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.


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.

MJA 2008; 188: 89–94
1 Interview to identify causes of prescribing errors by interns

Background to the interview
The interviewer (I D C) 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 represcription, and any instruction or supervision.

The questionnaire
This was based on Vincent et al’s framework of contributory factors 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 system 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 represcribing 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 represcribing 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 intern as leading to slips related to eight represcribing 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 represcribing 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 represcribing). 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

<table>
<thead>
<tr>
<th>Stage of error and drug</th>
<th>Details of error</th>
<th>Performance-influencing factors</th>
<th>Latent themes underlying the errors, from thematic analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>New prescriptions</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>On admission</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Morphine</td>
<td>Dose selection</td>
<td>+§</td>
<td>Supervision, training, guidelines</td>
</tr>
<tr>
<td>2 Ranitidine</td>
<td>Dose selection</td>
<td>+§</td>
<td>Supervision, training, complex, not their patient</td>
</tr>
<tr>
<td><strong>During stay</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Indomethacin</td>
<td>Dose selection</td>
<td>–§</td>
<td>Guidelines, supervision, not their patient</td>
</tr>
<tr>
<td>4 Azithromycin</td>
<td>Dose and route selection</td>
<td>+§</td>
<td>Medical chart layout, distracted, nurse defence failed</td>
</tr>
<tr>
<td>5 Gentamicin</td>
<td>Drug selection</td>
<td>+§</td>
<td>Supervision, training, error awareness</td>
</tr>
<tr>
<td>6 Enoxaparin</td>
<td>Need for drug: no longer indicated</td>
<td>+§</td>
<td>Supervision, pharmacist defence failed</td>
</tr>
<tr>
<td>7 Diltiazem</td>
<td>Drug selection: previous ADR</td>
<td>+§</td>
<td>Supervision, intern trust in registrar, medical chart location</td>
</tr>
<tr>
<td>8 Dicloxacillin</td>
<td>Drug selection: previous ADR</td>
<td>+§</td>
<td>Supervision, communication, forced long hours</td>
</tr>
<tr>
<td>9 Amoxycillin + clavulanic acid</td>
<td>Drug selection: previous ADR</td>
<td>+§</td>
<td>Lack of knowledge of patient, not own patient, communication, chore</td>
</tr>
<tr>
<td><strong>At discharge</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 Aspirin</td>
<td>Need for drug therapy: omission</td>
<td>+§</td>
<td>Supervision, training, poor morale, discharge chore</td>
</tr>
<tr>
<td>11 Lisinopril</td>
<td>Need for drug: no longer indicated</td>
<td>+§</td>
<td>Supervision, communication, forced long hours</td>
</tr>
<tr>
<td><strong>Represcriptions</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>On admission</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 Gliclazide</td>
<td>Dose selection</td>
<td>–§</td>
<td>Discharge prescribing, patient complex, training, chore</td>
</tr>
<tr>
<td><strong>During stay</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13 Valproate</td>
<td>Dose selection</td>
<td>–§</td>
<td>Medical chart layout, multitasking</td>
</tr>
<tr>
<td>14 Multiple</td>
<td>Wrong patient, drug selection</td>
<td>+§</td>
<td>Medical chart location, “faceless system”, multitasking</td>
</tr>
<tr>
<td><strong>At discharge</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15 Ramipril</td>
<td>Dose selection</td>
<td>–§</td>
<td>Previous prescription, supervision, training</td>
</tr>
<tr>
<td>16 Warfarin</td>
<td>Need for drug therapy: omission</td>
<td>+§</td>
<td>Medical chart layout, task in isolation, pressured</td>
</tr>
<tr>
<td>17 Insulin</td>
<td>Need for drug therapy: omission</td>
<td>+§</td>
<td>Separate insulin chart, task in isolation, pressured</td>
</tr>
<tr>
<td>18 Warfarin</td>
<td>Need for drug therapy: omission</td>
<td>+§</td>
<td>Medical chart layout, multitasking, discharge requirement, chore</td>
</tr>
<tr>
<td>19 Multiple</td>
<td>Need for drug therapy: omission</td>
<td>+§</td>
<td>Multitasking, supervision, communication, chore</td>
</tr>
<tr>
<td>20 Warfarin</td>
<td>Need for drug therapy: omission</td>
<td>+§</td>
<td>Medical chart layout, distraction, discharge requirements</td>
</tr>
<tr>
<td>21 Amoxycillin + clavulanic acid</td>
<td>Drug selection: previous ADR</td>
<td>+§</td>
<td>Supervision, multitasking, forced long hours</td>
</tr>
</tbody>
</table>

+ = 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. On one occasion, 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-
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 round knew about him. There was no chart with him. No one
on the ward round 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, p.r.n.
(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’
miscoding 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)

Abs” or “change to orals” — but we often have to ask what drugs or
doses and for how long. (9)

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 inci-
dent. 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’
protection 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 pre-
scribing 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 compe-
tence, the specific medications being pre-
scribed 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 sup-
port offers a partial solution.24,25 but an
effective system is not currently widely
available in Australia.26 Standardised medi-
cation charts and systems incorporating
decision support and forcing functions have
been developed and should be implemented
to reduce prescribing errors.27 With a stand-
ard 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 handover of patients between doctors. The environments in which interns prescribe must not be distressing. 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.

ACKNOWLEDGEMENTS

We thank all the junior doctors involved in this study and Dr Bryony Dean Franklin, University of London, for help developing the interview schedule.

COMPETING INTERESTS

None identified.

AUTHOR DETAILS

Ian D Coombes, BPharm(Hons), MSc, Senior Pharmacist1,2
Danielle A Stowasser, BPharm, PhD, Director1,2
Judith A Coombes, BPharm, MSc, Senior Pharmacist1,2
Charles Mitchell, MBBS, FRACP, Physician2,3
1 Pharmacy Department, University of Queensland, Brisbane, QLD.
2 Safe Medication Practice Unit, Queensland Health, Brisbane, QLD.
3 School of Medicine, University of Queensland, Brisbane, QLD.

Correspondence: ian_coombes@health.qld.gov.au

REFERENCES

13 Lesar TS, Briceland L, Stein DS. Factors related to errors in medication prescribing. JAMA 1997; 277: 312-317.