

What do hospital staff in the UK think are the causes of penicillin medication errors?

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Abstract *Background* Medication errors are a potential major threat to patient's health, and allergic reactions occurring in patients with known allergies are an important preventable form of adverse drug event. The use of penicillin antibiotics in patients who are allergic to penicillin, in particular, is a major concern. *Aim* To survey staff attitudes and beliefs to incidents involving penicillin allergic patients who are prescribed and administered penicillin antibiotics. *Setting* A 650 bed teaching hospital in England. *Method* Using individual and (focus) group interview proceedings with a purposive sample of doctors, nurses and pharmacists, an electronic questionnaire was administered hospital wide to all clinical staff. No reminders were issued. Main outcome measures: Clinical staff's views on the causes of penicillin medication errors. *Results* The electronic survey was completed by 235 members of the clinical staff. Half the respondents definitely considered themselves knowledgeable about which antibiotics contain penicillin medicines, though approximately 90 % of respondents considered that misinformation or lack of knowledge on which antibiotics contain penicillin medicines was an issue for some or most colleagues. Various organisational issues such as the use of red wrist bands, the

wearing of red tabards by the nurse during the medicines round, and a busy work environment were recurrently highlighted as systems factors that could be improved upon. *Conclusion* Our study elucidated concerns amongst clinical staff relating to the scenario of a penicillin allergic patient receiving a penicillin antibiotic. The resulting local learning and feedback about staff beliefs pertaining to this one specific type of error will be used to consider the nature and type of local action to be taken to help improve patient safety.

Keywords Allergy · Education · England · Hospital · Medicines administration · Penicillin · Pharmacist

Impact of findings on practice

- Medication errors may be influenced by a variety of factors including patient, task, individual, team, environment, organisational and institutional context.
- Elucidating the concerns of clinical staff in relation to penicillin medication errors has provided an opportunity to consider interventions that may reduce the incidence of this type of error.

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Introduction

Medication errors are any incident where there has been an error in the process of prescribing, dispensing, preparing, administering, monitoring or providing medicines advice, regardless of whether any harm occurred or was possible. In England the number of medication incidents reported to the National Patient Safety Agency (NPSA) Reporting and

Learning System has increased from approximately 42,000 in 2005 to 132,000 in 2010 [1], with approximately 1–2 % of patients in UK hospitals thought to be harmed by medication errors [2]. Such errors are thus a major threat to patient safety.

In this field of medical errors it is argued that errors cannot be understood as discrete events but require an appreciation of the context in which these events occur. Human error theory recognises that three types of error are common: errors due to lapses of memory or slips in attention; errors of judgement in planning (rule-based errors); and errors due to lack of knowledge (knowledge-based errors) [3]. The systems approach to human error distinguishes between active failures or mistakes committed by an individual or individuals at the ‘sharp end’ of the system, and latent (system related) conditions inherent in the design and maintenance of the workload and environment that make errors more likely [4]. In healthcare the patient safety movement depends upon effective strategies for preventing errors which are predicated on an understanding of the causes and conditions which lead to their occurrence—given that up to 87 % of the instances of medication errors implicate human factors and organizational inadequacies [5]. For instance, one study of hospital medication errors reported that most of these were due to slips in attention occurring during routine prescribing, dispensing or drug administration, and that latent conditions that made medication errors more likely were common [6]. Interviews with hospital doctors whose actions had led to an adverse drug event have noted that workload, team communication, lack of knowledge and lack of self-awareness of errors were relevant factors [7]. Others observe that day-to-day experience would suggest that staff shortages, cognitive overload of members of staff, distractions, poor communication, haste, and fatigue are common contributory factors to incidents that cause patient harm [8].

In their paper defining the four challenges for improved patient safety, Leistikow et al. [9] argue that healthcare professionals should not be forced to adopt pre-designed, disputable safety interventions, but should be involved in interactive processes to develop interventions in their own specific context. An advantage of this approach is that professionals gain influence and become committed to a workable and reasonable outcome. They also acquire knowledge about patient safety that directly or indirectly improves their daily patient care. Engaging staff is therefore important in delivering on increased patient safety and improved quality of care.

Allergic reactions occurring in patients with known allergies constitute an important preventable form of adverse drug event. Approximately 3.2 % of the hospital medication incidents reported to the NPSA occurred when

patients were prescribed, dispensed or administered a medicine to which they were known to be allergic, with almost one-third of these resulting in some patient harm [10]. Penicillin allergy itself is reported by 10 % of hospital inpatients, though the incidence of true allergy is relatively low at 1–2 % of the hospital population [11]. It is, however, a significant problem that can cause death if penicillin antibiotics are inadvertently administered [12]. To prevent harm arising from a patient being given a drug to which they have an allergy requires patient and medicines information being readily available and acted on, by various health professionals, at the time of prescribing, dispensing and administration.

Trend analysis of patient error reports at our teaching hospital of approximately 650 beds over a 12 month period suggests an occurrence of about 28 incidents in which a patient was given a prescribed medicine to which there was documented evidence of allergy. Penicillin antibiotics accounted for about three quarters of these incidents although it is likely such incidents are under reported.

Aim of the study

The aim of this study was to elicit views of the clinical staff on the perceived causes of a penicillin allergic patient being prescribed and administered a penicillin antibiotic.

Method

As part of a broad initiative investigating how the specific example of a penicillin allergic patient given a penicillin antibiotic may be prevented we undertook various activities. Stage one consisted of a focus group conducted in late 2010 with clinical staff (two doctors, four nurses, and three pharmacists) involved in the drug prescribing and administration process to identify where there is potential for such penicillin incidents to arise. Analysis of the proceedings yielded two recurrent themes representing potential risk for penicillin-allergic patients: organisational deficits i.e. failure by personnel to follow procedures and systems designed to reduce risk; and knowledge-related issues (patient and practitioner) concerning distinctions between general adverse reactions and allergic reactions. The second stage consisted of face-to-face semi-structured interviews, conducted in late 2010, with four doctors, four nurses, and four pharmacists to explore practitioners’ beliefs and expectations of these incidents and how they could be prevented.

All proceedings from both focus groups and interviews were transcribed and data managed using framework analysis [13]. This process involved coding the transcripts

from which selected themes or categories were extracted iteratively by mapping data on a matrix or framework. The main themes were organisational (issues with the hospital's red wrist band policy¹, and nurses workload); interprofessional issues (the shared responsibility of identifying a patient's allergic status); knowledge (of which antibiotics contain penicillin [14], and distinguishing between a side effect and an allergic reaction); cultural (a cavalier approach to the prescribing of penicillin antibiotics because of the perceived low risk of harm); and consequential (a clear distinction between how doctors and nurses are treated when mistakes are made).

These findings were used to develop an electronic questionnaire delivered hospital-wide to survey staff attitudes and beliefs to these incidents. A draft questionnaire was piloted on three clinical staff, resulting in minor modifications being made to the final document. The questionnaire consisted of 12 closed multi-response questions, and a final question inviting free text comments. The only personal information collected asked whether the respondent was a doctor, nurse or pharmacist/pharmacy technician. The link to the electronic questionnaire (Survey Monkey) was emailed to all clinical staff once a week over a 5 week period (April to May 2011). The covering email briefly explained the reason for the questionnaire, invited staff to complete it and guaranteed anonymity. Although there are approximately 1,700 clinical staff, it is known that many do not use their email account and hence would not even be aware of this questionnaire. It is the results of the electronic survey that are described here. Free text comments were analysed for similarity and grouped into recurring themes. A copy of the questionnaire is available from the authors.

Results

The electronic survey was completed by 235 members of the clinical staff (132 doctors, 71 registered nurses, 32 from the pharmacy team) though not all respondents answered all the questions. As regards organisational arrangements designed to prevent penicillin medication errors, approximately three quarters (75.2 %) of respondents judged the hospital's red wristband policy for patients with allergy to be highly effective or effective. A slightly lower number (65.6 %) considered that a list of penicillin antibiotics contained in the patient's inpatient chart would be highly effective or effective. However only one-third (31.2 %) considered the use of plain tabards² as possible being very effective or effective in preventing unnecessary distractions during the medicines round (Table 1).

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Approximately one-third (35.3 %—73/207) of respondents felt that the Trust promotes open and free communication about medication safety related issues across all professional groups, 43.5 % only with some professional groups; and 12.6 % only within professional groups. When considering whether patient safety has the potential to be improved by professionals learning from mistakes, 82.1 % (174/212) agreed that this could happen among all professions, and 12.7 % among some professions.

When asked what should occur if a documented allergic patient is erroneously given a penicillin antibiotic (for which respondents could tick more than one answer), 63.3 % (133/210) of respondents anticipated that all staff would be reminded of the risks to patient safety, 60 % (126/210) answered that the matter would be dealt with internally by the professional group of the responsible individual, and 5.2 % (11/210) answered that no positive action would be taken.

Of the questions examining possible knowledge deficits (Table 2) just over half the respondents definitely considered themselves knowledgeable about which antibiotics contain penicillin medicines. However interestingly approximately 90 % of respondents considered that misinformation or lack of knowledge on which antibiotics contain penicillin medicines was an issue for some or most colleagues.

Sixty-two (30.8 %) of 201 respondents identified from five options (Table 3) "lack of knowledge of which antibiotics contain penicillin medicines" as the one main factor accounting for these medication errors. Twenty five respondents provided free text comments relating to 'other causal' factors. One new theme to emerge from these comments (albeit only six respondents) identified the problem associated with the diagnostic accuracy or otherwise of a patient claiming to be penicillin allergic.

"False reassurance due to many patients reporting allergies which are in fact merely side effects. This dilutes the seriousness with which staff take records of allergies."

In relation to the question about nurses wearing tabards during the medicines round, there was an overwhelming view from the 83 free text responses that a busy ward cannot cope with a nurse who is dedicated solely to administer medicines.

"This only works if there are enough nurses not wearing tabards to do all the other things that need to be done."

¹ A hospital's wrist band policy will require patients with a known history of allergy to be identified with a red identification wrist band displaying the allergen.

² Tabards may be worn by nurses conducting a medicine administration round to signal that they should not be disturbed whilst undertaking this task.

Table 1 Staff views on the effectiveness of various interventions as preventative measures

	The trust's red wristband policy for patients with allergy N = 222	A listing of penicillin antibiotics contained in the patient's inpatient chart N = 221	The wearing by nurses of plain tabards during the medicines round to prevent unnecessary distractions N = 218
Highly effective	18 (8.1 %)	38 (17.2 %)	11 (5.0 %)
Effective	149 (67.1 %)	107 (48.4 %)	57 (26.1 %)
Not particularly effective	45 (20.7 %)	52 (23.5 %)	91 (41.7 %)
Ineffective	9 (4.1 %)	11 (5.0 %)	45 (20.6 %)
Undecided	n/a	13 (5.9 %)	14 (6.4 %)

n/a not offered as an optional answer to this question

Table 2 Questions relating to a possible knowledge gap

To what extent do you consider misinformation or lack of knowledge concerning which antibiotics contain penicillin medicines is an issue among colleagues? N = 211	
I don't consider it an issue	26 (12.3 %)
I consider it an issue for some colleagues	163 (77.3 %)
I consider it an issue for most colleagues	22 (10.4 %)
Do you consider yourself knowledgeable about which antibiotics contain penicillin medicines? N = 211	
Yes, definitely	118 (55.9 %)
I think so	77 (36.5 %)
I'm unsure	16 (7.6 %)

Table 3 The one factor above all others considered to account for allergic patients being prescribed and administered penicillin-related antibiotics. N = 201

Lack of knowledge/awareness of antibiotics containing penicillin-related medicines	62 (30.8 %)
Distractions and interruptions	61 (30.3 %)
Constraints on staff time	36 (17.9 %)
Inadequacy of existing safeguard mechanisms	22 (10.9 %)
Poor adherence to policies/procedures	20 (10.0 %)
Other	25 (12.4 %)

"Tabards are fine—what fails the system is the availability of other nurses for answering queries during the drug round."

The final question eliciting free text comments on how these incidents can be reduced was answered by 62 (26.4 %) respondents. The key themes identified were:

- the use of red wrist bands as part of the allergy policy, attracting both supportive and negative views of this approach
- the busy work environment "All staff are frequently interrupted during drugs rounds and at all other times. It is no wonder there are mistakes"
- poor patient knowledge of their true allergy status "It would be great if patients with allergies could be more aware of this and carry some relevant information"
- safe systems for prescribing and administration "Don't dispense drugs unless the drug allergy box is filled in" and "Electronic prescribing and dispensing bar code system which would highlight allergies at the time of dispensing and administration"
- education and training on which antibiotics contain penicillin, and the role of the pharmacy team in this "Also, I wonder how many staff nurses are aware that Augmentin has penicillin in if a doctor was to prescribe this by mistake." and "Pharmacy staff having higher profile on wards to highlight issues before they happen and to pick up incidences where a patients allergy status is not established on admission."
- separate storage of penicillin antibiotics from other antibiotics. This was deemed by respondents both as a worthwhile step to take and as a risky action. "Physical separation or colour-coding of penicillin-related drugs is a good idea as long as it can be applied in a useful way clinically" and "Separating penicillin based antibiotics will lead to "nanny state"³ type working. There are many other drugs with risks attached to them thus it would be totally impracticable to separate all drugs.

³ Nanny state conveys a view that a government or its policies are overprotective or interfering unduly with personal choice.

Staff simply need to get back to focussing on medication round and it's importance in the delivery of healthcare."

- a view that errors of this nature will be difficult to reduce "Simple human error: therefore no amount of protocols and 'safeguards' will change things" and "It is so multi factorial that no single item will create a solution"

Discussion

Though the actions and failures of individuals usually play a central role in errors, their thinking and behaviour is strongly influenced and constrained by their immediate working environment and by wider organisational processes. Reason's organisational accident model [4] has been adapted for use in a healthcare setting, classifying the error producing conditions and organisational factors in a single broad framework of factors affecting clinical practice [15]. The 'seven levels of safety' framework describes the contributory factors and influences on safety under seven broad headings and some of these can be cross referenced to themes identified in our study (see Box 1).

Hence, in relation to individual staff factors, a knowledge deficit linked to penicillin antibiotics appears to be recognised amongst the staff who participated in the electronic survey with most reporting that misinformation or lack of knowledge concerning which antibiotics contain penicillin is an issue for some or most colleagues. Interestingly over half (55.9 %) did not recognise this knowledge deficit as a problem for themselves. Overconfidence bias can cause individuals to be poor at assessing the gaps in their knowledge, leading them to overestimate both how much they know and how reliably they know it, and may be a cause of error [16]. However, only 31 % identified lack of knowledge as the main causative factor for medication errors from five possible contributory factors. This would suggest that knowledge improvement on its own will not be sufficient to prevent these errors. A systematic review, from a small number of empirical studies, has shown that prescribing errors have potentially multiple causes and error-provoking conditions, often acting together [17]. The authors of this review acknowledge that the complexity of prescribing error causation means that simplistic solutions or quick fixes, which address a single cause, are likely to have only limited benefit.

Organisational factors would include the use of red allergy wristbands. These act as an alert for health professionals and, when combined with other safeguards or defensive layers (e.g. wristband and completed allergy box on the prescription) are intended to reduce the likelihood of an adverse event, since all layers have to be breached simultaneously for a bad outcome to occur [18]. Although

three-quarters of respondents deemed the Trust's red wrist band policy to be very effective or effective as a preventative measure, there was a clear concern from the free text comments that the implementation of the policy was not totally safe. Indeed, previous audit work within the hospital from 2010 to 2011 had shown that only half of the patients with a documented allergy on the inpatient chart were wearing a red wristband. Others have acknowledged poor practice in the utilisation of allergy wristbands [19].

Working conditions, such as distractions that staff endure at points where concentration is required, was highlighted by the relatively low number of respondents (31.1 %) who judged the wearing of red tabards during the medicine round to be very effective or effective as a preventative measure against distraction. The free text comments were largely against their use as it was not considered practical on a busy ward to have one nurse dedicated to the sole task of administering medicines. Though the use of red tabards has attracted media attention [20], the evidence base to support them as a risk management strategy is very limited [21] and others have found negative views on their benefit in reducing interruptions [22].

Most respondents (82.1 %) acknowledged that learning from mistakes can improve patient safety—a laudable goal if there is active learning (where lessons are embedded into culture and practice) [23]. However a much smaller proportion of respondents (35.3 %) perceived that open and free communication about errors is promoted across all professional groups. Organisations that have an ideal safety culture would expect potential learning opportunities to be communicated across all relevant staff and teams no matter what the profession.

Our broad study examining the inadvertent administration of penicillin antibiotics to penicillin allergic patients had three main components anchored on staff engagement and feedback. It is believed that some of the emerging themes have generated opportunities for patient safety improvements focused on the system (e.g. consideration as to whether the hospital's red wrist band policy should be maintained or not) and on personnel (the need and usefulness of various educational prompts). The concept of collective discussion about patient safety issues among professional groups of clinical staff with the aim of uncovering a deeper understanding of local contextual issues and potential educational needs has been described elsewhere [24].

Limitations

The electronic survey results are subject to some of the usual limitations associated with surveys of this nature: survey data are potentially biased by non-responders and we obtained responses from only a small proportion of the

Box 1 Seven levels of safety framework [15], identified risk areas and supporting free text comments

Patient factors	Ability and confidence of patients to communicate with staff about their allergy status	“Unclear history from patients as to their allergies. Over-reporting by patients of non-hypersensitivity reactions to penicillin e.g. diarrhoea and vomiting being reported as true allergy.”
Task factors	Completion of, and checking of, drug allergy status on medicines chart	“The allergy box should always be filled in even if it is to say no allergies. It is frequently left blank and so the patient is assumed to have no allergies when they may have some.”
Individual staff factors	Knowledge of which antibiotics contain penicillin	“Give more training to junior doctors—at the end of the day it’s their prescribing errors that cause patient’s to be administered potentially incorrect medications.”
Team factors	Blame apportioned to different professional groups when errors are made	“Some nurses are able to pick up on errors but don’t always check the allergy status of the patient and just give what’s prescribed.”
Working conditions	Time pressures Use of tabard during medicines round. Separate storage of penicillin antibiotics	“Tabards will only be effective if there is another nurse available to have a discussion with. Drug rounds take a long time and waiting for a nurse to finish before communication can occur is not practical.”
Organisational factors	Red wrist band policy Need for education on penicillin antibiotics	“I worked in a trust that stopped using Red Bands which meant that you had to check all patients notes before giving any medication to check for allergies.”
Institutional context	Not clearly elucidated in our study	

total clinical staff workforce. In addition, predetermined responses may force respondents into selecting an answer that is not entirely accurate. Although the survey contained no explicit prompt about technology, electronic prescribing and decision support was offered as a solution in the free text comments by a number of respondents. Indeed, this hospital now has an implementation strategy for the introduction of an electronic prescribing and medicines administration system.

Conclusion

Our study has elucidated concerns amongst clinical staff relating to the scenario of a penicillin allergic patient receiving a penicillin antibiotic. It is evident that the hospital staff we surveyed were mindful of penicillin medication errors, and the causes, but were inclined to consider the complexity of the problem to be such that organisational attempts to minimise these were not optimally effective. Those factors perceived by staff to be causal, and in some instances to be remedial, have in the main been identified in other studies. It is clear that there is no one quick solution to these identified error provoking conditions. Therefore efforts to reduce the rate of errors should be predicated on encouraging open and free flowing communication across all involved in the prescribing, dispensing and administration of penicillin medication.

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Conflicts of interest No conflicts of interest to declare.

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