Research Paper

Retrospective analysis of DATIX dispensing error reports from Scottish NHS hospitals

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Abstract

Aim The primary objective was to analyse reported dispensing errors, and contributing factors, in Scottish National Health Service hospitals by coding and quantifying error reports from the DATIX patient-safety software. The secondary objective was to gather managerial responses to dispensing error in order to gain a perspective on interventions already in place.

Methods Incident reports collected from 23 Scottish hospitals over a 5-year period were analysed retrospectively. Reported incident types, contributory factors and managerial responses were categorised according to the event description, and the frequency of such factors calculated.

Key findings Dispensing errors ($n = 573$), from both pharmacies and wards, were analysed. The main incident types were incorrect drug (19.2%, $n = 110$) and incorrect strength of drug (16.8%, $n = 96$). The main contributory factors were reported as drug name similarity (15.5%, $n = 30$) and busy wards/pharmacies (14.9%, $n = 29$). Patient-centred issues (6.1%, $n = 12$) also featured. Managerial responses to these errors took the form of meetings (16.7%, $n = 42$), increasing staff awareness (14.7%, $n = 37$) or staff reminders on the importance of checking procedures (17.9%, $n = 45$).

Conclusions The pattern of incidents reported is similar to previous research on the subject, but with a few key differences, such as, reports of errors associated with filling dosette boxes, and patient-centred issues. These differences indicate a potentially changing pattern of errors in response to new techniques in medicine management. Continued assessment of dispensing errors is required in order to develop practical interventions to improve medication safety.

Introduction

The safety of a patient in a healthcare system is of paramount importance. Considered preventable, and yet responsible for an estimated 7000 patient deaths per annum in the US,[1] one of the biggest threats to patient safety is medication error. A recent report from the UK National Health Service (NHS) showed that 83% of medication error reports detailed no harm to the patient, 4% reported moderate harm and 0.1% reported severe harm or death.[2] Dispensing errors accounted for 18% of the reported incidents.[2] Despite this, the majority of past research has focused on prescribing and administration errors.[3]

It is estimated that more than 900 million prescriptions per annum are dispensed across England and Wales.[4] There is a lack of consistent reporting on the rate of dispensing error in the UK,[5] but it has been estimated to be between 1% and 24%.[2] Errors can occur within both community[6,7] and hospital[2] pharmacies, though the nature of those errors can differ.[4] The dispensing process in both settings is similar and encompasses several tasks, including processing a prescription and labelling the medication, with the potential for error present at each stage.[8,9] The entire process is interspersed with several checks.[10]

A recent review of the literature indicated that the majority of reported dispensing errors were in the form of selection of the wrong drug, dosage or quantity, or the provision of incorrect labelling.[6] A survey of pharmacist attitudes towards

dispensing error reported common contributory factors to errors as fatigue, similar drug names and interruptions.[11] Research on this topic has been conducted internationally,[7,11] but the majority has been based in the USA[6] and the UK.[3,12] However, only a small proportion of that research features data gathered from the UK as a whole[13] with the majority focused primarily on England and Wales. This highlights a gap in this area of research, namely the scarcity of data collected from Scotland. This is particularly relevant following the devolution of responsibility for the Scottish health service to the Scottish Parliament in 1999.[14] This change has increased the possibility of health policy discrepancies, and therefore differences in the provision of health services, between Scotland, England and Wales. Thus, data collection specific to Scotland is required if authorities are to develop appropriately tailored intervention strategies.

The need for consistent accurate error reporting was highlighted by the 'spoonful of sugar' UK Audit Commission report.[15] Essentially, if hospitals are to learn from their mistakes, those mistakes need to be clearly documented so that the factors leading to error can be understood.[16] However, no study to date has considered the nature of interventions which have been implemented in reaction to these error reports. Such an analysis is necessary in order to aid researchers in identifying the nature of past interventions and to produce new error management strategies.

Past research studies have examined dispensing error using observation techniques,[17] where a pharmacist or similarly qualified observer records errors as they are made. Such studies are subject to the 'Hawthorne' effect[7] where the presence of an observer may alter the natural flow of events within a pharmacy. As an alternative, several researchers have utilised retrospective analysis of voluntary error reports from hospital pharmacies.[7,13] This has been made considerably easier with the advent of online reporting tools,[18] such as the DATIX patient-safety software system that will be reported here.

The primary objective of the current study was to analyse reported dispensing errors, and contributing factors, in Scottish NHS hospitals by coding and quantifying DATIX error reports. The secondary objective was to gather managerial responses to dispensing error with the aim of detailing past actions to gain a perspective on those interventions already in place within Scottish NHS hospitals.

Method

Data collection

Anonymous error reports were collected from 25 Scottish hospitals within one board of NHS Scotland (one teaching, two district general, two palliative care, one specialist, one children's, one maternity, one psychiatric, one elderly and 15 community hospitals) on a voluntary basis using the integrated risk management information system (DATIX).

The DATIX patient-safety software system

Data are submitted by reporters using an entry form accessible from an intranet system – which shares online information. Individual responses are then organised using a coding system where the individual reporting the incident must indicate their location, the stage of the medication process, the nature of the error, the outcome and any contributing factors. The level of severity is also reported, ranging from 'low' where the risk to the patient is minimal and not likely to result in any permanent harm, through to 'severe' where the error could result in permanent harm, or even death. Since these reports are voluntary, the manner in which the forms are filled out is not strictly monitored. This allows for some discrepancies in the system, such as variation in the amount of detail provided about an event, or differences in the use of the coding scheme by each individual reporter. However, the reports are reviewed by managers who have a responsibility to amend the coding where necessary. The data is then stored and collated at a single site for monitoring purposes.

The DATIX system currently in use in Scottish NHS hospitals

Access to the data store for research purposes was granted by the North of Scotland Research Ethics Service on the basis that the data search and analysis was classified as an audit.

Details of un-prevented medication incidents, which can be reported by any member of the medical staff (including nurses, doctors and pharmacists), have been routinely collected for the past 5 years (July 2005–March 2010) from all 25 hospitals. These data were made available for the purpose of this paper. As part of the coding system, these incidents were separated according to the stage of the medication process (prescribing, dispensing or administering), with 3798 cases of medication error reported overall. The location and all personal details of the staff involved in each incident were removed from the dataset in order for the hospitals, and staff, to remain anonymous.

Data management

Data were downloaded from the DATIX database as a locked Excel spreadsheet. All prescribing and administration errors were removed from the dataset and the coding scheme for the remainder checked to ensure accuracy. A coding frame, based on that described by Beso *et al.*,[3] was used to classify the reported dispensing errors. This coding frame was utilised by

Table 1 Description of classifications used to categorise drug errors, based on the classification model proposed by Beso *et al.*[3]

Error type	Classification
Content errors	
Incorrect drug	Drug dispensed does not match prescription
Incorrect strength of drug	Drug is correct but supplied at wrong strength
Drug not dispensed	Drug prescribed to patient but omitted when medication is dispensed
Incorrect form of drug	Drug dispensed is correct but dosage form is incorrect, i.e. supplying a standard formulation when a modified release form was prescribed
Medication out of date	Medication dispensed is correct but has exceeded its expiration date
Drug dispensed in error	Drug dispensed was originally prescribed to patient but has been discontinued – supplied to patient in error
Drug not dispensed in time for discharge	Drugs are known to have been requested but prescription is not filled in time for patient to be discharged
Preparation error	Drugs prepared incorrectly for administration i.e. medication not dissolved correctly in liquid
Labelling errors	
Incorrect quantity	Drug quantity on label differs from that specified by prescriber
Incorrect patient name	Omission of patient name or incorrect patient name written on dispensed drugs
Labelling error	Drugs dispensed are correct but name of drug on label is incorrect, or, drug dispensed is correct but instructions for drug administration are incorrect
Incorrect instructions	Instructions for administering drug are wrong
Dispensing aids	
Dosette box filled incorrectly	The dosette box is an aid for the patient to take their medication correctly – an error refers to the dosette box containing the incorrect drug, or the wrong quantity or strength of the prescribed drug
Care package not dispensed	Care package not dispensed
Other	

two independent reviewers to categorise each factor and reported response using the reporter's own description of the event (see Table 1).

For example, the following report 'Tramadol 50 mg Capsules dispensed against prescription for Trazodone 50 mg Capsules' describes an error where the wrong drug is supplied and would therefore be categorised as 'incorrect drug' in the coding scheme. Any events where there was a lack of agreement between the two coders, or insufficient information to allow a decision to be reached were removed from the dataset.

The section of the DATIX report relating to contributory factors and managerial responses was often left incomplete. However, where this information was filled in, each reporter had already classified the nature of the contributing factor or managerial response, i.e. 'the ward was busy', so the factors were simply counted and then placed in a descriptive category.

As part of the data analysis, and in order to consider the wider context of each contributory factor, we further modified a previous adaptation[19] of Reason's[20] model of organisational accidents, designed to consider the causes of accidents in a healthcare setting. The reported contributory factors from the current dataset were then mapped onto the five categories (work environment, product presentation, team, task and patient) of the resulting framework.

Results

Initial analysis of the 3798 error reports split the dataset according to the stage of the medication process, 16% ($n = 622$) of errors originated in the dispensing of medicines from a pharmacy or ward, 24% ($n = 925$) from an error in prescribing and 59% ($n = 2251$) in the administration of medicine from the ward. For the purpose of this paper, we will concentrate on those errors reported to occur during dispensing, from both the pharmacy and ward – with 461 reports classified as pharmacy dispensing errors and 161 error reports classified as dispensing on hospital wards.

Dispensing error

The majority of the dispensing errors reported over the 5-year period were rated as 'Low' (87%, $n = 541$) in terms of patient outcome. The remaining reports were rated as 'Medium' (12.6%, $n = 77$) or 'Severe' (0.6%, $n = 4$).

The majority of the reported dispensing cases occurred whilst the patient was resident on a hospital ward (73%, $n = 454$), with the remainder occurring upon admission (7.5%, $n = 47$) or discharge (19.7%, $n = 122$). The combined findings for all three patient types, as rated by two independent raters (inter-rater reliability: rho $(622) = 0.62, P < 0.01$), are illustrated in Table 2. Due to a lack of detail in some of the cases, and a lack of agreement in terms of the rating

Table 2 Frequency and type of dispensing error from 573 error reports

Reported error	Frequency of reports featuring factor % (*n*)
Content errors	
Incorrect drug	19.2 (110)
Incorrect strength of drug	16.8 (96)
Drug not dispensed	7.2 (41)
Incorrect form of drug	9.8 (56)
Medication out of date	5.9 (34)
Drug dispensed in error	2.6 (15)
Drug not dispensed in time for discharge	1.7 (10)
Preparation error	4.5 (26)
Labelling errors	
Incorrect quantity	9.8 (56)
Incorrect patient name	4.2 (24)
Labelling error	7.1 (41)
Incorrect instructions	3.9 (22)
Dispensing aids	
Dosette box filled incorrectly	2.4 (14)
Care package not dispensed	0.5 (3)
Other	4.4 (25)

Table 3 Frequency and type of reported contributory factors to dispensing error taken from 193 reports

Reported contributory factor	Frequency of reports featuring factor % (*n*)
Work environment	
Busy ward/pharmacy	14.9 (29)
Staff shortage	7.2 (14)
Distraction/interruption	5.7 (11)
Noise	1 (2)
Protocols not followed	5.7 (11)
Product presentation	
Drug name similarity	15.5 (30)
Similar packaging	1.5 (3)
Poor labelling by manufacturer	1 (2)
Team	
Inexperienced staff	13.4 (26)
Staff error in calculating dose	3.6 (7)
Other medical staff in hurry or unhelpful	2.1 (4)
Loss of concentration	1.5 (3)
Stress	0.5 (1)
Fatigue	0.5 (1)
Task	
Careless checking procedures by staff	7.2 (14)
Information not passed to relevant person	4.6 (9)
Illegible handwriting	2.1 (4)
Patient	
Patient self-medicating	3.1 (6)
Patient aggression	1.5 (3)
Demanding patient	1 (2)
Patient supplied wrong information	0.5 (1)
Other	
All other factors	5.6 (11)

Classification of factors was based on a modified version of Vincent's[19] framework of factors influencing healthcare practice.

used for others, 49 cases were removed at this stage leaving 573 cases for further analysis.

Table 2 indicates that the most common type of error was dispensing a drug which differed from that prescribed to the patient (incorrect drug: 19.2%, *n* = 110), usually the drug supplied in error had a similar name to the requested drug, for example, 'patient had been prescribed clomiphene . . . but supply of tablets from pharmacy was clomipramine'. The second most common dispensing error reported was supply of the wrong strength of the correct drug (incorrect strength: 16.8%, *n* = 96), for example, 'patient presented with a prescription for levothyroxine 125 micrograms once daily but received 150 micrograms in error'. The third most commonly reported errors were incorrect quantity (9.8%, *n* = 56) and incorrect form of the correct drug (9.8%, *n* = 56). Supply of the incorrect form of the correct drug is perhaps less likely than other types of error to cause severe injury, but could reduce the efficiency of administration, alter the pharmacokinetics and potentially delay the start of a medication regime, i.e. 'faxed outpatient script for sodium docusate suspension 200mg twice daily – writing unclear and so capsules supplied – returned from radiotherapy and liquid formulation supplied'.

Contributory factors

The next stage in the analysis was to categorise the reported contributory factors to dispensing error. Factors thought to have an impact on the dispensing process were reported in 193 of the 573 dispensing error cases. The results illustrate that the individual factors most commonly reported to negatively impact dispensing across the hospitals were drug name

similarity, busy wards and inexperienced staff (see Table 3). When the results were mapped onto the modified framework of factors influencing healthcare practice[19] those factors associated with the category of work environment (34.5%, *n* = 67) were found to be the most commonly reported.

Interestingly, the factors of 'drug name similarity' and 'similar packaging' reported in Table 3 were often mentioned in conjunction with other contributory factors such as 'busy ward', 'tiredness' or 'distraction' (42% of all the reported cases of drug name similarity and similar packaging). One example is 'similar packaging for differing strengths of levothyroxine. Tired from working excessive evening hours in *** dispensary due to high workload low staffing'. This is indicative of potential interactions between different contributory factors in producing an error.

Managerial responses to error

Finally, the response of the hospital management to the error was recorded for 251 of the 584 reports of dispensing error (Table 4).

Table 4 Frequency and type of hospital managerial response taken from 251 dispensing error reports

Managerial response to reported error	Frequency of response % (*n*)
Staff awareness	
Staff reminded of importance of checking procedures	17.9 (45)
Meeting with members of staff to discuss event	16.7 (42)
Staff made aware of incident	14.7 (37)
Improved training to be provided	10 (25)
Protocol reiterated to staff and problem area highlighted	8.8 (22)
Staff reminded to double check drug strength before dispensing	6 (15)
Importance of remaining undisturbed whilst dispensing medication reinforced	4.4 (11)
Staff member asked to provide written reflective statement	3.2 (8)
Supervision of staff whilst they carry out their duties	2.4 (6)
Staff communication encouraged	1.2 (3)
Staff provided with medicines management handbook	0.8 (2)
Risk assessment	
Investigation by professional body	2 (5)
Risk assessment updated	1.6 (4)
DATIX form completed	1.2 (3)
Medication incident action plan implemented	1.2 (3)
Change to workplace environment	
Staff to dispense medication in pairs	1.6 (4)
Altered shelf arrangement to split easily confusable drugs	1.6 (4)
New policy implemented	1.2 (3)
Drug expiry date to be highlighted	1.2 (3)
Staffing levels increased	0.4 (1)
Part-used packs to be highlighted	0.4 (1)
Size of dispensing label to be increased	0.4 (1)
Patient education	0.4 (1)
Warning label applied to shelf	0.4 (1)
Use of drug round tabards	0.4 (1)

The majority of the responses to dispensing error was to remind staff of the importance of checking procedures (17.9%, *n* = 45) and the use of a staff meeting to discuss the incident (16.7%, *n* = 42). Actual changes to policy were far more rare (8%, *n* = 20: new policy implemented, instigate paired dispensing, expiry date highlighted, staffing increased, etc.), though retraining was also a popular response to error (10%, *n* = 25).

Discussion

The main findings were that dispensing errors in the sample of Scottish hospitals usually take the form of incorrect drug (19.2%), incorrect strength (16.8%), incorrect quantity (9.8%) and incorrect form of the correct drug (9.8%). These findings are in agreement with the data reported for hospitals across the UK[13] where the majority of reported errors were supply of the wrong drug (23%[13]) or the wrong strength of the prescribed drug (23%[13]).

Similarly, in terms of the reported contributory factors, the most commonly reported categories were workplace environment (34.5%), team factors (21.6%) and product presentation (18%). This is similar to the frequency of contributory factors reported for hospitals elsewhere in the UK, where 'lookalike–soundalike' drugs were reported as the most common cause of error (33%), followed by high workload (23%) and inexperienced staff (20%).[13] Since managerial responses are not usually collected, the results reported here cannot be compared to UK-wide findings. However, the main finding suggests that the majority of managerial responses were based on communication with staff (34.6%).

The main limitation for this study is the nature of the self-reports used as a data source. There are four main issues with these types of data. First, it is likely that the data set is subject to under-reporting.[4] Second, there is likely to be individual variability in the error reports. Third, the data are subject to individual bias, particularly when describing the contributory factors relating to an event. Fourth, data are often missing or incomplete. An additional limitation of the study was the collection of data from one region within NHS Scotland. This prevents generalisation of the results across the whole of Scotland as some variation in the nature and number of dispensing errors is likely to occur across regions.

The main positive aspect of the results was the collection of recent data on Scottish NHS dispensing errors which enabled us to highlight specific areas for further research (dosette boxes, patient-as-an-error factor). Furthermore, by focusing on specific error types we were able to provide a detailed analysis on the nature and causes of various dispensing errors, as opposed to providing a more general overview. These specific points could be used in the future to generate original interventions.

Dosette boxes

Of particular interest in the current study were those dispensing errors which have not been previously reported elsewhere. Primarily, those errors relating to the filling of dosette boxes (2.6%) represent a new finding that may warrant further research. Dosette boxes were designed to aid the accurate self-administration of drugs by the patient, particularly those patients recovering from a transplant[21] or part of the mental health system.[22] The errors reported here describe dosette boxes being filled incorrectly, either with insertion of the incorrect drug or confusion relating to the arrangement of drugs within the box. Combined with the multiple reports of inexperienced staff and careless checking procedures, these findings suggest that increased use of the dosette box system

may lead to an increase in errors if staff are not adequately trained.

Workplace environment

One of the largest categories of reported contributory factors influencing dispensing errors related to the work environment (34.5%). The scale of the potential problem caused by these workplace factors is illustrated by observational research. For example, interruptions and distractions have been shown to significantly affect ambulatory pharmacy care levels,[23] with more than 200 interruptions and distractions recorded over 23 days.

The patient

Also of interest was the finding that the patient themselves can function as a contributory factor in dispensing error, with 6.5% of the reports stating that patient behaviour, particularly aggression, influenced the dispensing process. The patient as a potential error factor has not, to our knowledge, been reported previously in studies of hospital-based dispensing error. However, a recent survey of Finnish community pharmacists[24] mentions the customer as a potential cause of error, through the customer being talkative, having many prescriptions or being in a hurry.[24] The current result may, therefore, be indicative of a potential problem which has not yet been examined in a hospital pharmacy setting. This is a particularly important consideration in light of recent efforts to involve patients in their medication regimes through processes such as shared decision making.[25]

Product presentation

Drug name similarity was the single most reported contributory factor within the current dataset. Orthographic similarity, or 'lookalike' drug names have been shown to adversely affect accurate perception of drug names in the US.[26,27] The authors suggested the utilisation of measurable aspects of orthography in order to prevent the future production of similar drug names.[21] The US Food and Drug Administration (FDA) responded by producing a list of easily confusable drug names in order to alert pharmacists, and has introduced the use of TALL MAN lettering, a textual enhancement using capital letters, in an attempt to reduce this confusability.[28] The utilisation of barcode technology has also been shown to reduce selection error.[29]

Managerial response

The results suggest that various responses to dispensing error have been generated by managerial teams in Scottish NHS hospitals. This is an important stage in the use of error reports as a method of quality and safety improvement,[30] and provides an insight into how system changes might be implemented in NHS hospitals. The majority of the reported management responses involved attempts to improve staff awareness, often through meetings. However, there were a minority of reports detailing an actual change to the workplace environment, such as an increase in staffing levels (0.4%). Research conducted to gather pharmacist opinion on improving dispensing safety, reported that checking procedures and the design of distinctive medication packaging were viewed as integral to reducing errors.[11] Thus, the reported practical changes to pharmacy practice described here are more likely to be viewed favourably by pharmacists than the more remote intervention of meetings.

Conclusions

The majority of the data reported are similar to those gathered in past studies, but with some key differences, including, reports of errors in filling dosette boxes, and reports of patient behaviour influencing the dispensing process. These differences are indicative of the potential development of new error types in response to changes and developments in medicine management. Analysis of the managerial responses to dispensing error suggest that the majority of interventions take the form of staff meetings, with only a minority illustrating practical changes to the dispensing process. Future research could focus on the further analysis of such interventions, in order to establish the relative success of the varying methods reported here. To conclude, dispensing error remains an important consideration in medication safety, with continued evaluations of error reports required if we are to develop innovative interventions and monitor the effect of new dispensing procedures.

Declarations

Conflict of interest

The Author(s) declare(s) that they have no conflicts of interest to disclose.

Funding

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