The extent of medication errors and adverse drug reactions throughout the patient journey in acute care in Australia

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ABSTRACT

Aim: To provide an estimate of the numbers of medication errors and adverse drug reactions that occur along a person’s journey through their hospital stay in Australia.

Methods: A search of databases and online resources was undertaken to identify published literature on medication safety in the acute care setting in Australia from 2008 to 2013. Data on the rates of adverse drug reactions and medication errors associated with hospitalization was extracted from the published studies. This evidence was synthesized with evidence from previous reviews of medication safety in the acute care setting in Australia conducted in 2002 and 2008.

Results: Findings from the Australian literature across the two previous reviews of medication safety and the present review indicate the proportion of all hospital admissions that are medication-related is between 2 and 3%. Studies assessing medication errors on admission to hospital suggest there may be an overall rate of two errors for every three patients at the time of admission to hospital. Large studies examining the rates of prescribing errors in major Australian teaching hospitals give insight into the rates of prescription error and suggest that prescription error rates of up to one error per patient occur in the hospital system. The best available evidence from more recent research suggests that errors (excluding errors of timing) occur in around 9% of medication administrations in hospital. At hospital discharge, errors in medication documentation in discharge summaries may occur at a rate of up to two errors per patient.

Conclusions: Medication safety in the various stages of the patient journey through acute care in Australia continues to be a significant problem. However, the extent of medication-related problems in acute care needs to be interpreted within the context of increasingly complex health care. There are an estimated 230 000 medication-related hospital admissions occurring per year. This suggests an annual cost of medication-related admissions of AU$1.2 billion.

Key words: acute care, adverse drug reaction, Australia, medication error, medication safety


Background

Medications play a central role in health care and contribute to significant improvements in health outcomes when used correctly and appropriately. However, because medications are so commonly used, they are also one of the most common sources of error and adverse events in health care. Nearly all patients who are hospitalized will take at least one medication during their hospital stay. Australian and International studies indicate a high prevalence of medication-related...
problems including medication errors and adverse drug reactions (ADRs) associated with hospitalization.

Medication error can be defined as ‘a failure in the treatment process that leads to, or has the potential to lead to, harm to the patient’. Problems with medications may be the cause of a hospital admission, whereas other undesirable events occur during hospital stay. Medication errors can occur at the time of admission to hospital, when prescriptions are written, when medicines are administered, at the time of discharge and even after discharge from hospital. Examples of common types of error that occur include the following:

1. the incorrect documentation of a person’s medication history at the time of admission,
2. the prescription of an incorrect dosage of a medicine,
3. the omission of therapy when it should have been administered or administration of the wrong medicine,
4. the continuation of medicines only intended during hospital stay at discharge,
5. the administration of a medicine when there is a history of allergy or contraindication,
6. the administration of a medicine that interacts with another medicine, and
7. a lack of explanation to consumers and community health care providers of medication changes made during hospital stay that should be maintained after discharge.

A number of studies have assessed the frequency of medication errors and medication-related problems in acute care in Australia. However, few studies have synthesized the findings to provide an estimate of the numbers of errors or problems that occur at each stage across the continuum of a person’s hospital stay.

Aim

Through a review of published literature on medication safety in the acute care setting in Australia, we sought to provide an estimate of the numbers of medication errors and ADRs that occur along a person’s journey through their hospital stay.

Criteria for considering studies for this review

Criteria for inclusion of studies were that the studies addressed adverse medicine events, ADRs or medication incidents as a result of the therapeutic prescribing, dispensing and or administration of medicine. Studies about incidence of medication-related problems or harm occurring on admission to Australian hospitals, in Australian hospitals (including emergency department admissions) and on discharge from hospital were included. Studies conducted in acute care settings within Australian urban, rural or regional hospitals, or tertiary care centres were included. Studies assessing errors collected via incident reports were excluded from the analysis reported in this study.

Search strategy

Literature on medication safety in acute care published since the last major review of medication safety in the acute care setting in Australia in 2008 was identified through database searches for the time period 2008 to June 2013. The databases searched are listed in Table 1 and search terms used are detailed in Appendix 1. Reference lists of publications located through the database search were also checked to identify any further relevant studies.

The database search was supplemented with searches of relevant websites as listed in Table 1.

Data extraction

To select relevant studies or reports to be included in the review, the abstract or full paper was assessed by two independent reviewers, with any differences in opinion resolved by discussion. Data from included publications were extracted in a standardized manner by the primary reviewer and organized into a standardized table format based on that used in previous reviews of medication safety in Australia. The extracted data were then checked by a second reviewer. Data extracted included the authors, number and type of patients, location/setting, time period of the study and study type and design. Information specifically relevant to this review was also extracted, including type of medication-related problem assessed, the stage at which the medication-related problem occurred, the numbers, rates and types of medication-related problems, the severity or clinical significance of the problems or errors detected and the types of medications involved.
Results
Studies and reports examining medication errors and other medication problems were reviewed for the various stages of a patient’s hospital journey – hospital admission, prescribing of medication in hospital, administration of medication in hospital, hospital discharge and overall ADR or error rates during hospital stay. Studies relevant to each of these stages are summarized in the following sections.

Medication-related hospital admissions

Studies included
Medication-related hospital admissions have previously been estimated to comprise 2–3% of all Australian hospital admissions, with rising estimates of prevalence when sub-populations are studied, such as the population aged 65 years and over.

No new studies were located that assessed the overall rate of medication-related hospital admissions. Three studies were located that assessed the rate of ADRs or medication errors associated with hospitalization, either as a cause of admission or occurring during hospital stay (Table 2). Two of the studies were undertaken in cohorts of patients that had a hospitalization involving an overnight stay, the third in a cohort of patients with diabetes. All three studies used International Classification of Diseases (ICD) coding used in routine administrative data to examine ADR rates.

The study by Hodgkinson et al. was a retrospective observational study conducted in three Victorian public

<table>
<thead>
<tr>
<th>Study and characteristics</th>
<th>Medication-related problem assessed</th>
<th>Rate at admission</th>
<th>Rate overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hodgkinson et al., 2009 (n = 12,414, multi-centre)</td>
<td>ADRs measured by ICD codes, supported by medical record review. Limited to hospital admissions with overnight stays.</td>
<td>1.3%</td>
<td>3.3%</td>
</tr>
<tr>
<td>Hauck and Zhao, 2011 (n = 206,489, multi-centre)</td>
<td>ADRs and medication errors based on ICD coding. Modeled rate is for a 2-day stay. A 0.5% increase in risk for each additional day.</td>
<td>Not assessed</td>
<td>3.4%</td>
</tr>
<tr>
<td>Claydon-Platt et al., 2012 (n = 9,530, single centre)</td>
<td>ADRs and medication errors based on ICD coding. Limited to diabetes population.</td>
<td>1.7%</td>
<td>7.2%</td>
</tr>
</tbody>
</table>

ADR, adverse drug reaction; ICD, International Classification of Diseases.
hospitals in 2004. Data were collected from administrative records, supported by medical record review and review of the adverse reaction spontaneous reports. A total of 12,414 hospitalizations were assessed. After comparison of ADR-related ICD codes, ADR spontaneous reports and patient medical records, it was concluded that 3.3% of hospitalizations involving an overnight stay were associated with an ADR that occurred as a cause of or during admission.

Another study, also conducted in Victoria, found a very similar overall rate of ADRs. Undertaken in 2005–2006, the study employed econometric modelling with administrative claims data to determine the extent of hospitalizations associated with adverse events, including ADRs. The ADRs included were those that contributed to the cause of admission, as well as those that occurred during hospital stay. In all, 206,489 hospitalizations were included with an ADR/medication error rate of 3.4% for an overnight stay. The risk increased by 0.5% for every additional day in hospital.

A similar study using hospital administrative claims records from a Melbourne teaching hospital was undertaken as a retrospective cohort study of medication-related problems in people with diabetes. The study was conducted in 2005/2006 using the medication problems coded in routinely collected administrative data. Of the 9,530 admissions assessed, medication-related problems were documented as the cause of admission in 1.7% of cases, and as a secondary diagnosis in 5.5% of admissions. Thus, overall 7.2% of hospitalizations were associated with medication-related problems. Medication error, which included accidental overdose or hypoglycaemia, accounted for 64% of problems. This may be an under-estimate of the true extent of medication-related problems in this population, as this study relied on routinely collected data and some hypoglycaemic events may not have been coded. Since ICD codes are recorded primarily to allow health care cost reimbursement, more serious medication-related problems may be recorded in the electronic hospital record; however, less serious problems may not.

**Summary of medication-related problems as a cause of admission and hospital stay**

When considering the Australian literature collectively across the two previous reviews of medication safety (2002, 2008) and the present review, the proportion of all hospital admissions that are medication-related is between 2 and 3%. The ICD coding used in routine administrative data, although likely to under-report the true extent of the problems, provides estimates that 1.4% of admissions are likely to be due to ADRs, and this rises to 3% when considering both ADRs that occur either on admission or during hospital stays. One study has estimated that the risk of an ADR increased by 0.5% for every additional day in hospital.

**Medication errors on admission to hospital**

**Studies included**

Four studies were located that assessed medication errors on admission to hospital (Table 3). These studies assessed discrepancies between medication charts written on admission and reconciled medication lists based on interviews conducted by pharmacists or researchers not involved in the patients’ care. Consistent with previous Australian research, these studies show high levels of error with medication histories at admission where medication reconciliation is not undertaken. Two studies showed that between 60 and 80% of patients were noted to have a discrepancy with their medication history, whereas three studies reported error rates ranging from 1 to 2.5 per patient. Omission of therapy was the most common discrepancy, accounting for between 40 and 60% of errors.

**Summary of error rates on admission to hospital**

Previous Australian research on the accuracy of medication charts on admission to hospital has shown that there was one omitted medicine from the medication history among every two people admitted. Four more recently published studies included in this review provide further support for this level of error with medication charts on admission where medication reconciliation is not undertaken. Two studies showed that between 60 and 80% of patients were noted to have an error (discrepancy) with their medication history. This suggests there may be an overall rate of two errors for every three patients at the time of admission to hospital.

**Prescribing errors in hospital**

**Studies included**

Previous Australian research has reported error rates of between 5 and 11% of medicine orders. However, these estimates were from studies with small sample sizes. Four new research papers were located that document rates of prescribing errors in the Australian acute care setting. Three of these papers (Table 4) reported rates of prescribing errors as a part of studies examining the effectiveness of interventions (electronic prescribing systems or standardized paper-based medication charts). These studies provide insights into prescription error rates when these different prescribing systems are used.
### Table 3. Medication error on admission

<table>
<thead>
<tr>
<th>Study and characteristics</th>
<th>Patients assessed</th>
<th>Patients with at least one error</th>
<th>Median errors per patient</th>
<th>Extent of harm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tompson et al., 2012&lt;sup&gt;14&lt;/sup&gt; (n = 487, multi-centre)</td>
<td>Patients aged over 50 years, with at least two chronic conditions, and who took at least three medications regularly. Limited to patients admitted via the emergency department, aged over 60 years, who took four or more regular medications, and had three or more conditions or had been admitted within the previous 3 months.</td>
<td>66%</td>
<td>1</td>
<td>Not assessed</td>
</tr>
<tr>
<td>Vasileff et al., 2009&lt;sup&gt;15&lt;/sup&gt; (n = 45, single centre)</td>
<td>Not assessed</td>
<td>76%</td>
<td>2.5</td>
<td>Not assessed</td>
</tr>
<tr>
<td>Chan et al., 2010&lt;sup&gt;13&lt;/sup&gt; (n = 100, single centre)</td>
<td>Patients over 18 years brought to the emergency department by ambulance, taking at least four regular medications. Patients were not from institutional care, subsequently admitted to hospital and had not seen the emergency department pharmacist prior to the medication chart being written.</td>
<td>Not reported</td>
<td>1.5</td>
<td>Not assessed</td>
</tr>
<tr>
<td>Yong et al., 2012&lt;sup&gt;16&lt;/sup&gt; (n = 200 single centre)</td>
<td>Patients admitted through the acute assessment unit prior to admission to a medical ward.</td>
<td>Not reported</td>
<td>Not reported</td>
<td>24% of errors serious enough to cause temporary harm or require intervention (37% if on 10 or more medicines)</td>
</tr>
</tbody>
</table>

### Table 4. Prescribing errors in hospital

<table>
<thead>
<tr>
<th>Study and characteristics</th>
<th>Type of system</th>
<th>% Patients with any error</th>
<th>Any error (clinical or procedural) per patient</th>
<th>Clinical error per patient</th>
<th>Harm per patient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Westbrook et al., 2010&lt;sup&gt;17&lt;/sup&gt; (n = 27 bed unit, number of admissions not reported, single site)</td>
<td>Paper-based</td>
<td>71%</td>
<td>4.7</td>
<td>1.1</td>
<td>No serious errors</td>
</tr>
<tr>
<td>Westbrook et al., 2012&lt;sup&gt;20&lt;/sup&gt; (n = 1923 admissions, dual site)</td>
<td>Paper-based</td>
<td>Not reported</td>
<td>5.8</td>
<td>1.5</td>
<td>0.27 errors leading to increased length of stay, permanent harm or death</td>
</tr>
<tr>
<td>Coombes et al., 2011&lt;sup&gt;18&lt;/sup&gt; (n = 15 557 medication orders, multi-site)</td>
<td>Paper-based</td>
<td>85%</td>
<td>4.8</td>
<td>0.18</td>
<td></td>
</tr>
<tr>
<td>Coombes et al., 2011&lt;sup&gt;18&lt;/sup&gt; (n = 15 416 medication orders, multi-site)</td>
<td>Paper-based standardized chart</td>
<td>74%</td>
<td>3.5</td>
<td>0.14</td>
<td></td>
</tr>
<tr>
<td>Westbrook et al., 2010&lt;sup&gt;19&lt;/sup&gt; (as above)</td>
<td>Electronic</td>
<td>72.4%</td>
<td>2.05</td>
<td>1.05</td>
<td></td>
</tr>
<tr>
<td>Westbrook et al., 2012&lt;sup&gt;20&lt;/sup&gt; (n not reported, dual site)</td>
<td>Electronic</td>
<td>Not reported</td>
<td>1.64</td>
<td>1.4</td>
<td>0.14 errors leading to increased length of stay, permanent harm or death</td>
</tr>
</tbody>
</table>
Collectively, these studies show that prescribing errors are common using paper-based systems in hospitals, at a rate of approximately five per patient; however, these are predominantly procedural errors (errors of documentation such as the unclear prescriptions, missing signatures, route of administration missing). When only clinical errors are considered, rates of up to 1.0–1.5 errors per patient are reported. Slightly lower levels of error were reported with the use of a standardized medication chart18 (Table 4). Two studies also show overall prescribing error rates with electronic prescribing systems of approximately two per admission, about half of that which was observed with paper-based systems19,20 (Table 4).

Procedural errors were less common in studies in which electronic prescribing was used compared to paper-based systems. The rate of clinical errors was similar for paper-based and electronic systems when compared in the same institutions (Table 4). The largest study, across 22 sites using paper-based systems, reported lower clinical error rates.18 This may be due to differences in patient mix, such as illness severity. The studies with higher clinical error rates were located in wards of major teaching hospitals. The effect of electronic prescribing on serious errors was only reported in one study,20 in which the electronic prescribing system also included decision support, suggesting decreased serious error rates with this system.

### Summary of prescribing error rates in hospital
Clinical prescribing errors are reported at rates of up to 1.0–1.5 errors per patient.

### Medication error during medication administration in hospital

#### Studies included
In the previous reviews of medication safety in the acute care setting,4 we found that administration errors varied with the type of system in place. When errors of timing were excluded, we found the clinical administration error rate (such as omission of therapy, wrong dose) was between 5 and 8% of medication administrations where individual patient supply systems were in use and rose to 15–18% of medication administrations when ward stock systems were in place.4 The majority of this evidence was from studies undertaken in the 1990s.

Three new studies were located that examined error rates associated with medication administration,21–23 with one further study examining errors for administration of intravenous fluids.24 Two of these studies used a direct observational method to detect administration errors23,24 and provide the best estimates of error rates. These are summarized in Table 5.

The study of Westbrook et al.23 conducted in two major teaching hospitals in New South Wales found around 9% of medication administrations were associated with a clinical error (excluding timing errors). This study also assessed how the medication error rate varied according to interruptions at the time of administration. With each interruption, there was a 12% increase in the likelihood of a procedural error and a 13% increase in the likelihood of a clinical error.

In the observational study of intravenous administration errors,24 wrong infusion rates accounted for 95 out of 101 serious errors. Bolus administrations were more likely to be associated with more serious error (23% compared with 10.6% for other types of intravenous administration; \( P < 0.0001 \)). Error rates with infusion pumps were similar to error rates by other methods; however, no detail was provided on error rates with infusion pumps that included software that had hard alerts (that do not let the operator over-ride alerts such as maximum doses or flow rates). Nurse experience was associated with error, with the risk of error highest for newly registered nurses.

### Table 5. Observational studies of administration errors in Australian hospitals

<table>
<thead>
<tr>
<th>Study and characteristics</th>
<th>Design</th>
<th>Any error (clinical or procedural) per administration</th>
<th>Clinical error per administration</th>
<th>Harm per patient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Westbrook et al., 201023 ( n = 98 ) nurses administering 4271 medicines to 720 adult patients, dual site</td>
<td>Participant observation</td>
<td>80%</td>
<td>25% (8.9% when timing errors excluded)</td>
<td>11% of clinical errors causing increased length of stay, permanent harm or death</td>
</tr>
<tr>
<td>Westbrook et al., 201124 ( n = 107 ) nurses preparing and administering 168 i.v. medicines, dual site</td>
<td>Participant observation</td>
<td>Not reported (74% procedural)</td>
<td>70% (bolus administrations 77%, other i.v. 48%)</td>
<td>25.5% increased length of stay, surgical intervention or permanent harm (bolus = 23%, other i.v. = 11%)</td>
</tr>
</tbody>
</table>

i.v., Intravenous.
In addition to the observational studies summarized in Table 5, one study of 288 patients in a Queensland hospital used retrospective medication chart review to identify medication omission rates identified by the absence of a signature on the medication chart. An average number of 5.8 omissions per patient were identified. However, the retrospective nature of this study limits conclusions that can be drawn about the true rate of medication omissions. Another study across 19 hospitals used patient record review and incident reporting to examine administration error rates as part of a larger study. Medication errors were found to have occurred in 16% of patients, with errors of timing of administration the most common error type. However, as this study was limited to detecting errors that were documented in the patient record or incident systems, it is likely to have under-estimated the true error rate.

Summary of administration error rates in hospital
Previous literature reviews have suggested administration error rates in Australian hospitals of between 5 and 18%, depending on the medication supply system used. The best available evidence from recent research suggests that administration errors (excluding errors of timing) in Australian hospitals occur in around 9% of administrations. Collectively, this evidence equates to an error rate of approximately 1 error per 10 medication administrations in hospital.

Medication error on discharge
Studies included
Previous Australian studies assessing the accuracy of medication discharge summaries undertaken in the late 1990s revealed that, on average, one medicine was omitted per discharge summary. Three new studies were located that examined medication errors in discharge summaries, with two of these studies examining the error rates between handwritten and electronic discharge summaries. These studies are summarized in Table 6.

In one of the studies that examined both handwritten discharge summaries (which required doctors to transcribe medications from the medication chart) and electronic discharge summaries (that still required doctors to manually type prescriptions), the most common type of error in both systems was ‘medication omitted’. An additional medicine listed was the next most frequently detected error. Error rates were equally common whether the discharge summary was written by the intern, resident medical officer or registrar.

In the study that assessed discharge summaries for elderly patients, a review of communication of changes to medicines that occurred during the hospital stay found only half of the changes to regularly scheduled medicines and only a quarter of the changes to medicines scheduled ‘as required’ were documented in the discharge summary.

Summary of error rates on hospital discharge
The two studies from a small metropolitan hospital suggest that around 12–13% of discharge summaries contained a discrepancy (error), whereas the study from a large teaching hospital assessing patients discharged to aged care found 80% of discharge summaries contained a discrepancy (with a rate of two errors per patient), which is similar to the proportion reported in previous Australian literature.

<table>
<thead>
<tr>
<th>Study and characteristics</th>
<th>Type of discharge summary</th>
<th>Any error per discharge summary</th>
<th>Error per patient</th>
<th>Harm per patient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Callen et al., 2010&lt;sup&gt;25&lt;/sup&gt; (n = 966, 78 bed hospital single site)</td>
<td>Handwritten</td>
<td>12%</td>
<td>Not reported</td>
<td>Not reported</td>
</tr>
<tr>
<td>Callen et al., 2010&lt;sup&gt;25&lt;/sup&gt; (n = 842, 78 bed single site)</td>
<td>Electronic (not linked to in patient system)</td>
<td>13%</td>
<td>Not reported</td>
<td>Not reported</td>
</tr>
<tr>
<td>Callen et al., 2008&lt;sup&gt;26&lt;/sup&gt; (n = 94, 78 bed hospital single site)</td>
<td>Paper</td>
<td>6%</td>
<td>Not reported</td>
<td>Not reported</td>
</tr>
<tr>
<td>Callen et al., 2008&lt;sup&gt;26&lt;/sup&gt; (n = 151, 78 bed hospital single site)</td>
<td>Electronic (not linked to patient system, only doctors trained in system could use it)</td>
<td>13%</td>
<td>Not reported</td>
<td>Not reported</td>
</tr>
<tr>
<td>Elliott et al., 2012&lt;sup&gt;27&lt;/sup&gt; (n = 71, single site)</td>
<td>Paper-based. Limited to patients discharged to aged-care facilities</td>
<td>80% of those with medicines listed</td>
<td>2</td>
<td>Not reported</td>
</tr>
</tbody>
</table>
Medication error through the patient journey for an acute care admission

On the basis of evidence from previous literature reviews of medication safety in the acute care setting in Australia, as well as evidence from a review of literature 2008–2013 estimates of extent of medication-related problems including ADRs and medication errors for a typical patient in the acute care setting in Australia can be approximated. These are depicted as the medication problems occurring through the hospital journey in Australia.

Discussion

Since the last review of medication safety in the acute care setting in Australia in 2008, there is now a stronger research base examining the types and extent of errors and ADRs occurring at various stages of the patient journey through hospital. Through this review, we sought to synthesize this more recent evidence with previous reviews of medication safety in acute care in Australia to provide a picture of the numbers of undesirable medication events that occur during the various stages of the acute care hospital stay – as illustrated in Fig. 1.

When considering medications as a cause of hospital admission, collectively, the literature reviews of medication safety in Australia suggest the proportion of all hospital admissions that are medication-related is between 2 and 3%. There were 9.3 million separations from Australian hospitals in 2011–2012, which would suggest a medication hospital admission rate in Australia of 230 000 annually. With an average cost per separation in 2011–2012 of $5204, this suggests the annual cost of medication-related admissions is AU$1.2 billion.

Transitions from one health care setting to another are known to be a point of vulnerability for medication management. This includes hospital admission and discharge. Data from studies examining the accuracy of medication history on admission add to the evidence base, suggesting high levels of errors with medication histories at admission where services providing medication reconciliation are not provided. Likewise, at hospital discharge, studies have suggested high rates of medication discrepancies in discharge summaries. Although the reported rates do vary, the literature suggests up to two errors per patient may occur in discharge summaries, with the highest rate reported for older patients being discharged to aged care.

Large studies examining the rates of prescribing errors in major Australian teaching hospitals, and comparing different prescribing systems, give better insight into the rates of prescription error and the effects of interventions including electronic prescribing. These studies suggest that prescription error rates of up to...
Conclusion

Medication safety in the acute care setting in Australia still represents a significant challenge. Understanding where medication errors occur and the contributing factors can assist in the development of strategies to improve medication safety. Tackling this issue will require an ongoing commitment and coordinated effort by government, health professionals, consumers, researchers and health services. There is a need for ongoing study of the rates of medication errors occurring at different stages in the acute care setting, so that progress and developments can be monitored.

References


Appendix 1 Search terms used in database searches
To identify publications about incidence of medication-related problems the following terms were used (phrase followed by / denotes subject heading, " denotes a truncation in a keyword search): Medication Errors, Medication Reconciliation/ Medical Errors, Diagnostic Errors/ Safety Management, Quality of Health Care; Drug Toxicity/; Quality Assurance, Health Care/ patient’ safety; medication’ safety; patient’ safety; Adverse Drug Events/; adverse drug event"; adverse drug react"; medication mishap"; medica” incident"; medica” mishap"; medica” mistake"; medica” misadventure"; drug misadventure"; drug’ toxicity; medication related harm"; medication related incident"; medication related problem"; medication reporting system”; pharmaceutical reporting system”; medica” prescri” error”; drug’ prescri” error”; prescri” error”; medica” dispensing error”; drug’ dispensing error”; dispensing error”; medication” administra” error”; drug” administra” error”; administra” errors”; medication” related admission”; drug related admission” or patient transfer; key words above and incidence; prevalence; rate”; Drug Substitution/; therapeutic shift”; brand substitution”; generic substitution.”

The literature was restricted to studies in the Australian healthcare setting using the terms: Australia/ or Australian Capital Territory/ or New South Wales/ or Northern Territory/ or Queensland/ or South Australia/ or Tasmania/ or Victoria/ or Western Australia/ or Australia or Victoria or Tasmania or New South Wales or Queensland or Australian Capital Territory or Australia".

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