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Non-Therapeutic Medication Omissions: Incidence and Predictors at an Australian Hospital

Sharon L Latimer, Wendy Chaboyer, Tony Hall

ABSTRACT

Background: The inconsistent definition of non-therapeutic medication omissions, under-reporting, and a poor understanding of their associated factors hamper efforts to improve medication administration practices.

Aim: To examine the incidence of non-therapeutic medication omissions among acutely ill medical and surgical adult patients; and to identify the patient-, drug- and system-related predictors of these omissions.

Method: A medication chart audit of 288 acutely ill adult medical and surgical patients admitted to 4 target wards (2 surgical and 2 medical) at an Australian hospital. Patients admitted to these wards from December 2008 to November 2009, with at least one regularly prescribed medication, were eligible. The sample was stratified according to gender, season and ward. A medication chart audit identified medication omissions, and data were collected on gender, age, length of stay, comorbidities, medication history and clinical pharmacy review.

Results: Of the 288 medication charts audited, 220 (75%) had one or more medication omissions. Of the 15 020 medication administration episodes, there were 1687 omissions, resulting in an omission rate per medication administration episode of 11%. Analgesics and aperients were the most frequently omitted medications, with failure to sign the medication record and patient refusal, the main reasons for omission. Female gender ($p < 0.001$) and the number of medication administration episodes ($p < 0.001$) were statistically significant predictors of non-therapeutic medication omissions.

Conclusion: The high incidence of medication omissions suggests there is need for an agreed definition of medication omission and its inclusion as a reportable incident. Increasing medication reconciliation via implementation of the Medication Management Plan may also reduce the opportunity for error.

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INTRODUCTION

Patient safety is a priority for hospital administrators and health professionals.¹⁻³ Medication administration is central to contemporary patient management, and is the second most frequently performed nursing activity in many hospitals.^{4,5} In Australian hospitals, medication error is the second most frequently occurring incident, with patient falls rating as number one.⁶ Until recently, little was known about the incidence of medication error and omission. The Institute of Medicine's report *To Err*

is Human: Building a Safer Health System estimated that up to 98 000 patients die annually in US hospitals because of medication errors.² In Australia, there are approximately 190 000 medication error related hospital admissions per year at a cost of \$660 million.⁶

In patient safety reports, medication administration is identified as a high-risk activity, although how this relates to medication omissions is less well known.⁷ Risks to patients' include medication duplication, omission and dosing errors.⁷⁻⁹ Increased polypharmacy associated with the ageing population, and chronic disease, further compounds this issue.^{10,11} Medication omissions are the most frequent medication error, with acutely ill patients being vulnerable.^{6,12} Medication errors are under-reported, with omissions accounting for 2% to 79% of all medication errors.^{6,10,12} In recent Australian studies, 81% of all identified medication errors are reported to be omissions, with 86% of omitted medications placing patients at some risk of harm.^{8,13} These results are mirrored internationally.^{10,14}

The aim of this study was to examine the incidence of non-therapeutic medication omissions among acutely ill medical and surgical adult patients; and to identify patient-, drug- and system-related predictors of these omissions.

METHOD

A medication chart audit was used to collect data on the incidence and possible predictors of non-therapeutic medication omissions. Ethics committee approval was obtained from Griffith University and Gold Coast Hospital Human Research Ethics Committees. Adult patients at the 450-bed Gold Coast Hospital were eligible if they were admitted to the four target wards (2 medical and 2 surgical) over the 12-month (1 December 2008 to 30 November 2009) study period.

Using an average length of stay of 3 days, it was estimated that 7680 admissions would occur across the four target wards during the study period. It was estimated that a sample size of 288 would provide 15 000 to 22 000 medication prescriptions and provide sufficient opportunities for medication omissions. The sample size for multivariate regression analysis was calculated by allowing nine cases per stratum, providing sufficient power analysis. A random sample of 288 patients, stratified according to gender, season and ward were used. Inclusion criteria were patients aged 18 years and over; admitted to one of the four target wards; and prescribed at least one regular medication. Patients were only included once in the sample and for patients with multiple admissions, their most recent admission was included. Prescriptions were excluded if they were: once-only and variable dose medications; telephone orders; intravenous and subcutaneous continuous infusions; *pro re nata* (as required) and nurse-initiated medicines, because these are not regularly prescribed medications.

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A non-therapeutic medication omission was defined as a medication dose not administered before the next due dose. The absence of a signature or the presence of a tick (✓) on the medication chart were defined as omissions due to the lack of administration accountability.⁸ A tick (✓) is not an accepted abbreviation of the organisation, nor is it one of the National Inpatient Medication Chart's (NIMC) omission codes. A therapeutic medication omission was defined as a medication not administered based on clinical decisions documented in the medical notes. Therapeutic medication omissions were not included in the analysis.

The study by Warne et al.¹⁰ and the NIMC informed the audit tool design. Eight NIMC codes (A = absent; F = fasting; L = on leave; N = medication not available; R = patient refused; S = self-administered; V = vomiting; W = withheld) and three additional codes were adopted (Nil = no reason or signature; Acc = no route access [intravenous]; T = tick [✓] instead of a signature). Data were collected on nine possible predictors: three patient-related (age, gender, number of comorbidities), two drug-related (medication history, medication administration episodes), and four system-related (clinical pharmacy review, length of stay, season, ward).^{6-8,10,11} During data collection, the medical records and clinical notes were reviewed to determine if the identified medication omission was supported by documented clinical decision-making (e.g. aperients withheld due to diarrhoea). If evident, the omissions were deemed therapeutic and not included in the analysis.

The characteristics of the first medication omission experienced by a patient were analysed (this type of analysis was used in a similar study).⁷ De-identified data were entered into the Statistical Package for the Social Sciences (version 17). Descriptive statistics were performed to describe the sample and identify the incidence of medication omission. A model building approach was used to identify the significant predictors ($p < 0.05$) of medication omissions. Chi-square analysis was used to test for association between individual variables and the outcome – medication omission. All significant variables from the chi-square analysis were then entered as predictors in the multivariate logistic regression analysis. Only variables that were significant ($p < 0.05$) were then entered into a second multivariate

logistic regression analysis, to develop a parsimonious predictive model of medication omission.

RESULTS

The randomly selected sample ($n = 288$) was drawn from a population of 5654 patients admitted to the four target wards during the study period. Two hundred and twenty (76%) patients experienced more than one medication omissions; more females ($n = 122$; 55%) than males ($n = 98$; 45%) comprised this group. The age range was 18 to 95 years (mean 61.3; SD 20.9) and half ($n = 147$; 51%) were over 65 years of age. The highest incidence of omissions ($n = 116$; 40%) occurred in this older age group (Table 1).

Table 1. Patient characteristics

Patient characteristics	Medications omitted (n = 220)	No medications omitted (n = 68)	No. of patients (n = 288)
<i>Gender</i>			
Male	98 (34%)	46 (16%)	144 (50%)
Female	122 (42%)	22 (7.6%)	144 (50%)
<i>Age (years)</i>			
18-24	8 (2.8%)	6 (2.1%)	14 (4.9%)
25-34	20 (6.9%)	5 (1.7%)	25 (8.6%)
35-44	20 (6.9%)	11 (3.8%)	31 (11%)
45-54	27 (9.4%)	11 (3.8%)	38 (13%)
55-64	29 (10%)	4 (1.4%)	33 (12%)
≥ 65	116 (40%)	31 (11%)	147 (51%)
<i>Length of Stay (days)</i>			
1-2	70 (24%)	50 (17%)	120 (42%)
3-4	46 (16%)	9 (3.1%)	55 (19%)
5-7	51 (18%)	6 (2.1%)	57 (20%)
8-10	27 (9.4%)	3 (1%)	30 (10%)
≥ 11	26 (9%)	0	26 (9%)

On average, patients had 2.8 comorbidities, with half reporting more than 3 comorbidities ($n = 146$; 51%), and the majority having up to 5 comorbidities ($n = 256$; 89%).

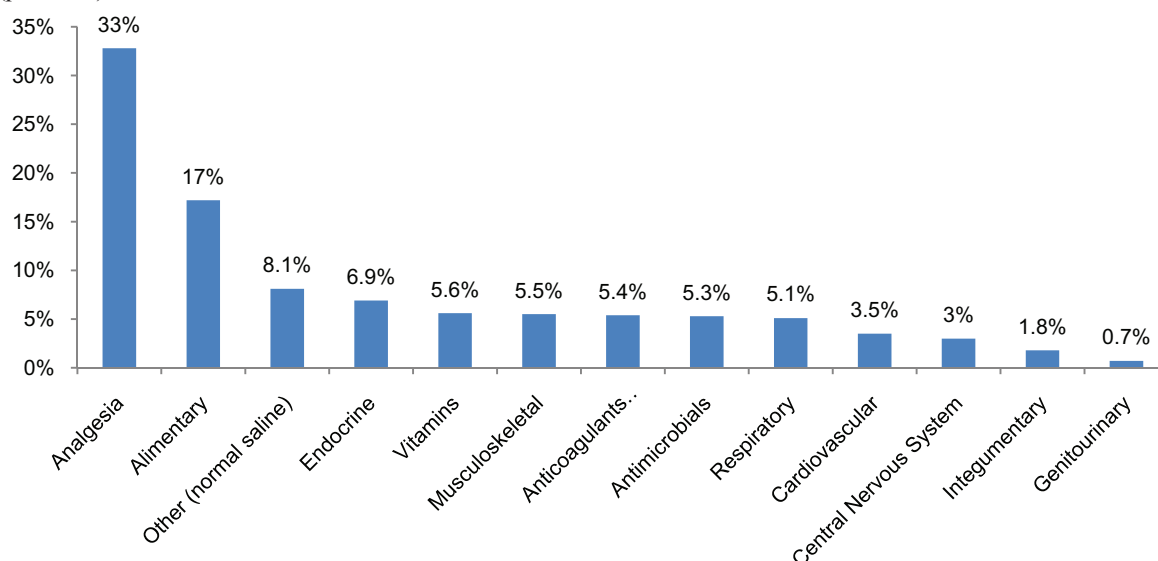


Figure 1. Medication classification of the 1687 identified medication omissions.

Of the 2095 medications prescribed that resulted in 15 020 medication administration episodes, 1687 non-therapeutic omissions were identified, representing an omission rate per medication administration episode of 11% or an average of 5.8 (SD 7.9) omissions per patient. The 1687 non-therapeutic medication omissions were classified according to the *MIMS* (Figure 1).

Analgesics (simple analgesics and opiates) were the most frequently omitted medications (33%) with alimentary medications (17%) the second most frequently omitted medications (Figure 1).

The characteristics of the first omission were examined for statistical significance. There was strong statistical significance ($\chi^2 = 57$; $df = 5$, $p < 0.001$), between the number of medication administration episodes and an omission. Patients with more than 25 medication administration episodes ($n = 146$; 66%) were more likely to experience an omission compared to those with fewer medication administration episodes. The number of comorbidities did not increase the likelihood of an omission ($\chi^2 = 2.9$, $df = 4$, $p = 0.6$).

Of the drug-related factors, most patients experiencing an omission did not have a medication history ($n = 169$; 77%) completed by the clinical pharmacist. However, there was no statistical significance between completion of a medication history by the clinical pharmacist and a medication omission ($\chi^2 = 0.5$, $df = 1$, $p = 0.5$). The absence of a signature or the use of an NIMC code ($n = 65$; 30%) on the medication chart, were the main reasons for the first medication omission. Patient refusal ($n = 55$; 25%), medication unavailability ($n = 38$; 17%) and withholding a medication ($n = 27$; 12%) without a documented clinical reason, were the subsequent reasons for omissions. Of the patients requiring to fast for a procedure, 5.9% ($n = 13$) had medications omitted without a documented medical order. In 5.5% ($n = 12$) of first medication omissions, the presence of a tick (✓) on the medication chart was identified as omissions. Finally, a lack of access, either intravenous or gastrointestinal, accounted for 2.3% ($n = 5$) of first medication omissions experienced by a patient.

Of the first omission experienced by a patient, oral medications ($n = 162$; 74%) were the largest group, with the remaining 26% ($n = 58$) of omissions distributed across six other routes of administration. Intravenous ($n = 24$; 11%) and subcutaneous ($n = 20$; 9.1%) routes were the second and third, routes omitted, with antimicrobials and anticoagulants the main medications involved.

Of the system-related factors, patient's length of stay ranged from 1 to 31 days (mean 4.8; SD 4.7). For patients experiencing more than one medication omissions, over two-thirds ($n = 150$; 68%) had a length of stay of 3 days or more (Table 1). The frequency of omissions were closely distributed across the four seasons, with no statistical association ($\chi^2 = 2.3$, $df = 3$, $p = 0.5$) between medication omission and season. The majority of patients ($n = 182$; 83%) experiencing an omission did not have their medication chart reviewed by a clinical pharmacist. There was no statistical significance between these factors ($\chi^2 = 2.1$, $df = 2$, $p = 0.4$).

The overall predictive model was statistically significant ($\chi^2 = 102$, $df = 22$, $p < 0.001$). Two independent variables, gender and medication administration episodes, were statistically significant in predicting the likelihood of medication omission. Table 2 represents the results for predicting the probability of a patient experiencing a non-therapeutic medication omission.

Table 2. Multivariate logistic regression results: predicting the probability of a patient experiencing a medication omission

Predictor	B (SE)	Wald*	Odds ratio	P-value	95% CI
Gender (male)	1.05 (0.32)	10.78	2.86	0.001	(1.53-5.34)
Medication administration episodes	0.04 (0.08)	26.07	1.04	0.001	(1.03-1.06)
Constant	0.48 (0.29)	2.78	1.62	0.096	

Model (likelihood ratio) chi-square = 69.06, $df = 2$, $p < 0.001$.

B = coefficient for the constant in the null model. CI = confidence interval. SE = standard error around the coefficient for the constant.

*Evaluates the significance of predictors in logistic regression

This final predictive model was statistically significant ($c^2 = 69$, $df = 2$, $p < 0.001$). When compared to males, females were almost 3 times more likely (OR 2.9; 95%CI 1.5–5.3) to experience a medication omission. Medication administration episodes increased the likelihood of a patient experiencing a medication omission (OR 1.04 95%CI 1.0–1.1). For each additional medication administration episode, a patient has a 4% increased likelihood of experiencing a medication omission.

DISCUSSION

Medication omissions fall under the broad category of medication errors. Recent studies report omission rates per patient ranging from 26% to 79% and our study found an omission rate per patient of 76%.^{10,15} In our study, the omission rate per medication dose was 11% suggesting 1 in every 9 doses were omitted. A finding supported by recent studies.^{8,10}

In our study, analgesics and alimentary medications were the most frequently omitted, possibly suggesting pain and bowel management strategies at the research site may need reviewing. These findings are supported by studies from Australia and the UK.^{8,10} Unexpectedly, 92 doses (5.4%) of subcutaneous anticoagulants (heparin, enoxaparin) were omitted without a valid documented clinical reason. These omissions are difficult to explain, especially when the doses were refused by the patient or withheld by the nurse. Current prescribing practices, poor knowledge of potential patient harm, a lack of patient understanding, and reduced reporting of patient refusal may explain these results.¹⁰

Drug unavailability has been reported as the foremost reason for medication omission.^{12,13,15} In our study, the principal reasons for omissions were the absence of a medication chart signature and patient refusal. During data collection, the notation 'all medications administered' was frequently observed in the medical notes, but the medication chart revealed numerous omissions, making it difficult to ascertain which document was accurate. The absence of a signature may in part be a 'failure to document' due to distractions rather than a genuine medication omission.¹⁶ The major issues of concern relate to an increased risk of patients receiving additional medication doses, coupled with a lack of administration accountability.⁸ Our study supports the development of visual reminders, such as 'Have you signed your chart?' stickers, to change clinician behaviour.^{17,18}

We also found that pharmacological and manual thromboprophylactic measures were simultaneously prescribed on the medication chart, with only one space for the signature. If the signature was absent, it was assumed both measures were omitted, which may not have been the case. Implementation of the Venous Thromboembolism NIMC with two separate orders for pharmacological and manual thromboprophylactic measures, will assist clinicians to know, with greater certainty, which drugs have been administered.¹⁹

Of the first medication omission experienced by a patient, the intravenous route was the second most frequent route of omission. A lack of intravenous access was the reason medications were omitted via this route, suggesting poor timely replacement of the intravenous device by staff. Antimicrobials were mostly involved in this route of omission.

The vast majority of patients and more than three quarters of patients experiencing a medication omission did not have a medication history completed by a clinical pharmacist. Medication reconciliation reduces the opportunity for medication errors, although accurate information from health professionals and patients impacts on the robustness of the reconciliation process. Some studies report that clinical pharmacy services have a direct impact on clinical and economic outputs, such as reduced medication errors and patient mortality rates.^{4,20,21} Our study found low rates of clinical pharmacist medication histories, but this variable was not statistically significant. Despite this, implementation of the Medication Management Plan will provide a systematic approach towards medication reconciliation, reflecting the Pharmaceutical Society of Australia's practice standards.^{16,22} This strategy should increase medication history completion rates by the multidisciplinary healthcare team.

Of the data collected on the nine possible patient-, drug- and system-related predictors, two significant predictors of omissions were identified: medication administration episodes and female gender. Medication administration episodes were a statistically significant predictor of omissions, i.e. as the number of medication administration episodes per patient increased, so did the likelihood of omission. Numerous contributing factors have been identified and include polypharmacy; prescribing practices; and system, individual and organisational failures.^{9,10,23}

Gender too, was a statistically significant predictor of medication omission with females experiencing an increased likelihood of omissions. One-third of females in our study were aged 65 years and over, with more than 80% having one or more comorbidities. These factors often result in polypharmacy, and possibly higher rates of omission.⁹

This study had some limitations. Firstly, only one research site was used, however, the sample size was large compared to similar studies.^{8,10,13} Secondly, medications without a signature and those with a tick (✓) were assumed to have not been administered and this may have not been the case. Finally, many of the results are representative of the first medication omission experienced by a patient with extrapolation to subsequent omissions questionable.

In conclusion, the high incidence of medication omissions suggests there is need for an agreed definition of medication omission and its inclusion as a reportable incident. Increasing medication reconciliation via implementation of the Medication Management Plan may also reduce the opportunity for error.

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