ORGANIZATIONAL FACTORS: IMPACT ON ADMINISTRATION VIOLATIONS IN RURAL NURSING

Christine M. McKeon BSc PhD
Counselling Psychologist, Student Services, University of Southern Queensland, Toowoomba, Queensland, Australia

Gerard J. Fogarty BA PhD DipEd
Professor of Psychology and Deputy Dean, Faculty of Sciences, University of Southern Queensland, Toowoomba, Queensland, Australia

Desley G. Hegney BA PhD RN
Professor of Nursing & Director, Research Centre, University of Queensland and Blue Care, Brisbane, Queensland, Australia

Aim. This paper reports a study investigating organizational factors contributing to procedural violations by nurses during medication administration.

Background. Health care is not as safe as it could be, with research indicating that errors involving medications are a leading cause of unintended harm to patients. In the safety literature, strong claims are made about the connection between violation of procedures and adverse occurrences but, in the healthcare field in particular, there is limited empirical evidence that can serve as a basis for understanding why workers deviate from established procedures.

Method. Quantitative and qualitative data were collected by questionnaire in 2002 to 627 nurses working in rural and remote areas in Queensland, Australia. The response rate was 31%. The data were used to build a model that shows how organizational variables can produce conditions that improve work practices that fall short of best practice standards.

Results. The statistical model accounted for a reliable 19% of the variance in self-reported violations. A higher level of knowledge was found to be associated with lower levels of violations. Conversely, higher workloads and higher expectations by doctors were associated with a higher incidence of violations. Qualitative comments tended to support the conclusions drawn from the model and helped to explain the observed associations.

Conclusions. Attempts to deal with deviations from work procedures through interventions such as retraining or disciplinary action are likely to be ineffective unless they take a more holistic management approach aimed at the individual, the team, the task, the workplace, and the institution as a whole and are directed at the weaker points in the system. These interventions may take the form of training programmes, systems redesign, or the injection of resources. The costs of providing adequate resources to a healthcare system are likely to be offset by savings gained through worker productivity, and better patient outcomes.

Keywords: empirical research report; medication errors; nursing; quality, questionnaire; rural nursing, survey; systems approach

Introduction

In a landmark study in the United States of America (USA), Leape et al. (1991) reported that drug complications were the most common type of medical error, accounting for 19% of all injuries caused by medical treatment. Similar studies in Australia and the United Kingdom indicate that the problem is not confined to the USA (Wilson et al. 1995, Vincent et al. 2001). From the handful of empirical studies that have been conducted on this topic, it is clear that in health care, as in other high risk industries, failure to follow procedures is a common antecedent to errors (Reason 1997). However, it is not particularly enlightening to say that errors are caused by a failure to follow procedures because this type of behaviour is itself a form of unsafe behaviour that requires explanation. With this problem in mind, the present study investigated the influence of organizational factors on procedural violations during administration of medication. Violations are defined as behaviour that involves the deliberate deviation from rules that describe the safe or approved method of performing a particular task or job (Lawton 1998). Using a combination of quantitative and qualitative techniques, the present study set out to develop a model that would help to explain some of the variance in self-reported procedural
violations during administration of medication. A brief description of the work context follows.

**Background**
Administration of medication is a complex and time-consuming task that forms a major part of the nurse’s role (O’Shea 1999). The nurse must ensure that correct operating procedures are followed so that the correct dose of the correct drug is administered to the correct patient at the correct time by the correct route (Delaune & Ladner 1998). The complexity of the medication process increases the potential for error. If an unsafe act results in an error, the nurse often assumes or is assigned responsibility for the error even though the actions of others involved in the system and the system design itself may have contributed to the situation (Wakefield *et al.* 1998).

**Context of study: work settings and regulations**
Although some studies have examined the factors contributing to unsafe acts by nurses (e.g. Edmondson 1996, Meurier *et al.* 1997, Wakefield *et al.* 1998, O’Shea 1999, Meurier 2000), relatively little attention has been paid to the interactions among these factors. Managing risk and reducing unsafe behaviour requires attention to the design of tasks and processes, to the conditions under which people work, to how people interact with one another, and to how people are trained (Leape & Berwick 2000). These issues are particularly relevant to the 30% of Australian nurses located in rural and remote areas, far removed from the resources of the large metropolitan teaching hospitals. The facilities where these nurses work range in size from base or provincial hospitals where medical and allied health professionals are on site (rural), to health facilities staffed by one nurse who relies on communication with the Royal Flying Doctor Service or other off-site medical support (remote). The literature suggests that the nature of the rural and remote environment determines the scope of nursing practice in these areas. The professional isolation that most of the remote area nurses experience can result in them taking on an expanded or advanced practice role in order to fill the gaps caused by the lack of medical and allied health professionals (Hegney *et al.* 1997).

The *Health (Drugs and Poisons) Regulation* (Queensland Government 2003) outlines the practice requirements of registered (RN) and enrolled nurses (EN) in Queensland, Australia. ENs are authorized to administer Schedule 2 (S2; e.g. paracetamol) and Schedule 3 (S3; e.g. pseudoephedrine) poisons under the supervision of an RN or doctor and, with further education, are able to administer restricted drugs that require a doctor’s prescription under the supervision of an RN or doctor. S2/S3 poisons are substantially safe substances used for minor ailments, with most being available from the supermarket (S2 substances) and pharmacy (S2/3 substances). Controlled drugs (e.g. pethidine) are prescription-only medications and are mainly used for strong pain relief. Their supply is controlled because of their potential for inducing dependency and abuse. Restricted drugs (e.g. antibiotics and vaccines) are available only on prescription because they require professional management and monitoring. RNs can administer S2/S3 poisons without authorization, and controlled or restricted drugs on a doctor’s instruction. They can also obtain rural and isolated practice endorsement, which enables them to administer and supply controlled and restricted drugs from a drug formulary without the need to contact a doctor. Endorsed RNs are not authorized to prescribe these medications, however. To administer means to give a single treatment dose to be taken immediately and to supply is to give one or more treatment doses to be taken for a certain period.

**The study**

**Aim**
The aim of the study was to investigate the effect of organizational issues in the rural and remote environment on nurses’ ability to follow procedures for safe or approved methods of medication administration.

**Design**
A survey design was adopted, and the data were collected in 2002 in one state in Australia (Queensland) with a sample of RNs and ENs.
Participants
The participants were 627 nurses working in either rural \((n = 302, 48.2\%)\) or remote areas \((n = 324, 51.7\%)\) (one unidentified). Most respondents \((481: 76.7\%)\) were RNs (Bachelor’s degree or equivalent), with 140 \((22.3\%)\) being ENs (diploma or equivalent), and six participants not indicating their Registration category. The majority worked in acute hospitals \((n = 387, 61.7\%)\). Other health services sites included community health \((n = 69, 11.0\%)\), multi-purpose health services \((n = 39, 6.2\%)\), and residential aged-care facilities \((n = 53, 8.5\%)\). Most were employed on a permanent full-time \((n = 287, 45.8\%)\) or permanent part-time basis \((n = 241, 38.4\%)\). The overwhelming majority of respondents \((95.4\%)\) were not authorized to administer medication without prior approval from a doctor.

Questionnaire
The variables selected for inclusion in the questionnaire were chosen with reference to the nursing and safety literature (e.g. Gladstone 1995, Wakefield et al. 1998, O’Shea 1999, Flin et al. 2000, Snelgrove & Hughes 2000; McGillis Hall et al. 2004) and to the expertise of members of the team from the University’s Centre for Rural and Remote Area Health (CRRAH), who have many years of experience in rural and remote nursing. A preliminary questionnaire was assembled and reviewed several times by the team. After pilot testing, the questionnaire was peer-reviewed by the registering authority and selected rural nurses from the study. A description of each variable and the rationale for its inclusion follows.

Level of knowledge
Nurses are expected to have up-to-date knowledge of the actions, side-effects and dosage of any medication they administer (Delaune & Ladner 1998). A lack of knowledge about medications has been identified as one of the most common system failures contributing to medication errors (Leape et al. 1995, O’Shea 1999).

Reference material
Nurses are required to know the rules and regulations governing their practice (Delaune & Ladner 1998). They are also required to consult reference material if they are unsure about the actions or dosage of a particular medication or about its side-effects. However, if reference material or the regulations are not readily accessible, up-to-date, and adequate, nurses’ ability to follow the rules for safe practice is likely to be compromised (Reason 1997).

Workload
Susceptibility to unsafe acts is strongly affected by adverse conditions of work (Leape 1994, Vincent 1998). Research indicates that workload factors have an effect on the rate of unsafe acts performed by nurses during medication administration (Leape et al. 1995, O’Shea 1999).

Expectation by doctor
In the safety literature, the attitude of managers and super-visors is considered one of the most common factors influencing workers’ attitudes to following procedures for safe practice (Reason 1997, Flin et al. 2000). In rural nursing, these attitudes do not always encourage strict adherence to procedures (Hegney 1997); for example, although nurses are obliged to check with a doctor before administering certain medications, some nurses report that they are not encouraged to do so by doctors in rural and remote areas, especially after surgery hours (Hegney et al. 1997). This expectation is driven by the high workloads experienced by rural doctors and also partly by the fact that it is now possible for Queensland RNs to gain certification to administer (but not prescribe) controlled and restricted drugs from a drug formulary without the need to contact a doctor (Queensland Government 2003).

Violations
Violations are defined as behaviours that involve the deliberate deviation from rules that describe the safe or approved method of performing a particular task or job (Lawton 1998). Self-reported violation was chosen as the dependent variable rather than errors because of the greater likelihood that nurses will be aware of instances where they have worked outside the regulations, whereas they may not always be aware of the fact that they have committed an error or, for that matter, what constitutes an error (see Cook et al. 2004).
Format of the questionnaire

The questions were embedded within a larger instrument constructed by the authors and a team from CRRAH. The larger instrument contained 10 demographic items, and 16 quantitative and 12 qualitative items relating to medication practice. This questionnaire was used to measure current medication administration practice in rural and remote areas, to identify whether this practice complied with current legislation and best practice guidelines, and to identify whether patient safety was being compromised. A full report on these findings can be found elsewhere (Hegney et al. 2003). Details of the scales, including estimates of internal consistency reliability (Cronbach’s alpha) are given below. All items employed 5-point Likert scales, except for violations which used a 4-point scale.

- **Level of knowledge.** Three items assessed the adequacy of respondents’ level of knowledge of medications and their ability to explain this information to patients. Higher scores indicated a higher level of knowledge ($\alpha = 0.78$).

- **Reference material.** Three items assessed the accessibility and adequacy of up-to-date reference material, and the accessibility of the Regulation. Higher scores represented a higher level of accessibility and adequacy ($\alpha =0.75$).

- **Workload.** Two items assessed whether workload issues were impacting on nurses’ ability to comply with the Regulation. The first item assessed the extent to which the sheer amount of work affected compliance, the second item assessed the impact of low staffing levels on compliance. Higher scores indicated a greater combined impact of these factors (item correlation = 0.71).

- **Expectation by doctor.** Respondents were asked whether the medical practitioner in their facility/town expected them to work outside the Regulation. Higher scores represented higher expectations by the doctor for them to work outside.

- **Violations.** Seven items assessed the respondent’s compliance with legal and best-practice issues regarding medication administration. Higher scores represented higher numbers of violations ($\alpha = 0.76$).

Questions seeking additional qualitative comments were placed after the relevant quantitative questions. A general question was also placed at the end of the questionnaire inviting comments about further issues or concerns.

Data collection

The Queensland Nursing Council (QNC) supplied us with a list of codes from its database representing all RNs and ENs working in eligible health facilities in rural and remote areas in the state. From these codes, a list of random numbers was computer-generated by the research team. A non-proportional stratified sampling scheme was used so that all RNs with isolated practice endorsement (57) were sampled, as well as equal numbers (971) of all nurses from rural and remote areas. Approximately half of the population of nurses registered with the QNC were sampled. Coded questionnaires were forwarded to the QNC, who then affixed an address label to correspond with the code number and posted packages to respondents. The package included a reply-paid envelope so that respondents were able to post completed questionnaires directly to the researchers. Consent was implied by return of the questionnaire. Reminder packages were posted to non-respondents 3 weeks after the initial mailing. As with the initial mailing, these packages were sent to the QNC.

Of the 1999 questionnaires distributed, 627 were returned, representing a response rate of 31%. A total of 297 questionnaires contained written comments that were suitable for qualitative analysis.

Ethical considerations

The study was approved by the Human Research and Ethics Committee of the University of Southern Queensland.

Data analysis

The data were used to build a path model showing how the workplace variables were linked and the extent to which they explained variance in medication violations. The questionnaire also contained sections inviting respondents to comment on each of these areas. Qualitative data were transcribed verbatim from the questionnaires. Two researchers used thematic content
analysis to identify common themes and sub-themes in these data. These qualitative comments were then used to help explain linkages in the path model. Such cross-checking was considered to be an important step in the model validation process.

Results

Descriptive statistics

The descriptive statistics and correlations are presented in Table 1. Mean responses to the Level of knowledge and Reference material scales were high (above 4.0 on a 5-point scale) suggesting that most nurses perceived few problems in these areas. Workload was rated as average (mean of 3.0 on a 5-point scale) and the variance was larger for this variable. To gain a better appreciation of this variability, response frequencies were checked. Approximately 33% of respondents either agreed or strongly agreed that their ability to comply with the Regulation was affected by excessive workload and staffing inadequacies and approximately the same proportion either disagreed or strongly disagreed that this was the case. The mean response for Expectation by doctor was below the midpoint (2.22 on a 5-point scale). However, once again the variance was high for this item, with 110 respondents (approximately 18%) either agreeing or strongly agreeing that they felt pressured by doctors’ expectations to work outside the Regulation. The Violations scale was measured using a 4-point scale with the mean response (2.26) indicating a less-than-desirable level of compliance with best practice procedures.

Path analysis

The correlations (columns 4–7 in Table 1) show that Violations was statistically significantly related ($P < 0.01$) to all four predictor variables. As expected, high knowledge levels and access to reference materials were associated with lower levels of violation behaviour and higher workload and higher expectations by doctor were associated with more violations. To help explain the full pattern of correlations, maximum likelihood procedures from the structural equation modelling package Amos 4 (Arbuckle & Wothke 1999) were used in an exploratory fashion to develop a path model that provided the best statistical and conceptual representation of the relationships among these variables. The fit statistics for the resulting model (Figure 1) were good: $\chi^2 (30, n = 627) = 49.29, P = 0.015$; Confirmatory Fit Index = 0.99; Root Mean Square Error of Approximation = 0.03. All pathways in the model were statistically significant, except that from Reference material to Violations, which is represented by a dotted line. The model accounted for 19% of the variance in Violations.

TABLE 1. Summary statistics and correlations for all variables ($n = 627$)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>SD</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level of knowledge</td>
<td>4.06</td>
<td>0.56</td>
<td>0.43*</td>
<td>−0.03</td>
<td>−0.05</td>
<td>−0.28*</td>
</tr>
<tr>
<td>Reference material</td>
<td>4.02</td>
<td>0.72</td>
<td>−</td>
<td>−0.14*</td>
<td>−0.24*</td>
<td>−0.26*</td>
</tr>
<tr>
<td>Workload</td>
<td>3.01</td>
<td>1.14</td>
<td>−</td>
<td>0.28*</td>
<td>0.18*</td>
<td></td>
</tr>
<tr>
<td>Expectation by doctor</td>
<td>2.22</td>
<td>1.09</td>
<td>−</td>
<td>0.30*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Violations</td>
<td>2.26</td>
<td>0.57</td>
<td>−</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*P < 0.01.

The numbers shown along the pathways in the model indicate the strength of the relationships between each variable. The higher the absolute value of the number, the stronger the relationship and the greater the benefit there is to be gained by improving scores on the factor at the start of the causal chain. A negative value indicates an inverse influence on the outcome variable, that is, higher scores on one variable are associated with lower scores on the other. The model shown in Figure 1 indicates that the two main predictors of violations are Level of knowledge, with better knowledge associated with fewer violations, and Expectation by doctor, where violations were more likely if it was believed that the doctors endorse this behaviour.
Qualitative data
As mentioned earlier, 297 respondents added comments to the questionnaire. These were analysed to determine whether they supported the conclusions drawn from the statistical model. A summary of the results under each variable heading follows.

Level of knowledge
The path model suggests that more knowledgeable individuals are less likely to contravene regulations. Most of the qualitative comments on this variable focused on broad aspects of training rather than on the link between training and violation behaviour. However, the comments did highlight some knowledge issues for rural and remote nurses:

Associating with different and unfamiliar drugs at times and ward being so busy, one administers without full knowledge of all [information] pertaining to drugs.

Nowhere near enough time is available at work for self development in this area. All self development is attended in my own time.

Reference material
Availability of reference materials was expected to impact on violations but the path analysis indicated that the direct link was not significant. The qualitative data provided a possible explanation for the absence of this link with a number of nurses commenting that having the material on hand was one thing, having the time to access it was another:

Often there is no time to look up drugs while at work…

I would like to have the time to use the online MIMS [drug reference system] information, which is quite useful. But there are not enough computers and not enough time to access it.

Workload
The path model shows that workload has both a direct and an indirect effect on violation behaviour. Qualitative comments were received from 71 nurses regarding workload, staffing levels and skill mix. Comments strongly supported the conclusion that workload issues were impacting on the nurses’ ability to work safely, for example:

Mistakes happen because time frames to complete tasks safely become ridiculous and miscalculations may be done … disruptions happen trying to do too many things at once. Interruptions occur all the time.

The current skill mix requires that staff often work above and beyond their expected role.

Expectation by doctor
The path analysis indicated that doctors’ expectations had a direct effect on the number of violations. The importance attached to this variable is reinforced by the qualitative data, with 29 respondents commenting on how issues relating to doctors’ expectations impacted on their ability to work within the Regulation. These circumstances often involved emergency situations or referred to after-hours situations when doctors were less available:

Several MOs [medical officers]... never provided documentation... expected you to make judgment calls re S4 [restricted drugs] meds at night...would get very short/hostile if woken for ‘trivial matters’.

I am the only nurse...the doctors do expect me to work outside my scope of practice sometimes, usually during an emergency.

Comments such as the following suggest that nurses perceive doctors in rural and remote areas to be overworked:

In our area we have approximately 4000 people who are serviced by one GP/Medical Superintendent. He is on call 24 hours a day. The number of doctors available in our district is totally inadequate – they have too many demands made on them ... Nurse is obligated to fill the gap left by doctors.
Figure 1. Structural model of relationships between organizational factors and violations. Note: Q2.5a = My knowledge of medications and how they work is adequate for my current level of practice. Q2.5b = I am able to explain to my patients, in terms they can understand, how the medications they receive work. Q2.5c = I am able to explain to my patients, in terms they can understand, the major side-effects of the medications they receive. Q2.5d = I have easy access to up-to-date reference material with regard to the administration and supply of medications. Q2.5e = The reference material supplied in my health facility is adequate to maintain my competence with regard to the administration and supply of medications. Q2.5f = In my workplace, I have easy access to the Queensland Health (Drugs and Poisons) Regulation 1996 and its amendments. Q3.4c = The workload in my facility is excessive. Q3.4d = The staffing levels in my facility are inadequate.

Violations

The quantitative data (Table 1) indicated a less-than-ideal compliance with legal and best-practice guidelines. This observation was supported by some of the comments; for example, a total of 94 comments such as the following were received:

Small hospital... one doctor. Common practice to initiate, administer, and supply meds without MO order.

I do this in the best interest of the patients. I do this only when it is within the scope of my knowledge and skills. It is done when a doctor is not readily available and it is unreasonable to expect patient to wait or suffer unnecessarily... this practice is done with the knowledge and concurrence of the medical superintendent. My concern is that it is not according to the letter of the law and I will be deregistered if caught.

The following quote sums up the general feeling and difficulties faced by nurses working in rural and remote areas:

It is very difficult for all staff to exactly follow the rules of the Regulation at all times. Pressure of workload; small numbers of GPs; emergency situations lead to staff doing what is best for the patient at the time even if it is outside the guidelines. Nobody deliberately flouts the rules, but staff know that the GPs would ‘burn out’ if they were called every time someone presents to the hospital after hours.

Discussion

The statistical model accounted for a reliable 19% of the variance in self-reported violations. In Cohen’s (1988) terms, this is a large effect size. Higher level of knowledge was found to be associated with lower levels of violations. This variable therefore acts as a buffer against unsafe practices. This finding is in line with previous research which suggests that a lack of knowledge is one of the most common system failures contributing to unsafe practices (e.g. Leape et al. 1995,
Meurier et al. 1997, O’Shea 1999, Meurier 2000). Conversely, higher workloads and lower staffing levels and higher expectations by doctor were associated with a higher incidence of violations. In addition, an indirect pathway was found linking Workload with Expectation by doctor and Violations. Our interpretation of this indirect pathway is that the busier everyone becomes, the more doctors expect nurses to work outside regulations; a situation that leads directly to more violations by nurses. Previous research supports these results (e.g. Gladstone 1995, Meurier et al. 1997, Meurier 2000, McGillis Hall et al. 2004); for example, in a study of inter-professional relationships between doctors and nurses, Snelgrove and Hughes (2000) found that work pressures often led to informal crossing of boundaries, that is, nurses making decisions about treatment without consulting a doctor. In addition, McGillis Hall et al. (2004) found that units that employed a lower proportion of professional nursing staff had a higher number of medication errors and wound infections.

Our findings re-emphasize the importance of traditional buffers against errors and procedural violations, such as good training and adequate resourcing. In that sense, these findings can be generalized to any health region where budget constraints might force less than optimal resourcing. In addition, our findings highlight the role of factors that often fail to receive adequate recognition, such as geographical context. The rural and remote area nurses, who participated in this study, work under constraints that are not found in larger, urban health centres (Hegney et al. 1997). Foremost among these constraints is the lack of availability of doctors always to give formal approval for necessary medication procedures and the perception that nurses are expected to carry out the procedures without approval.

The shortage of doctors in rural Australia is a widely recognized problem in the health sector and, similar to other developed countries, there has been a great deal of discussion on the impact of this shortage on the healthcare system, especially in terms of availability of services and the need to introduce an advanced practice role for nurses (Hegney 1998, Caplin-Davies & Akehurst 1999, Byrne et al. 2000). However, we also need to recognize the impact that the shortage has on work practices. Given the longevity of the doctor-shortage problem, nurses should be given specific advice on how to handle the kinds of situations described in this study. In 1997 the Queensland Government changed the Regulation to allow rural and remote area nurses, who had undergone additional training, to administer and supply restricted and controlled drugs, as listed in a drug formulary, without the need to contact a doctor. This change is a step in the right direction. However, at the time of our study, there were few RNs who had gained this rural and isolated practice endorsement.

Study limitations

Further research is required to establish whether the findings from the current study can be generalized to other hospital environments. This research was carried out predominantly in public sector hospitals in rural and remote areas. Although this is a diverse population, it is unclear whether these findings are limited to this particular sample. Despite the attempt to achieve a representative sample through a stratified sampling technique, the 31% response rate was also less than desirable, perhaps limiting the strength of relations observed in the present study because of restriction in range. The cross-sectional nature of the present study is a further limitation; longitudinal data would certainly help to verify the causal mechanisms that are being promoted here.

Conclusion

Attempts to deal with deviations from work procedures through interventions such as retraining or disciplinary action are likely to be ineffective when dealing with a well-qualified and highly motivated workforce (Reason 1994, Sexton et al. 2000). A more holistic management approach is required, which targets several areas: the individual, the team, the task, the workplace and the institution as a whole (Moray 1994, Reason 2000). Within this holistic framework, however, interventions work better if effort is directed at the weaker points in the system. The findings of studies such as ours increase knowledge of the factors influencing violations and errors and, by defining appropriate targets for interventions, therefore have the potential to contribute to a safer health-care system. These interventions may take the form of training programmes, systems redesign, or the injection of resources. The last of these may be the hardest to realize but, from a human factors viewpoint, we argue that the costs of providing adequate resources to
a healthcare system will be offset by savings gained through worker productivity, better outcomes for patients, and the knowledge that we are a society that not only knows how to develop and maintain complex medical technologies but also how to build and manage healthcare systems that capitalize on these technologies.

What is already known about this topic

- Medication errors are a leading cause of unintended harm to patients.
- The traditional approach to reducing the frequency of error in healthcare has been to retrain and possibly punish the individual who carried out the unsafe act.
- A more effective approach is to look at the conditions under which individuals work and, where appropriate, change the system.

What this paper adds

- Organizational variables, such as expectations of others, can lead to unsafe work practices.
- Variables that can be targeted in interventions designed to improve compliance with best practice standards in medication administration include educational programs, systems design and allocation of resources.
- A systems approach is valuable because it concentrates on the conditions under which people work and tries to build in defenses to prevent unsafe behaviour.

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Author contributions

GF and CM were responsible for the study conception and design and drafting of the manuscript. CM, DH and GF performed the data collection and data analysis. DH and CM obtained funding and provided administrative support. GF and CM provided statistical expertise. GF and DH made critical revisions to the paper. GF and DH supervised the study.

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