error.

Relatively few studies have considered the context of medication errors.[7] A study from a UK hospital interviewed medical practitioners whose actions had led to an ADE and reported that workload, team communication, lack of knowledge and lack of self-awareness of errors were relevant factors.[8]

To determine whether similar factors were relevant to our hospital, we carried out a qualitative study in which we interviewed frontline staff who had committed a significant medication error.

METHODS

Context of the study

Our study was conducted at Fremantle Hospital, Western Australia, a 450-bed metropolitan teaching hospital. The hospital has a busy emergency department, with the full range of general and specialist medical and surgical units. The hospital has participated in a statewide incident reporting system (the Australian Incident Monitoring System [AIMS]) since 2001, and a number of patient safety committees have been developed, including one dedicated to medication safety.

Study participants

In December 2004, letters were sent to all medical staff and nurse managers informing them of the project. Between March and August 2005, ward-based clinical pharmacists identified clinically significant errors in dispensing, prescribing or administration of drugs during their routine clinical rounds. A senior pharmacist (T-S C) selected incidents for study based on whether preventable errors had caused actual or potential patient harm (AIMS categories 6–8, where 6 indicates the need for extra diagnostic tests or treatment, 7 and 8 denote patient morbidity or increased hospital stay or death).

A convenience sample of key personnel involved (ie, the identified prescriber or the staff member who dispensed or administered the medication) were invited by the senior pharmacist to be interviewed. An information sheet explaining the project was provided, and every effort was made to offer a confidential, non-judgemental, private interview. During the study period, 46 staff members were approached and 26 were interviewed (15 doctors, seven nurses and four pharmacy staff members). Non-interviewed staff included 15 who refused to participate (eight doctors, six nurses and one pharmacist) and five who had agreed but were subsequently unable to be contacted (four nurses, one pharmacist). The interviewed doctors were junior (six interns, four resident medical officers, five registrars); the nurses were ward-based clinical nurses; and pharmacy staff members were experienced (three pharmacists and one pharmacy assistant with at least 5 years' experience).

Study protocol

Between 1 and 60 days after the error had occurred (median, 8 days), the interviews were carried out by a single researcher experienced in qualitative research (P N). Neither the interviewer nor the interviewees had access to the medical records. The interviews were taped and transcribed, removing identifiable features. (In one interview in which there was a technical malfunction, written notes were taken and transcribed immediately.)

1 Error-producing conditions volunteered by 26 staff members

Context	Category	Number (%) of respondents
Stressed	Individual	10 (38.5%)
Tired	Individual	7 (26.9%)
Busy, doing multiple tasks	Individual	6 (23.0%)
Distracted	Individual	3 (11.5%)
Personal or family health issues	Individual	2 (7.7%)
Poor communication within team	Team	8 (30.8%)
Poor communication with others	Team	8 (30.8%)
Lack of guidance from senior colleague	Team	7 (26.9%)
Pressure from others to prescribe	Team	3 (11.5%)
Unfamiliar medication	Task	7 (26.9%)
Task dependent on timing of drug delivery	Task	3 (11.5%)
Emergency situation	Task	1 (3.8%)
Unfamiliar patient	Patient	8 (30.8%)
Patient with complex issues	Patient	5 (19.2%)
Night duty, on call, extra-long shifts	Environment	8 (30.8%)
Difficulty accessing drug information	Environment	6 (23.0%)
Difficulty accessing protocols or guidelines	Environment	6 (23.0%)
Unfamiliar ward	Environment	5 (19.2%)
Multiple medical charts	Environment	2 (7.7%)
Wrong drugs in bedside medication drawer	Environment	3 (11.5%)
Under-staffed	Environment	1 (3.8%)
New medication bottle, similar to another	Environment	1 (3.8%)

Transcripts from the first four interviews were read and coded by at least two investigators (PH, DGB), a clinical psychologist and a research assistant to establish consistency in theme identification and to assess the validity of the interview style and the reliability of the questionnaire. All interviews were conducted face to face in a quiet area within the hospital.

The interview included open-ended questions and prompting for context-specific detail (recollections of the error, contributory events and conditions; the interviewee's perception of the impact of the ADE on the patient and on himself/herself; and suggestions for reducing future errors). The interview also included structured questions for data consistency (questions relating to whether any of a list of error-producing conditions was a contributing factor and whether the person's knowledge of the offending drug was sufficient). A single pilot interview was conducted to trial the interview process (the results of this were not included in our analysis).

Transcripts were entered into the NUD*IST (Non-numeric Unstructured Data — Indexing Searching Theorising) qualitative analysis software program, version 4 (QSR International, Melbourne, Vic), to code and link emergent themes.

Ethics approval

Our project was approved by the Fremantle Hospital Human Research Ethics Committee. All participants signed a consent form.

RESULTS

Sample characteristics and error types

We interviewed 26 staff members who were involved in 29 medication errors relating to 25 patients. There were 21 slips or lapses, eight knowledge-based mistakes and no rule-based errors (although some knowledge-based errors could have been so classified). The errors led to patients getting the wrong dose (13 occurrences) or the wrong drug (10 occurrences), a drug being withheld (two occurrences) or the wrong patient receiving a drug (one occurrence). All administration and dispensing errors were caused by slips in attention or lapses of memory. The prescribing errors included 10 slips or lapses and eight knowledge-based mistakes. The slips were mainly caused by failures of attention, and several lapses were due to memory failures. Knowledge-based mistakes included deficits in drug knowledge (eg, giving the wrong dose for renal or older patients) and failure to apply a protocol (eg, modifying the dose in the presence of renal failure). In three patients, two types of error were identified in the same case. Slips by doctors often occurred when rewriting drug charts, and slips by nurses usually happened during routine tasks, particularly when checking the name and dose of a drug before administration.

Error-producing conditions

Every medication error was associated with one, and usually more than one, error-producing condition (Box 1, Box 2). Overall, 16 subjects (61.5%) reported one or more personal factors having an influence at the time of the error, including staff being busy, tired and/or engaged in multiple tasks, and hence being potentially distracted. Several admitted to feeling stressed, usually because of the heavy workload, and, in two cases, personal issues were thought to be contributory. Commonly, staff were working after hours (eight instances) or in unfamiliar hospital areas (five instances) or attending a patient who was not their prime responsibility (eight instances). Changeover in staff seemed important in four cases, and eight staff were unfamiliar with the patient at the time of the error.

Problems with communication were reported by 10/15 doctors and 6/7 nurses. In the case of doctors, this was generally between teams at the time of handing over care. In the case of nurses, communication problems occurred mainly within the nursing team. Junior medical staff also reported lack of guidance from senior colleagues (seven reports), sometimes resulting from junior doctors' reluctance to bother a busy colleague or their low expectation of receiving a helpful response to a request for advice (Box 2). Two doctors felt pressured by nursing staff to increase sedation in older patients.

Knowledge-based mistakes were usually due to lack of knowledge about the relevant drug dose, coupled with difficulty accessing drug information. Six staff members commented that drug protocols or guidelines were non-existent, inadequate or not easily accessible on the hospital computer system because of difficulty accessing terminals or because too much time was required. Nurses reported mem-

2 Quotes from interviewees, illustrating the types of factors or conditions that may lead to error*

Individual factors
"At night it's very, very busy, it's a very busy term." *(Intern)*
"Well, on nights . . . you really get stressed out with people calling you in the ward and in the ED . . . you have so many patients to see." *(Registrar)*
"So I had actually started work at 7.30 in the morning . . . this occurred at something like 10 at night." *(Intern)*
"I expect myself and others to be tired . . . working all the day and the night, but again that is not an excuse not to be competent . . . with patient care." *(Registrar)*
"It's a busy period for us, we have quite a lot of prescriptions coming through at that time, including off our answering machine service . . . I put the prescription through in a hurry." *(Pharmacist)*
"There were three patients I was thinking about at that point in time . . . There was another person who was to be discharged on warfarin and I was supposed to write that up as well. And I think I was busy doing something else." *(Intern)*
"I had taken a sick patient around 7 pm in the evening and still hadn't really got him settled . . . I had to hand some stuff over to the night duties, and I was going to hand over the other guy's meds as well . . . so I quickly ran in there and gave them. So it was all like a bit rushed and stressful and I mean I still should have checked . . ." *(Nurse)*
Communication problems
"I wasn't [made] aware that there was a serious aberrant event happening to the patient while trying to adjust the doses." *(Registrar)*
"I should have been more clear with the medical registrar that I didn't know exactly how often [to give the drug], but he was so busy and I was busy . . ." *(Resident)*
"There wasn't any one else who was going to tell me what to do . . . Unless I rang them up . . . for something like that you wouldn't get a good, favourable response, I think." *(Intern)*
"I wasn't too careful because I knew that the med team was going to see him . . . So I think if a more senior doctor had seen him they would have picked up my mistake . . . but I still made the mistake in the end." *(Resident)*
Task-related problems
"[The registrar] didn't actually say 25 mg intravenously, which is probably the confusion I made . . . So, when the other medical registrar said '12.5 mg orally if you can't get her into the special nursing unit', I was thinking, if the first medical registrar was going to give 25 mg IV, it would be kind of safe to give the 12.5 mg IV as well." *(Intern)*
"That was the first time I had ever written up . . . [that] insulin and I still don't know how it differs from regular insulin." *(Intern)*
"I should have looked it up . . . I wasn't aware that it was four times a day and not once daily." *(Registrar)*
Work environment factors
"The information is there, but to have the time to read the pages and pages about every drug, it takes time." *(Intern)*
"It's just not easy to always find, it takes too long. There's not enough computers sometimes because MIMS is only fully available on the computer and the pharmacist isn't always accessible . . ." *(Nurse)*
"The thing [that] really sometimes gets confusing is how you prescribe it on discharge meds, because I wasn't told . . . like warfarin, the different doses of drugs . . . are 5, 2 and 1, and sometimes it's a variable dose and so I mean I just wrote 'warfarin 5 mg 1 and 2 mg for 5 days each' and then I said 'titrate accordingly'." *(Intern)*
"I just took the drugs that were in the [patient's] drawer." *(Nurse)*

ED = emergency department. IV = intravenously. * The type of staff member giving the response is shown in parentheses after the quote. ◆

ory lapses associated with drugs that required precise timing of administration following individual preparation and delivery (two cases) and with drugs variably kept in bedside drawers or ward trolleys (three cases).

Participants' awareness of errors

Ten interviewees, all doctors, did not know that they had caused a medication error until approached by the research team, because the error had occurred when they were dealing with an unfamiliar patient, usually after hours. In contrast, the majority of nurses committing an error had discussed the error with a senior nurse because the incident had been reported through the AIMS.

Solutions suggested by participants

A range of possible improvements was suggested. A common suggestion was that staff should exercise greater personal vigilance and should always check (and double check) their actions. A pharmacist suggested that pharmacists should be uninterrupted while dispensing drugs. The doctors recommended caution when prescribing high-risk drugs, and nominated psychotropics, unfamiliar drugs and drugs prescribed for older patients as being categories for special attentiveness. They wanted increased knowledge and experience with prescribing, greater use of prescribing guidelines (especially for drugs requiring dose titration) and easier access to drug information, including information on drug interactions. One doctor suggested the use of hand-held computers.

Several staff, including doctors previously unaware of their error, thought that learning from the incident would be beneficial. Few staff suggested changes to staffing or shift levels, but a pharmacist thought that improved staffing was required in pharmacy. The emergency department was singled out by several staff as an environment in which errors were more likely to occur. Suggestions for improvement included increased staff levels, issuing clearer prescribing guidelines and having separate medication charts. There seemed to be uncertainty about whether the responsibility for documenting routine medications should rest with emergency department staff or ward medical staff. Other suggestions included using coloured markers to highlight high-risk drugs on charts and involving competent patients in their drug management.

DISCUSSION

In our study, latent conditions that made medication errors more likely were common. Attentional slips, memory lapses and knowledge-based mistakes occurred when staff were busy, distracted or tired — often when they were working after hours or on long shifts or were dealing with patients who were unfamiliar or had complex conditions. Additional latent conditions increasing the risk of error included communication problems between or within teams. Knowledge-based prescribing errors were mainly caused by prescribers failing to acquire relevant information before prescribing unfamiliar drugs. Such errors were partly related to communication barriers between the junior staff involved and more experienced colleagues and partly due to difficulty accessing drug information or guidelines at the time of prescription.

The qualitative study design we used had inherent advantages and disadvantages. The main advantage was that it allowed us to gain detailed information on behaviour and attitudes surrounding medication errors. The main disadvantage was the small sample size, which limits the extent to which our results can be generalised. Towards the end of the interviews, the fact that no new themes were emerging indicates that the sample size was probably sufficient to have elicited most relevant issues in our hospital, but the extent to which these would apply to other settings is unknown. Nevertheless, there were striking similarities between our results and those of a comparable qualitative study from the UK,[8] and other studies using different methodologies have reported similar findings on error types,[9] problems with prescribers' knowledge[10] and poor adherence to safe prescribing behaviours.[11] The latent conditions contributing to errors that we document in our study are likely to be common in Australian hospitals and, indeed, in any busy health care setting in which medications are prescribed, dispensed or administered.

The finding that errors occur during routine tasks has important implications for staff training and student education. Staff and students need to understand that human error is ubiquitous, that routine medication management carries significant risk, and that latent conditions increase the likelihood of medication error.

The participants in our study emphasised vigilance and personal responsibility. A key message to complement standard pharmacological and pharmaceutical training would be that drug prescribing, dispensing and administration are high-risk clinical tasks that need to be performed meticulously at all times. The problem of distraction should be addressed specifically, and it seems feasible to create an organisational culture in which staff who are transcribing charts or prescribing, dispensing or administering drugs should expect to do the task without interruption.

The doctors we interviewed supported the case for improved training in clinical therapeutics.[12] However, knowledge of pharmacology will not protect against errors from slips of attention, and the required knowledge base is constantly growing as more medications become available. Training programs need to increase awareness of prescribing error and the importance of adhering to safe prescribing principles. Prescribers must be inculcated in the need to acquire information on unfamiliar drugs before writing prescriptions, and the prescribing culture and hospital system need to support this practice. Culture change will require active and persistent promotion by senior medical staff. In our hospital, drug information and guidelines are available online, but access to computer terminals remains difficult in busy areas. This would be a relatively easy area to target for improvement.

Another potentially valuable educational strategy for improving staff performance is to learn from errors that have occurred. Yet many medical staff in the present study were unaware of their errors because they related to patients who were seen after hours or who were the responsibility of other teams. It seems feasible that hospital departments could develop an explicit error identification and analysis strategy as an educational tool to increase awareness of latent conditions, improve individual staff performance and consider ways to improve the system of drug management. Our experience suggests that such a system would be acceptable to staff and could influence the organisational culture surrounding drug therapy.

Few of our study participants mentioned increased staffing levels in their list of possible solutions, although being busy and tired were common latent conditions contributing to error. Improving nurse-to-patient ratios appears to improve the quality of patient care.[13] The importance of error-producing latent conditions indicates the need for further study of the relationship between staff workloads and error in our hospitals.

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COMPETING INTERESTS

None identified.

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