

Why do interns make prescribing errors? A qualitative study

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Adverse events caused by medication have been estimated to harm 1% to 2% of patients admitted to hospitals in the United States, United Kingdom and Australia.¹⁻³ Most incidents that result in harm to patients originate in the prescribing process.⁴ Human error is a frequent factor.⁵

The intern year is a time for consolidating medical school education through continued learning and acquisition of knowledge and skills under direct supervision. More prescribing errors occur in the first year after graduation than in all other years.⁶ In an American study, 45% of interns reported having made at least one clinical error; 29% were prescribing errors, of which 15% were fatal.⁷

Although a particular action or omission may be the immediate cause of an incident (described as an active failure or error),⁸ closer analysis usually reveals a series of events and departures from safe practice, known as an error chain.⁵ The notion of a single root cause, although widespread, is an oversimplification.^{8,9} A structured process, which uses human psychology methods, is available for analysis of errors.^{8,10} This analysis method considers the individual's working environment, including the team and the organisation.

In this prospective qualitative study, we aimed to identify and analyse the factors underlying prescribing errors made by interns in order to identify multifaceted interventions that would reduce the risk of similar events recurring.

METHODS

Between February and June 2004, pharmacists at a 700-bed teaching hospital prospectively reported potentially harmful errors by interns. The following definition of an error was used:

A clinically meaningful prescribing error occurs when, as a result of a prescribing decision or prescription writing process, there is an unintentional significant (1) reduction in the probability of treatment being timely and effective or (2) increase in the risk of harm when compared with generally accepted practice.¹¹

All prescribing was handwritten on an inpatient medication chart. Discharge prescriptions were generated from a triplicate

ABSTRACT

Objective: To identify and analyse factors underlying intern prescribing errors to inform development of specific medication-safety interventions.

Design: A prospective qualitative study that involved face-to-face interviews and human-factor analysis.

Setting: A tertiary referral teaching hospital, Brisbane, Queensland, February–June, 2004.

Participants: Fourteen intern prescribers involved in 21 errors.

Method: A structured questionnaire was used to identify factors causing the errors. Transcripts were analysed on the basis of human-error theory to identify underlying themes.

Main outcome measures: Factors underlying prescribing errors.

Results: Errors were multifactorial, with a median of 4 (range, 2–5) different types of performance-influencing factors per error. Lack of drug knowledge was not the single causative factor in any incident. The factors in new-prescribing errors included team, individual, patient and task factors. Factors associated with errors in represcribing were environment, task and number of weeks into the term. Defences against error, such as other clinicians and guidelines, were porous, and supervision was inadequate or not tailored to the patient, task, intern or environment. Factors were underpinned by an underlying culture in which prescribing is seen as a repetitive low-risk chore.

Conclusion: To reduce the risk of prescribing errors, a range of strategies addressing patient, task, individual, team and environment factors must be introduced.

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carbon copy system. All 34 interns at the hospital were informed that the study was taking place, that the goal was to introduce safety-improvement strategies, and that deidentified errors would be reviewed by the medication safety team and used subsequently in prescribing training for medical students. Interns rotated among clinical units every 10 weeks. Following local ethics approval, all interns interviewed gave signed consent. Only interns who were involved in incidents and contactable within 72 hours of the incident were interviewed, to ensure adequate recall of events.

Semistructured face-to-face interviews incorporating a questionnaire were conducted to assess the causes of the prescribing error. The process was adapted, with permission, from the methods of Vincent et al⁸ and Dean et al.¹² Interviews took between 15 and 115 minutes (average, 44 minutes) and used the process outlined in Box 1.

As interns were reluctant to be taped, a detailed deidentified transcript was made and then reviewed by the intern.

We (a senior physician and two senior pharmacists) analysed and coded the transcripts independently, using Vincent et al's framework of error-producing factors.⁸ Consensus was achieved through discussion.

Errors were classified as either "new prescribing" or "represcribing." New prescribing involved a decision to start, stop or change a drug, or a drug's form, route or dose. Represcribing was any continuing therapy, and included prescriptions written when patients were admitted to hospital, transferred or discharged.

We identified latent factors underlying the errors, by thematic analysis.

RESULTS

Forty-seven errors were reported, of which 21, involving 14 interns, were analysed. One intern was interviewed about four incidents, four about two and nine about one each.

Twenty-six errors were not analysed because prescribers were unable to be identified (8), declined to be interviewed (7; with 3 having been interviewed before), or did not attend (3), or the errors were reported more than 72 hours after the event (8).

The 21 errors that were analysed are described in Box 2. They occurred on admission to hospital (3), during the inpatient stay (9), and on discharge (9). Antithrombotic and antibiotic drugs accounted for half the errors.

1 Interview to identify causes of prescribing errors by interns

Background to the interview

The interviewer (IDC) discussed with the pharmacist the error, the patient outcome, and whether the pharmacist had discussed the error with the prescriber. Medication charts and medical records were reviewed.

The interview

The intern was contacted and interviewed at a location of his or her choice away from the ward. The interview identified the intern's role in the incident and whether the error was in a new prescription or a re-prescription, and any instruction or supervision.

The questionnaire

This was based on Vincent et al's framework of contributory factors⁸ and was used to identify and systematically explore any contributory factors. These factors included:

- Working-environment factors
 - Staffing levels, skill mix and workload
 - Layout of workplace, ward office
 - Administrative and managerial support
- Task factors
 - Poor design of equipment such as medication chart
 - Availability, clarity and use of protocols
 - Availability and accuracy of test results
- Individual factors
 - Knowledge, skills and competence
 - Motivation and attitude
 - Physical and mental wellbeing
- Team factors
 - Verbal and written communication
 - Supervision and seeking help
 - Team structure (consistency and leadership)
- Patient factors
 - Condition (complexity and seriousness)
 - Language and communication

Closing of interview

Interviews were closed by asking the interns if they had any questions, what they would do differently with the benefit of hindsight, and if they had any suggestions for systems improvements. ◆

In 10 of the incidents where prescribing was directed by a senior doctor, the intern determined the route, form, dose, frequency or duration of the drug and had to consider the previous adverse drug reactions or renal impairment. In only one case of new prescribing was the intern solely responsible for the decision to initiate a medication. In three cases, the intern was prescribing for another doctor's patient, two when on call.

In 13 incidents, the interns had previously prescribed a drug, but they often

mentioned that they did not know the dose. In seven cases, they admitted to having made the same or a similar error previously.

Identifying errors by using the framework

Causes of the errors, presented in accordance with Reason's model of accident causation, are shown as holes in layers of Swiss cheese to indicate the four levels in which failures occur, enabling an accident to penetrate barriers and defences, resulting in harm to the patient (Box 3).⁵

We identified at least one active failure, or error, in each incident (Box 2).

Interns cited two or more underlying or influencing factors contributing to each error (Box 2). In new-prescribing errors, a median of 5 (range, 3–5) different factors were mentioned. In re-prescribing errors, the median was 3 (range, 2–5). Details of different components of the error-producing factors were identified from analysis of the transcripts (Box 4).

Major factors involved with new-prescribing errors were team (11), individual (11) and patient (10). For re-prescribing errors, they were environment (10), task (9) and the intern's time on the term (8).

Environment factors were the most frequent factors in 19 incidents, and included the office area, staffing levels and workload (17) (ie, being either busy or working longer than rostered hours). Twelve interns felt they were being pressured to get things done, most frequently when prescribing for patients being discharged. The pressure was often further exacerbated by the working environment being "cramped", "noisy", "busy", "hectic" or "distracting".

Task factors were associated with 16 incidents. The design of the regular or long-stay medication chart was identified by interns as leading to slips related to eight re-prescribing errors and one new-prescribing error. The medication chart layout and its location on the ward were key themes in nine of 21 incidents. The design of discharge prescriptions and Pharmaceutical Benefits Scheme requirements were mentioned in four incidents. Interns assumed that if they were directed to prescribe by registrars or copying a senior doctor's order, it would be correct, and guidelines need not be checked. In two incidents, guidelines were ambiguous, leading to dosing errors.

Individual factors, including physical or mental wellbeing and lack of skills or knowledge, were mentioned in 17 incidents,

including all new-prescribing incidents. In 17 incidents, interns reported that they did not know the dose of the drug, had never prescribed the drug before, or had never had to modify the drug choice or dose. In 10 incidents, interns indicated that they lacked experience; six incidents occurred within 3 weeks of starting the 10-week term. In 11 incidents, interns were distracted. The comments "not thinking", "doing four discharges at once", "trying to get lunch" were mentioned. Nine interns cited physical issues of tiredness, hunger and thirst, such as "I was anuric each day for a week". Eight of the interns had received no prescribing training as undergraduates, and four reported minimal training. Seven had received some instruction during their induction program. Six interns mentioned that they were "down" or had low morale, stating that they felt like a "clerk" or "secretary".

Team factors were present in 16 incidents. They were associated with supervision, communication and responsibility. Poor supervision was a primary theme in nine new-prescribing errors but only three re-prescribing errors. Interns frequently (in 14 errors) mentioned communication about medication, with comments such as "dialogue is very one-way" and "there's not much discussion or opportunity to learn".

A major underlying theme emerged: that interns did not have the skills or knowledge to follow the instructions given and were not prepared to question or seek clarification. Implicit trust and an assumption that the registrar must have been correct were frequently mentioned (eg, "my registrar is really good; he has been prescribing for years"). Interns were often (11 errors) unclear as to who was responsible for the different stages of prescribing. Senior staff invariably decided to initiate therapy (eg, "the team decided to start the diltiazem"). However, in other incidents, the complex decisions to continue or change therapy were left to the intern. In four cases of errors in new prescriptions, the registrar gave instruction over the telephone. One intern received a pager instruction to discharge four patients. Ambiguities in other doctors' prescribing contributed to three errors.

Patient factors were mentioned for 13 incidents, the most frequent being the complexity or acuity of the case (10 new-prescribing and 3 re-prescribing). Other patient factors included belonging to other teams (4), being seen out of hours (2) and inability to communicate (3) because of language difficulty, sedation or a neurosurgical complication.

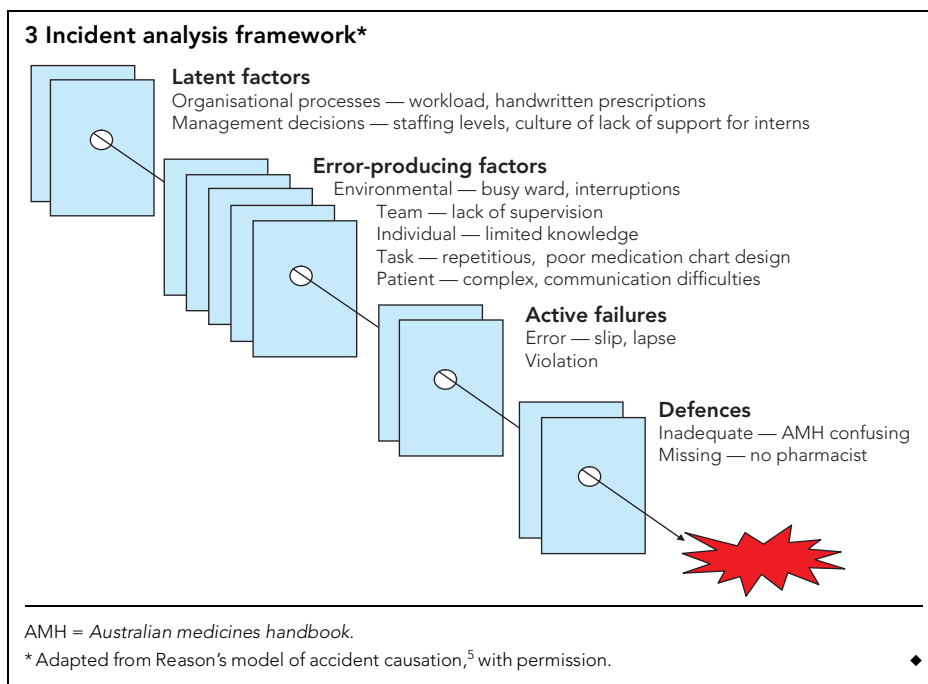
2 Prescribing errors and performance-influencing factors from interviews with interns and thematic analysis

Stage of error and drug	Details of error				Performance-influencing factors					Latent themes underlying the errors, from thematic analysis
	Context of error	Directed*	Prescribed before†	Experience‡	Environment	Team	Individual	Task	Patient	
New prescriptions										
On admission										
1 Morphine	Dose selection	+§	-	3	+	+	+	+	+	Supervision, training, guidelines
2 Ranitidine	Dose selection	+§	-	8	+	+	+	+	+	Supervision, training, complex, not their patient
During stay										
3 Indomethacin	Dose selection	-§	-	5	+	+	+	+	+	Guidelines, supervision, not their patient
4 Azithromycin	Dose selection	+§	-	7	-	+	+	-	+	Supervision, training, error awareness
5 Gentamicin	Dose and route selection	+	+	1	+	+	+	+	+	Medical chart layout, distracted, nurse defence failed
6 Enoxaparin	Drug selection	+§	-	3	+	+	+	+	+	Supervision, training, inability to check
7 Diltiazem	Need for drug: no longer indicated	+§	-	4	-	+	+	-	+	Supervision, pharmacist defence failed
8 Dicloxacillin	Drug selection: previous ADR	+	-	3	+	+	+	+	+	Supervision, intern trust in registrar, medical chart location
9 Amoxicillin + clavulanic acid	Drug selection: previous ADR	+§	+¶	6	+	+	+	-	-	Supervision, communication, forced long hours
At discharge										
10 Aspirin	Need for drug therapy: omission	+	+¶	1	+	+	+	+	+	Lack of knowledge of patient, not own patient, communication, chore
11 Lisinopril	Need for drug: no longer indicated	+	+	5	+	+	+	-	+	Supervision, training, poor morale, discharge chore
Represcriptions										
On admission										
12 Gliclazide	Dose selection	-§	-	8	+	+	+	+	+	Discharge prescribing, patient complex, training, chore
During stay										
13 Valproate	Dose selection	-§	+¶	10	+	-	-	+	-	Medical chart layout, multitasking
14 Multiple	Wrong patient, drug selection	-	+	6	+	-	-	+	-	Medical chart location, "faceless system", multitasking
At discharge										
15 Ramipril	Dose selection	-	+¶	1	+	+	+	+	-	Previous prescription, supervision, training
16 Warfarin	Need for drug therapy: omission	+	+¶	8	+	-	-	+	-	Medical chart layout, task in isolation, hassled
17 Insulin	Need for drug therapy: omission	+	+	8	+	-	-	+	-	Separate insulin chart, task in isolation, pressured
18 Warfarin	Need for drug therapy: omission	+	+¶	9	+	+	+	+	+	Medical chart layout, multitasking, discharge requirement, chore
19 Multiple	Need for drug therapy: omission	+	+	9	+	+	+	+	+	Multitasking, supervision, communication, chore
20 Warfarin	Need for drug therapy: omission	+	+¶	4	+	-	+	+	-	Medical chart layout, distraction, discharge requirements
21 Amoxicillin + clavulanic acid	Drug selection: previous ADR	+	+	6	+	+	+	-	-	Supervision, multitasking, forced long hours

+ = factor involved. - = factor not involved. ADR = adverse drug reaction. * Directed by registrar (usually) or consultant.

† Prescribed before by intern. ‡ Intern's time on this term (weeks). § Prescribing details done by intern. ¶ Previous similar error by the intern.

◆



Defences against errors, in the form of other staff, played a major role in preventing harm. In 13 incidents, a pharmacist identified the error and contacted the prescriber before drug administration. On one occasion, the intern was awaiting information from a pharmacist when a nurse administered the wrong drug. One nurse identified an error and refused to administer the order. In four incidents, the drugs were administered before the error was identified by a pharmacist. An adverse drug event (harm to a patient) was detected in at least two of these incidents. On 10 occasions, interns assumed that another senior doctor would have checked the drug order before administration of the drug to the patient. Self-initiated defences by four interns included checking their own orders (usually for completeness, not clinical safety) before signing them. The interns described being distracted from their checking process, resulting in a lapse or an attention slip. On two occasions, ambiguous dose-range information in guidelines, such as the *Australian medicines handbook*, led to errors.

Quotations illustrating specific factors are shown in Box 5.

Latent underlying factors identified from the analysis

Represcribing was commonly mentioned as requiring little thought and having low risk or importance. In four cases, simultaneous multiple prescribing tasks contributed to

errors. In general, prescribing was mentioned as a “job” or a “chore”, as in “I just copied it out”. Lack of training in drug knowledge and prescribing skills was another latent factor. Staffing numbers and expected patient throughput affected workloads, which led to mental and physical fatigue, stress and distraction. This included forced long working hours, such as early morning and early evening ward rounds. The need for interns to admit specialist patients out of hours was a result of management decisions and work practices.

DISCUSSION

All errors were associated with a varying combination of environment, team, individual, task, patient and latent factors, in a system with porous defences. We found that, while almost all errors were influenced by environment factors, factors associated with new-prescribing errors and represcribing errors were different, which was not the case in previous studies of error causation.^{1,12,13}

New-prescribing errors involved inexperienced interns, who were tired, hungry, and distracted, prescribing for patients with complex disorders. Team factors, in particular lack of supervision, were also more frequently associated with new-prescribing errors. Represcribing errors were often related to the task, including the design and location of the medication chart. Therefore, the view that a single intervention in isola-

4 Factors involved in prescribing errors*

Factor	n
Environment	19
Workplace	
Doctors' office	8
Staffing levels	
Staffing levels inadequate	5
Locum or agency staff	1
New staff	6
Another doctor's patient	4
Workload	
High workload, busy	13
Long working hours	14
Working out of hours	2
Pressure of workload	12
Task	16
Medical chart layout	9
Medical chart location	2
PBS discharge system	4
Ambiguous guidelines	2
Guidelines unavailable	3
Individual	17
Physical health	
Hungry or thirsty	7
Tired	7
Mental health	
Low morale	6
Distracted	11
Knowledge and skills	
Inadequate knowledge or skill	12
Inadequate experience	10
Inadequate training	12
Calculation error	1
Team	16
Communication	
Telephone orders	4
General communication	9
Supervision	
Lack of or unclear supervision	9
Remote supervision	6
Trust or assume that senior checks	7
Responsibility	
Decision by senior, detail by junior	8
Weighing risks and benefits	5
Responsibility too great	6
Patient	13
Complex problem	11
Acute problem	11
Communication	3

PBS = Pharmaceutical Benefits Scheme.

* Factors were identified from 21 interviews with interns.

5 Examples of error-producing conditions

Environment factors

I was covering for my colleague who was in OT [occupational therapy] — we run split shifts on the unit and share the workload. You might have nothing to do with them prior to writing a discharge or rewriting medications. (10)*

I have about 12 general med patients to look after today, sometimes one to 20 patients. On the day I made the mistake I think we had up to 30, my registrar was doing their exams and there was a floating covering consultant, who changed each week. (11)

Team factors

The ward rounds are all very much one way, a direction for tasks. We feel very much like clerks with no real discussion or teaching around each patient — the consultants obviously have a plan in their head often — but it isn't always clearly related to us . . . we are just seeing them [the patients] for the first and only time. (21)

Yes, supervision exists in that the registrar will direct us to "put them on Abs" or "change to orals" — but we often have to ask what drugs or doses and for how long. (9)

Individual factors

Yes, I was tired and hungry and wanting to go home. It was the end of the day, probably 6.30 pm by the time I had finished all this, so I had been on for over 12 hours . . . The fact that I could not communicate with the patient added to the difficulty. (12)

I felt like I had just made a mistake — I take total responsibility — I was told what to prescribe, but I didn't know about not using it [enoxaparin] in renal impairment, I'm not sure I would have worked out her renal function from the creatinine anyway. I have not done it before. (6)

I received no prescribing training (nil) in med school — only the sessions delivered in the end of fourth year. (1)

Patient factors

He had had no admission in ED [emergency department], or any subspecialty input, ended up on my ward as a neuro outlier, and no one seemed to know about him. There was no chart with him. No one on the ward knew about him. This situation admitting patients, especially to specialty units, is not an uncommon request on ward call. (2)

Task factors

I guess the med chart layout affects things, in that your eyes look down that left-hand side and you see the first regular drug — and start from there. Because the warfarin is separated from the other regular drugs by the variable dose section it's missed — a kind of blind spot. (20)

I had just made a mistake — I knew what I had to prescribe — but I was busy and missed it. When writing these scripts (discharges) you worry about the PBS [Pharmaceutical Benefits Scheme] quantities and number of tablets etc . . . but don't necessarily link it to the patient . . . I knew he was complicated but just missed writing them up. (18,19)

Defences

I misread the AMH [*Australian medicines handbook*]: indomethacin 50–200 mg daily in 2–4 divided doses, and I wrote up 200 mg qds, prn. (3)

Both clinical pharmacists are excellent and would have saved my bacon a few times over . . . maybe we could have them come on the ward round? (9,21)

Latent underlying themes: prescribing as a task or chore

The prescribing done by me is very directed — there is not much opportunity to learn or ask why or how. The morning round is very businesslike, with a lot of delegation of tasks — and then, because the registrar is doing exams they are off doing cases and in the library. At present, I just feel that I am doing a secretarial job. (11)

I made the decision to rewrite all of the charts that would have been about to expire in the next few days. During rewriting approximately 10 medication charts in total, I was doing these two patients' medication charts at the time. I attached patient ID stickers to the blank charts but mixed them up, and the wrong patient's medication was prescribed on one chart and vice versa. It's a kind of faceless system as all the charts are kept in a folder away from the patients and other patient information. (14)

It was just a chore. I was just copying down from her last discharge script, what she went out on last time. (12)

*Numbers in parentheses are incident numbers (Box 3).



tion will prevent most prescribing errors is simplistic.¹⁴

Our results confirm those of others that improving drug knowledge may decrease the risks of new-prescribing errors.^{14–18} However, a lack of drug knowledge was a partial cause of only one represcribing incident. Interns need to be able to apply drug knowledge to allow them to tailor therapy to an individual patient. Safe-prescribing skills and awareness of medication errors is required by all members of the health care team,^{19,20} and should be a core component of undergraduate and postgraduate training programs, as outlined in the new curriculum framework for junior doctors.²¹ Practical safe-medication practice training that improves the safety of medical students' prescribing should be a core component of prescribing education.^{14,20}

The primary focus of the intern year is to produce competent, independent practi-

tioners through an apprenticeship, with training in a range of supervised posts.²² In this study, there was an assumption by interns that senior staff would check their prescriptions. Often, this did not happen. Our findings reinforce those from the UK, where a culture exists in which new prescribing is seen by senior and junior staff as focused on drug selection, and represcribing as a low-risk chore for which training or supervision is not required.^{12,17}

The complexity of prescribing is not appreciated by the novice, and the novice's lack of deeper understanding does not appear to be understood and supported by supervisors. Interns often have insufficient knowledge to appreciate when they need to seek advice. Deference to a hierarchical structure is a well recognised risk in all complex teams, and junior staff need to have the skills and feel able to confirm and clarify directions.²³

Supervision should take account of all prescribing risk factors, including the patient's complexity, the intern's competence, the specific medications being prescribed and the availability of guidelines. This must be within a culture in which prescribing is seen as an important, high-risk intervention. Institutions must develop an environment in which prescribing errors can be constructively discussed and analysed, and learning from errors should occur at an individual, team and organisation level.¹²

Electronic prescribing with decision support offers a partial solution,^{24,25} but an effective system is not currently widely available in Australia.²⁶ Standardised medication charts and systems incorporating decision support and forcing functions have been developed and should be implemented to reduce prescribing errors.²⁷ With a standard chart in place, students can be trained to use one system, and the risks of error due to

unfamiliarity with chart design can be reduced.¹⁷

Nursing staff provide a critical defence by reviewing medications before administration, but training in safe medication is also required.²⁸ Pharmacists detect errors and improve the safety of prescribing.²⁹ Their role of reviewing prescriptions and contributing to prescribing decisions must be further developed.¹³

Guidelines and drug information must be readily available to prescribers. The *Australian medicines handbook* has reworded dosing instructions in response to the findings of this study, but similar risks remain unless guidelines and protocols are evaluated for such risks.

Changes to workload and staffing levels remain a risk for all health care professionals. Strategies such as split shifts need to be considered, but must ensure clinical hand-over of patients between doctors. The environments in which interns prescribe must not be distracting. The location of medication charts, ideally at the bedside, has already been addressed at the study site.

Our study, using a sample of convenience, cannot estimate the incidence of errors. Also, there may have been a degree of social desirability in responses, and the 26 incidents not investigated may have provided additional or different perspectives. However, we believe our findings are representative, and have raised important issues, which may lead to significant interventions.

CONCLUSION

The prescribing errors identified have happened before and will happen again unless changes at many levels are made. Prescribing skills and awareness of medication errors must be developed through training. Standardised medication charts reduce errors and are being implemented across Australia, and guidelines should be redesigned and readily available. A cultural shift, in which prescribing is seen as important, must occur, with continual senior review and tailored supervision of interns in an atmosphere that encourages clarification and learning.

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COMPETING INTERESTS

None identified.

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