RESEARCH ARTICLE

The frequency and potential causes of dispensing errors in a hospital pharmacy

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Abstract
Objectives: To determine the frequency and types of dispensing errors identified both at the final check stage and outside of a UK hospital pharmacy, to explore the reasons why they occurred, and to make recommendations for their prevention.
Method: A definition of a dispensing error and a classification system were developed. To study the frequency and types of errors, pharmacy staff recorded details of all errors identified at the final check stage during a two-week period; all errors identified outside of the department and reported during a one-year period were also recorded. During a separate six-week period, pharmacy staff making dispensing errors identified at the final check stage were interviewed to explore the causes; the findings were analysed using a model of human error.
Main outcome measures: Percentage of dispensed items for which one or more dispensing errors were identified at the final check stage; percentage for which an error was reported outside of the pharmacy department; the active failures, error producing conditions and latent conditions that result in dispensing errors occurring.
Results: One or more dispensing errors were identified at the final check stage in 2.1 % of 4849 dispensed items, and outside of the pharmacy department in 0.02% of 194,584 items. The majority of those identified at the final check stage involved slips in picking products, or mistakes in making assumptions about the products concerned. Factors contributing to the errors included labelling and storage of containers in the dispensary, interruptions and distractions, a culture where errors are seen as being inevitable, and reliance on others to identify and rectify errors.
Conclusion: Dispensing errors occur in about 2% of all dispensed items. About 1 in 100 of these is missed by the final check. The impact on dispensing errors of developments such as automated dispensing systems should be evaluated.

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Introduction

There is growing concern about the number of patients harmed by medication errors; the volume of research published on this subject is growing exponentially[1]. However, the majority of research is focused on prescribing and administration errors. While dispensing errors can also result in significant patient harm, there has been relatively little research in this area. Given the growing interest in the role of automation and computerisation in dispensing[2–5], it is important to understand the frequency, types and causes of the dispensing errors that currently occur. As well as helping to identify strategies to reduce errors, this will provide a baseline against which the impact of future technological developments can be assessed.

Studies carried out in the USA, report dispensing error rates of up to 24% in community pharmacies[6,7] and 12.5% in hospital outpatient pharmacies[8–12], although there are wide differences in the methods and definitions used. In the UK, there are many case reports of dispensing errors resulting in patient harm[13–15] and the resulting litigation[13], but relatively limited data is available on their nature and causes. Research may focus on errors identified at the final check stage within the pharmacy, or on those identified after medication has left the department.

There have been a small number of studies on dispensing errors identified at the final check stage within UK hospital pharmacies. For example, Noott and Phipps[16] reported an analysis of the errors routinely recorded in one hospital, as part of ongoing quality monitoring. An error was reported at the final check stage for 0.2% of all dispensed items. However, the authors suggested that is likely to be an underestimate, as there was a dramatic increase in reporting following a series of initiatives to raise awareness; reporting later returned to previous levels. Barker[17] reported an error rate of 0.7% but gives little detail of the methodology and definitions used.

Analyses of the numbers and types of dispensing errors identified outside of the pharmacy department have also been published[17–19]. For example, Spencer and Smith[18] analysed the errors reported in 19 hospital pharmacies, and suggested that an error is identified outside the department for about 0.02% of all items dispensed. The rate was lower (0.01 %) for 12 hospitals where all dispensing was checked by a second person, than that for the seven hospitals where only non-pharmacists' dispensing was checked (0.04%). A more recent analysis, this time based on 7158 errors reported in 89 hospitals, reported further details of the errors identified[19]. They were reported mainly by hospital nurses (45%), hospital pharmacists (17%) or patients (17%), and most commonly involved the wrong drug (23%), wrong strength (23%), wrong directions (10%) or wrong quantity (10%).

However, the methods and definitions used in many studies are ill-defined, and there have been no studies of their causes. The aim of the present study was to find out how often and why dispensing errors occur in a UK hospital pharmacy.

Our objectives were to determine the frequency and types of dispensing errors identified both at the final check stage and outside of the pharmacy department, to explore the reasons why they occurred, and to make recommendations for their prevention.

Method

The study was conducted in two parts. The first focused on counting and classifying the errors identified at the final check stage, as well as those identified once dispensed items had left the department. Staff remained anonymous for this part of the study, which we hoped would minimise biased reporting.

The second part concerned interviewing the staff involved, to explore their causes. For this part of the

study it was decided to focus only on dispensing errors identified within the pharmacy department. This was for two reasons. First, interviewing staff about errors that did not reach the patient was considered less threatening to those involved. Second, there may be considerable time delays between dispensing of medication and reporting of an error identified outside the department, which may make it difficult both to identify the staff involved and for them to recall the events surrounding the error.

Causes of errors were explored using Reason's accident causation model[20] as a theoretical framework (Figure 1). This model of human error has been used to explore the causes of errors in other health care environments, and has more recently been applied to prescribing errors [21].

Setting

The study took place in the pharmacy dispensary of a 450 bed London teaching hospital, which is part of a large NHS Trust. The hospital operated a typical UK ward pharmacy service; the dispensary was therefore responsible for individual inpatient supplies of drugs not stocked on the wards, discharge medication, and medication for hospital outpatients. All medication dispensed for individual patients is labelled with details of the medication and the patient's name and ward; discharge and outpatient medication is also labelled with full administration instructions. The dispensary was open from 9 AM to 6:30 PM Monday to Friday, 9 AM to 12:30 PM on Saturdays and 10 am to 12 noon on Sundays. On weekdays, it was typically staffed by 3–4 pharmacists, four pharmacy technicians and four pre-registration pharmacy students or pharmacy assistants. An average of 878 inpatient items, 1567 discharge items and 1297 outpatient items were dispensed each week during 2002. All prescriptions are clinically screened by a pharmacist; and labelling and dispensing is usually carried out by technicians, assistants or pre-registration pharmacists. Final checking can be carried out by a pharmacist or accredited checking technician. Pharmacists who have passed a dispensing accreditation do not have to have their dispensing checked. The trust has a well-established medication and blood transfusion incident reporting system, used to report prescribing, dispensing and administration errors. About 1000 forms are completed each year.

The study was approved by the local research ethics committee.

Definitions

Many different definitions and classification systems have been used for dispensing errors. However, many of these are very general, referring to any medication error linked to the pharmacy department[18,22,23] or any deviation from a 'perfect' prescription, without defining what 'perfect' means in this context[24]. Other studies do not give a definition[25,26]. We decided to use a definition developed for use in the USA[7] as this was the most comprehensive, and then adapt this for international use. Dispensing errors were further classified into content errors, labelling errors and documentation errors, with further classification based on those used previously[7,10,18,25,27,28]. A draft definition and classification system was sent to eight UK experts in risk or medication errors; these experts were asked to give suggestions about how they could be improved. Responses were received from seven respondents; one minor change was suggested and subsequently incorporated into the definition.

A dispensing error was therefore defined as a deviation from an interpretable written prescription or medication order, including written modifications to the prescription made by a pharmacist following contact with the prescriber or in compliance with pharmacy policy. Any deviation from professional or regulatory references, or guidelines affecting dispensing procedures, was also considered a dispensing error. Further classification is shown in Table 1.

Frequency of errors

Following a series of briefing sessions and a pilot study, pharmacists were asked to record details of all dispensing errors identified at the final check stage during a two-week period (17–28 June 2002). Weekends were excluded. Along with details of the error, pharmacists were asked to indicate whether it involved a non-stock inpatient item, a discharge prescription or an outpatient prescription. During this part of the study, the name of the person responsible for the error was not documented. At least one of the researchers was available at all times if there were any questions regarding the types of error that should be recorded, and frequent visits were made to the dispensary to remind staff of the importance of comprehensive data collection. The numbers of non-stock, discharge and outpatient items dispensed during weekdays of the study period were obtained from the pharmacy computer system. The 95% confidence intervals were calculated for each error rate.

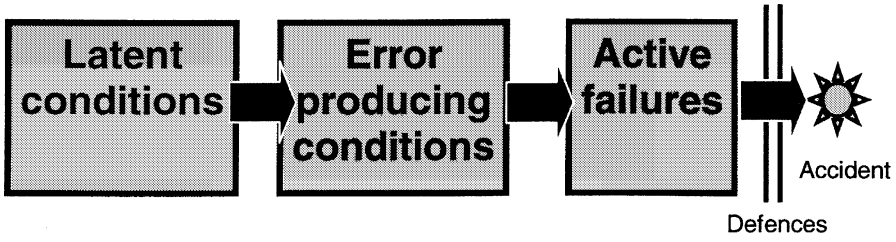

Figure 1 *The accident causation model[20].* Latent conditions *refer to organisational processes and managerial decisions that affect the environment on a wider level.* Error producing conditions *include factors affecting practice, at the level of the environment, team, individual, or task.* Active failures *include errors and violations. Errors refer to the failure of a planned sequence of actions to achieve a desired goal, either because an adequate plan was incorrectly executed (slips and lapses), or because the plan was inadequate (mistakes). Violations are instances in which rules of correct behaviour are consciously ignored.* Defences *are designed to protect against hazards and mitigate consequences of failure. Defences may or may not be adequate.*

Table 1 *Classification of dispensing errors*

Content errors	
Incorrect drug	Dispensing a drug that is different to that prescribed. Excludes generic or therapeutic substitution authorised by written hospital policy.
Incorrect strength	Dispensing a dose unit containing the wrong amount of the correct drug, without an appropriate adjustment to the dosing instructions.
Incorrect dosage form	Dispensing the correct drug in a dosage form different to that prescribed. This includes supplying a modified release formulation when a standard formulation was prescribed.
Dose added	Dispensing a larger quantity of medication to that prescribed.
Missing doses	Dispensing a smaller quantity of medication to that prescribed.
Omission of item	Failure to dispense a prescribed item.
Deteriorated medication	Dispensing a medication that has exceeded its expiry date or has been stored at a temperature different to that required, or for which the primary packaging is damaged.
Other content error	Any other content error not included in the above categories.
Labelling errors	
Incorrect patient name	Omission of the patient's name or use of a different name to that on the prescription or medication order.
Incorrect drug name	The drug name on the label deviated from that specified by the prescriber, except where amendments are necessary to conform to written hospital policy or good pharmaceutical practice.
Incorrect drug strength	Where more than one strength available, the strength on the label deviated from that specified by the prescriber, except where amendments are necessary to conform to written hospital policy or good pharmaceutical practice.
Incorrect drug quantity	The drug quantity on the label deviated from that specified by the prescriber, except where amendments are necessary to conform to written hospital policy or good pharmaceutical practice.
Incorrect dosage form	The dosage form on the label deviated from that specified by the prescriber except where amendments are necessary to conform to written hospital policy or good pharmaceutical practice.
Incorrect date	Omission of the date of dispensing or use of a date different to that on which the product was dispensed.
Incorrect instructions	The instructions deviated from those prescribed, except where amendments are necessary to conform to written hospital policy or good pharmaceutical practice.
Additional warning(s)	Omission or use of incorrect additional warnings, according to professional references (for example the British National Formulary in the UK).
Pharmacy address	Failure to include the correct name and address of the supplying pharmacy on the label.
Other labelling error	Any other labelling error not included in the above categories.
Documentation errors	
Absent/incorrect controlled drug documentation	For controlled drugs, absent or incorrect documentation in the controlled drugs register, as required by existing regulations.
Other documentation error	Any other documentation error not included in the above categories.

Any dispensing errors reported as having been identified outside of the pharmacy department were also examined both for the same two-week period and for the entire year 2002. Errors reported directly to the pharmacy department were routinely documented; a report was also obtained from the trust's medication and blood transfusion incident reporting system to identify any additional errors reported.

Potential causes of errors

During a second data collection period (15 July–4 September 2002), pharmacists were again asked to record details of dispensing errors identified at the final check stage. This time they were also asked to speak to the person who dispensed the medication, and ask if they would be willing to be interviewed the following day. It was emphasised that these interviews were intended to explore why errors occurred, and that they were confidential and entirely optional.

Semi-structured interviews were conducted by AB, exploring the reasons why the error occurred and how it could have been prevented (Box 1). A separate questionnaire was used to prompt for error producing conditions that could have contributed to the error. The interview schedule and questionnaire were based on those used in a previous study of prescribing errors[21], together with contributing factors reported in the dispensing error literature[10,12,26,29] and were piloted before use. With the interviewee's permission, the interviews were taped and transcribed verbatim.

Transcripts were coded using NUD*IST (v 4.0), a software package used to manage and code qualita-

Start questions

Can you tell me a bit about your background?

1. How long have you been qualified as a pharmacist/technician?
2. How long have you worked in this hospital?
3. What is your job in the pharmacy department?
4. What hours do you usually work?

This case

On [DATE] you dispensed a prescription/medication order for [DETAILS OF ORDER]

5. Can you remember dispensing this prescription?
6. Can you tell me about supplying items for this prescription?
7. Were you familiar with this item/dispensing procedure?
8. Have you dispensed this item before?
   - 8.1. If NOT, how did you feel about dispensing it for the first time?
9. Do you dispense it frequently?
10. Do you have any guidelines for (this task)?
    - 10.1. How useful are these documents?
    - 10.2. Is there anything you do not like about these guidelines?
    - 10.3. Have you had any training in their use?
11. Did you do anything different on this day?
    - 11.1. If so what?
12. Are you aware having made this error before?
13. When did you first find out that an error had occurred?
    - 13.1. How did you feel about this?
14. What implications does this have for you?
15. Regarding the dispensing of this particular prescription...
    - 15.1. Were there any factors that you remember affecting your performance?
    - 15.2. How did you feel at this time?
    - 15.3. Error producing conditions questionnaire*
    - 15.4. Do you feel you need to add any additional comments to the questionnaire you have just filled in?

(*)For each relevant factor ask:

What happened?	What did you do?
How did it affect you?	Did it affect the case?
How did you feel?	Does this occur in general?

End questions

16. With the benefits of hindsight, would you have done anything differently?
17. What improvements would you make?
18. Would you like to add any additional points or stress anything in particular?
19. From your point of view, how did you feel about me asking you these questions?
20. Is there anything I could do to make it better for future participants?

Box 1 *Interview questions.*

tive data, and analysed using the accident causation model.

Results

Frequency of errors

During weekdays of the two-week study period, a total of 4849 items were dispensed. These constituted 993 inpatient items, 1957 outpatient items and 1899 discharge items. At the final check stage, 104 of these (2.1%; 95% confidence interval 1.7–2.5%) were reported to have one or more dispensing errors (Table 2). There was no difference between the three types of dispensed item in terms of dispensing error rate ($P = 0.25$; χ^2 test).

The 104 items contained a total of 130 dispensing errors (Table 3), representing a mean of 1.25 per flawed prescription, or 2.7% per dispensed item.

During the two-week study period, there were no reports of dispensing errors as having been identified outside the department. For the entire year (2002), 26 reports of dispensing errors were made directly to the pharmacy department, one of which related to a ward stock item and therefore has not been included in this study. An additional five were reported to the medication incident database but not to the pharmacy department. One or more dispensing errors were therefore reported in 30 of 194,584 items during the year, representing a mean of 0.6 per week or 0.02% of dispensed items. These involved a total of 32 dispensing errors (Table 3).

Table 2 *Dispensing errors identified each week, presented according to type of dispensed item*

Type of item		*Inpatient*	*Outpatient*	*Discharge*	*Unknown*	*Total*
Items dispensed		993	1957	1899	0	4849
Items with one or more errors	Week 1	12	16	23	0	52
	Week 2	11	17	23	1	52
	Total (%)	23 (2.3%)	33 (1.7%)	46 (2.4%)	2	104 (2.1%)

Table 3 *Classification of the dispensing errors identified at the final check stage, according to type of dispensed item, together with those reported outside of the department*

Type of error	*Two-week study of dispensing errors identified at the final check stage*				*One-year study of errors outside dept*
	Inpatient	*Outpatient*	*Discharge*	*Total*	
Content errors					
Incorrect drug	3	2	6	11	4
Incorrect strength	4	6	5	15	13
Incorrect dosage form	1	3	2	6	0
Dose added	3	5	6	14	0
Missing doses	3	5	16	24	0
Omission of item	0	0	0	0	0
Deteriorated medication	0	0	0	0	3
Other content errors	0	0	0	0	1
Total content errors	14	21	35	70 (54%)	21 (66%)
Labelling errors					
Incorrect patient name	3	4	3	10	2
Incorrect drug name	1	1	0	2	3
Incorrect drug strength	1	1	4	6	4
Incorrect drug quantity	1	5	12	18	0
Incorrect dosage form	1	1	1	3	1
Incorrect date	0	0	0	0	0
Incorrect instructions	3	7	7	17	1
Additional warning(s)	2	0	0	2	0
Pharmacy address	0	0	0	0	0
Other labelling errors	1	1	0	2	0
Total labelling errors	13	20	27	60 (45%)	11 (34%)
Documentation errors					
Absent/incorrect controlled drug records	0	0	0	0	0
Other documentation error	0	0	0	0	0
Total documentation errors	0	0	0	0	0
Grand total	27	41	62	130 (100%)	32 (100%)

Potential causes of errors

A total of 27 interviews were conducted with 16 members of the dispensary staff. Five participants were interviewed twice, two were interviewed three times and one four times. Seven of the 27 interviews were with pharmacists, 11 with pre-registration students, six with technicians, two with assistants and one with a student technician. One additional person was approached but declined to be interviewed. Interviews were about 15 min in length.

Active failures

The primary active failure was a slip in 14 cases (52%), a lapse in one (4%) and a mistake in 12 cases (44%). Examples are shown in Table 4. The slips involved picking the wrong product from the list of options when labelling, or from the shelf when dispensing. Mistakes commonly involved making assumptions about the dose being the same as that dispensed previously, the number of tablets in a box, or that different products were interchangeable. No violations were reported.

Error-producing conditions

A total of 106 error producing conditions were reported, representing a mean of 3.8 per interview. Being busy, short-staffed, subject to time-constraints and the physical condition of the individual (feeling tired or unwell) were those most commonly reported (Table 5). Interruptions and look-alike/sound-alike drugs were also reported during many of the interviews, as was lack of knowledge about the availability of different drugs or formulations of the same drug.

Table 4 *Excerpts from interviews, giving examples of active failures*

Active failure	*Examples*
Slip	''I dispensed, twenty-eight, um, temazepam tablets. And I wrote in the CD [controlled drug] book five, and the label said five and the prescription said five, and – I thought I dispensed five but I didn't . . .'' ''. . . A lot of things we dispense in twenty-eights and I just did twenty-eight without actually thinking about it'' [interview 5; pre-registration pharmacist]
Slip	''. . . so it was supposed to be fifteen days. But instead of fifteen days I gave them fifteen [ethambutol] tablets. That's exactly what I did. Instead of giving fifteen days he got fifteen tablets. So I just sort of confused the two in my mind if you see what I mean [Interview 3: student technician]
Lapse	''I got, got to that patient and instead of changing it to a discharge I just kept it as an inpatient. . . I think I got interrupted. . . . . .I did all the other ones on the same sheet [correctly] as a TTA [discharge prescription]. . .'' [Interview 22; technician]
Mistake	''. . .I dispensed a cream that the label was saying clobetasone 0.5 on label or something and then there are actually two brands making the same thing. Yea. The generic name was the same, clobetasone*, but it comes in Eumovate® or Dermovate® and then I think the doctor wrote Eumovate® but I gave Dermovate®. Um, the chemical is still clobetasone, but I think the salt is different, the chemical salt is different. . .'' [interview 20; pharmacist].
Mistake	''When I was doing the labels on the prescription it was written sodium valproate, 200 mg. And they come in two types. You have got 'Chrono' which is the modified release, and the 'EC' [enteric coated]. What have happened was that it was not stated whether they need the 'Chrono' or the 'EC'. So um, I just assumed that it's 'Chrono' I should do the labels for, not the 'EC', not until the pharmacist come back to me after I did the label and said that no, we are supposed to do the 'EC' if they don't indicate . . .'' [interview 25; pre-registration pharmacist]

* There are two topical steroids with very similar names marketed in the UK: clobetasone (Eumovate®) which is classified as of moderate potency, and clobetasol (Dermovate®) which is classified as very potent (32). This interviewee incorrectly assumed that these were two brand names for the same generic product

Table 5 *Error producing conditions reported*

Category	*Error producing condition*	*Responses*
Workload	Busy	22
	Time restraints	12
	Short-staffed	13
Environment	Distractions	4
	Interruptions	10
	Working conditions	0
	Dispensary design	4
Drug design	Look-alike or sound-alike names	9
Protocols	Unavailable or inadequate protocols	0
	Inadequate training in the use of protocols	2
Communication	Illegible or incomplete prescription	1
	Abbreviations or other ambiguous nomenclature	0
	Unawareness of risk factors	2
Organisation	Inadequate supervision or support	1
	New (or locum) member of staff	2
	Negligence of management	0
Stressors	Physical condition	12
	Low morale	2
Skills & knowledge	Unfamiliarity with task	5
	Inadequate knowledge or experience	5
Total		106

Other issues emerged during the interviews that were not covered by the questionnaire. For example, several trainee members of staff reported lack of focus on the dispensing task:

> ''. . . and you're just flying through. It was a case of keep adding up the same. . . doing the same thing over and over again. Sometimes you do just get a bit sort of brain-dead really . . .'' [interview 3; student technician].

In contrast, another trainee reported focusing on the pharmacology of the drug rather than dispensing it:

> ''I was trying to figure out what it does and where it acts, rather than dispensing, rather than counting, to see how many tablets are needed. I was more interested in the drug than in the counting of the tablets'' [interview 18; pre-registration pharmacist]

Latent conditions

Various latent conditions were identified. These included a lack of guidance on how to prioritise tasks when interrupted during dispensing, no formal system for dealing with ward enquiries, a culture whereby errors were seen to be inevitable and 'minor' errors did not matter, poor labelling of stock boxes, and poor differentiation of items on the computer screen.

Several members of staff reported that when the phone rang or someone was waiting at the dispensary hatch, they found it difficult to decide whether they should attend to this immediately or complete the dispensing process first.

> ''this is something I don't know what the procedure is. Like, if you are labelling are you supposed to just finish what you are doing and let the other pharmacist. . . or let the nurses stand at the hatch, or should you go and attend to it?'' [interview 17; pharmacist]

This was particularly mentioned in relation to the perceived large volume of telephone calls received from nursing staff enquiring whether discharge prescriptions were ready. No one person was assigned to dealing with such queries and whoever was nearest to the telephone would usually answer it.

Most staff felt that errors were a fact of life and referred to making previous errors.

> ''Oh definitely, I definitely made mistakes where I've picked the wrong drug and the wrong drug strength on the computer when it is the same name'' [interview 16; pharmacist]

Others wanted to point out that the error concerned was only a 'minor' error and did not have major implications.

> ''I didn't mind at all when it's something like wrong quantity. I would be upset if I'd made a major error like giving them the wrong drug or the wrong strength or sent it to the wrong patient. But you know, giving twenty-one tablets instead of twenty-eight, I don't have a problem with that at all'' [interview 6; pre-registration pharmacist]

Lack of differentiation between similar products in terms of packaging, storage in stock boxes and on the computer system, appeared to contribute to many errors.

> ''the name and the strength and the amount should stand out a bit more [on the packaging]. It should hit you as you look at it. Where on some of them you actually have to look for it'' [interview 14; assistant]

> ''we could have, you know, tramadol *dispersible* [stresses] tablets, where 'dispersible' is in bigger or bright red letters, and then tramadol *ordinary* tablets and tramadol *slow release* tablets so that what comes out at you isn't 'tramadol, tramadol, tramadol' but 'dispersible, ordinary, slow-release' [interview 1; pharmacist]

> ''one brand of clobetasone, for example the Dermovate® one, is on the third shelf right hand corner. So it's only one brand there. And then the other brand is actually on the next shelf on the left hand corner. So unless you know the product . . . . . they might be better if they're put next to each other. Or at least have the brand name Eumovate® and Dermovate® written on the box so you are aware there are two brands'' [interview 20; pharmacist]

Defences

Defences were identified at various levels. First, if the labels are produced by one person and the product dispensed by another, the dispenser may identify any errors in labelling. However, it was recognized that errors were not always identified, and that some people dispensed from labels without checking them against the prescription.

Second, the second check in the dispensing process is an important defence; all of the interviews were based on errors identified at this stage. However, several of the interviewees felt that they were less careful because they knew the prescription was going to be checked by someone else.

> ''. . .it's also 'cause you know, 'cause I know that it's gonna be two more checks on it, it doesn't feel as serious. . .'' [interview 19; pharmacist]

> ''frankly speaking I was even shocked that atenolol was amitriptyline and I jotted in my small note book I keep. Of going to check in my notebook if really atenolol is amitriptyline you know. . . and I was just waiting for someone to remove that, um, error'' [interview 26; pre-registration pharmacist; dispensing a prescription for atenolol, but picked up a box of amitriptyline which was in the atenolol stock box]

Finally, there were several examples where people recognised that they had their own internal self-checking mechanisms, but sometimes they were inadequate,

> ''I can remember thinking this is sort of iffy. This is not right, like. But whether I got called away or something happened or whatnot – I just remember

putting the label on the box, and thought, I'll come back to it. And before I knew it, it was passed along the line [to be checked]. [interview 12; pre-registration pharmacist].

Discussion

Frequency and types of dispensing errors

The incidence of errors identified outside of the pharmacy department is at the lower end of the range previously reported in the UK[16,17]. In contrast, the incidence at the final check stage is higher than reported previously[16,17]. It is likely that this latter finding is due to our study design, which involved a focused and well-advertised data collection period over a relatively short period of time, rather than collection of data on an ongoing basis.

One obvious limitation of our study, which is based on self-reporting, is that there may be under-reporting of errors, particularly those identified outside of the department. This is supported by the different types of errors identified at each stage. Errors identified outside of the department were less likely to be labelling errors and more likely to be content errors; this may reflect the fact that content errors are easier to identify, or that they are perceived as more important and therefore reported.

Caamano et al.[30] reviewed methods used to study dispensing errors in community pharmacies. It was concluded that use of external observers and simulated clients were likely to maximise validity. However, these methods are both very time-consuming, expensive, and associated with potential ethical problems.

The clinical significance of the errors identified was not assessed; future studies should include this if possible, using validated methods[31].

Causes of dispensing errors

Various factors contributing to the occurrence of dispensing errors were identified. These findings can be used to design strategies for error prevention. The causes were identified by interviewing those involved, which has the potential limitation that interviewees may choose not to disclose information which reflects badly on them. However, it is very difficult to ascertain causes using any other approach, and we used a research student to conduct the interviews, rather than a manager, which we believe would minimise any bias in this respect.

Prevention of dispensing errors

Based on the interviews conducted, there are a number of areas where changes may result in reduced error rates. First, the advantages and disadvantages of different approaches to the storage of products on the dispensary shelves should be carefully considered. The labelling of shelves and stock boxes should emphasise the differences, rather than the similarities, between products. Whether or not similar items should be separated on the shelves may be a more contentious issue. In the study hospital, similar items had been physically separated in an attempt to avoid selection errors. However, the findings of our interviews suggest that this sometimes led to other errors occurring. Staff located a product that was similar to the one they needed and assumed it was the correct one as it was the only one in the vicinity. This approach may therefore need to be reconsidered.

Second, consideration should be given to how interruptions are handled. It may be that nominating one person to deal with queries would reduce interruptions and distractions to staff dispensing or labelling. A US study suggests that both interruptions (where the dispensing task has to be ceased and then resumed) and distractions (where the task is not ceased) are associated with an increased dispensing error rate[12], and it would seem prudent to minimise these.

Third, automated dispensing systems may reduce many of the errors. We found that 70 of the 130 errors identified at the final check stage, and 21 of the 30 identified outside of the department, were content errors. Automation could potentially eliminate this error type. However, labelling errors would not be affected, and incorrect labelling would automatically result in the incorrect item being dispensed. Many automated systems are also unable to dispense part packs. Twenty-four of the 70 content errors identified at the final check stage involved the wrong number of dosage units; the majority of these involved part packs and would therefore not be eliminated by an automated system. It is also possible that the introduction of automation would introduce new types of error; careful evaluation of such developments is therefore required before their use can be recommended.

Finally, while the final dispensing check is clearly important in preventing errors from reaching patients, staff involved in dispensing and labelling need to be aware that it is not infallible. Our results suggest that about 1 in 100 errors are missed at this stage, and allowing prescriptions about which staff are uncertain to go for final checking is not a safe practice. The best methods for encouraging all staff to take responsibility for labelling and dispensing need to be explored.

Conclusion

One or more dispensing errors were identified in 2.1% of items at the final check stage, and in 0.02% of items outside of the pharmacy department. The majority involved slips in picking products, or mistakes in making incorrect assumptions about the products concerned. Factors contributing to the errors included labelling and storage of containers in the dispensary, interruptions and distractions, a culture where errors are seen as being inevitable and sometimes acceptable, and reliance on others to identify and rectify errors. The impact of developments such as automated dispensing on dispensing errors should be evaluated.

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Possible conflicts of interest

There are none.

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