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Degree: MASTER OF CLINICAL PHARMACY

Department: PHARMACY

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MEDICATION HISTORIES AND THE IDENTIFICATION
OF ADVERSE DRUG EVENT-RELATED
HOSPITAL ADMISSIONS

by

R.P. Cooke

A dissertation submitted in partial fulfilment of the
requirements for the degree of
MASTER OF CLINICAL PHARMACY
at the University of Otago, Dunedin
New Zealand
2004
BACKGROUND: Drug-related problems are a common cause of admission to hospital. Medication histories are traditionally taken in the Emergency Department but are seldom complete with OTC medications often not asked about.

AIMS: To determine the accuracy of medication histories obtained during the admission process, identify and classify any discrepancies and medications involved and ascertain the value of a full medication history in the identification of an adverse drug event (ADE)-related admission.

METHODS: A full medication history including all prescribed and over-the-counter (OTC) medication was obtained from patients admitted to an acute medical team over a three month period. The second history was compared with the history obtained during the admission process, discrepancies were classified and the drugs involved identified and classified according to British National Formulary (BNF) categories. Clarification of any doses or medications was obtained from the patient's community pharmacy. The histories of those patients with a positively identified ADE-related admission were analysed to determine any differences with the non-ADE-related admissions.

RESULTS: A total of 320 interviews were obtained. Ninety two percent of patients had taken a prescribed medication in the two weeks prior to admission, 51.7% had taken an OTC/alternative medication. The average number of medications identified in the second history was significantly higher than that identified in the first history (5.6 ± 4.31 v 4.71 ± 3.93 items p< 0.001).

A total of 669 discrepancies were found: 56.2% were omission errors, 13.4% wrong dose, 13% commission errors, 8.7% dose missing and 8.7% wrong or missing dose form. Forty five percent of histories contained one or more omissions.
The BNF classifications of the drugs associated with discrepancies most commonly involved the gastrointestinal, respiratory system, cardiovascular system and central nervous systems.

Ten percent of patients did not have any drug allergy or sensitivity data documented and the second interviews revealed 37 extra sensitivities to medication.

Fifty one percent of patients interviewed had taken an OTC/alternative medication prior to admission. Only 29 items were identified at admission, the second interview revealed 335 items, most commonly analgesics, herbal supplements, cough and cold preparations and nine traditional medications.

Thirty seven patients or 8.7% of total admissions were identified as an ADE-related admission. Patients associated with ADE-related admission were older than those with non-ADE-related admission (72±16.9 years v 62.8± 20 years p< 0.01). They also took more medications than those with a non-ADE-related admission (7.35 ± 3.75 items v 5.38± 4.34 items p<0.01). There was no significant difference in the number of discrepancies or omissions in histories between the two groups. Extra information from the second interview revealed several cases of unintentional overdose, a warfarin interaction, drug allergy and a GI bleed associated with OTC purchased aspirin, all resulting in an ADE-related admission.

CONCLUSIONS: Full medication histories can aid identification of ADE-related admission, ensure the patient receives all current medication and prevent ADEs occurring during the hospital stay.
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CHAPTER 1: INTRODUCTION

The deregulation of medicines has resulted in an increasing number of previously prescription-only medicines to be available over-the-counter (OTC) and on the supermarket shelves. The increasing sale of these items indicates a trend towards self-care and that patients are taking greater responsibility for their own health.\(^1\) Published reports state that 32-70% of the general adult population over 60 years old in England, Australia and the USA regularly use OTC medications,\(^2-6\) most commonly analgesics, laxatives and vitamin supplements. Many general practitioners are often unaware of what their patients are taking\(^7,8\), and many do not ask about OTC use.\(^9\) In addition, 12-30% of patients interviewed are regular users of complementary and herbal remedies.\(^10,11\)

The relative ease of access to OTC medications portrays the perception that these medications are safe. However, problems may arise with poor self-diagnosis, the use of inappropriate drugs, limited understanding of usage directions and drug duplication. The use of OTC products in addition to prescribed medications (polypharmacy) increases the risk of an adverse drug event (ADE) occurring. The potential for drug-OTC medication interactions to occur is well documented.\(^12-18\) Herbal products have also been associated with memory loss, dementia and hepatotoxicity and should not be considered completely safe.\(^19-21\) In addition, Kofoed and colleagues found that 80% of older daily OTC users use alcohol, prescribed drugs or both, putting them at increased risks of sedation and falls.\(^5\) The elderly are particularly at risk, not only because of their increased likelihood of underlying illness, concurrent and increased number of prescribed medication but also age-related changes in drug distribution and metabolism.\(^22\)

1.1 ADVERSE DRUG EVENTS

Many adverse drug events may result in minor problems and are not brought to a physician’s attention but it has been reported that 4.3 - 28.1%\(^23-27\) of all Emergency Department visits are drug-related. The reason for these visits may result from adverse drug reactions, inappropriate prescribing and monitoring, lack of patient education, accidental or intentional overdose, drug interactions or drug-alcohol interactions.
The incidence of adverse drug reactions (ADRs) causing admission to hospital has been regularly reported since the 1960s but varies considerably depending on the definition used. The World Health Organisation defines an adverse drug reaction as “any response to a drug which is noxious and unintended and which occurs at a dose used in a human being for prophylaxis, diagnosis or therapy”. Some authors prefer the term "adverse drug event" (ADE). This term includes clinical events due to a change in dosage, accidental overdose, drug interactions and drug-alcohol interactions. In 1998, Lazarou published a meta-analysis of 21 prospective studies on ADR-related admissions from the years 1966-1996. The overall incidence of serious ADR causing admission was found to be 4.7% with the reported ranges between 1-16.8%. Other studies not included in this meta-analysis have reported a similar incidence range of 0.76-13.3%. This variance is also due to different methodologies and how the information was obtained. Many published studies have used retrospective chart review, review of discharge summaries, stimulated self-reporting and pharmacist case review and reporting. Retrospective analysis relies only on the documented information available in records and has the disadvantage of not being able obtain confirmation of a complete medication history from the patient or General Practitioner at the time of admission and may have led to the under-reporting of ADR incidence. Many did however acknowledge the need to categorise the reason for the drug-related admission, excluding those associated with non-compliance, drug abuse, intentional overdose or therapy failure.

Ives et al commented that the patient's symptomatology is often overlooked by medical personnel as drug-related at the time of admission. This is reiterated by Nelson et al who state that in almost 20% of patients with a drug-related admission this fact is not stated in the discharge summary. A variety of definitions for causality assessment to determine "definite", "probable", "possible" or "unrelated" status is evident and some published data that has included "possible" ADRs may have led to over-estimation of ADR prevalence. Despite the publication of several algorithms, only a small number of studies used one of these as criteria for ADR confirmation. Nelson et al classified their results by both the Naranjo classification and the Hallas probability criteria. They found that while the total drug-related admission rate did not change, those classified as definite or probable did. Using the Naranjo algorithm it is difficult to classify an ADE as definite...
without rechallenging the patient with the drug whereas laboratory evidence is sufficient with the Hallas criteria. Nonetheless, the use of either algorithm reduces subjectivity and increases the credibility of these studies. Nelson also acknowledged that for some cases the clinical pharmacist's knowledge was necessary to identify some of the drug-related admissions and that while some ADEs were obvious, others required several days of hospitalisation before the cause of the admission could be determined. This also reinforces the advantage of cases being reviewed by a panel of health professionals e.g. pharmacist, pharmacologist and physician for a more objective approach rather than those decided by a single clinician or peer review.

However, there is general agreement that the incidence of ADR-related admission increases with age, increasing numbers of concomitant medications and comorbidities, being female and those that have had a previous ADR. Col et al also found that those patients who used two or more pharmacies were identified as having a higher prevalence of ADR that those using one pharmacy.

Despite the continuing development of new drug classes and therapies, the drugs primarily implicated in ADE-related admission have remained relatively consistent over the years. The most commonly involved are: antidiabetic drugs, anticoagulants, anticonvulsants, beta-blockers, ACE inhibitors, analgesics, digoxin, corticosteroids, diuretics, NSAIDs and hypnotics, sedatives and psychotropic drugs.

The pathophysiology of the typical symptoms produced by diseases and those caused by drugs may often be similar and can make the differential diagnosis difficult. In these cases, establishing the time between the administration of the drug and onset of symptoms may be useful in distinguishing between ADE and another event. Therefore recognition and identification of an ADE can be aided by the obtaining of an accurate and thorough medication history.
1.2 MEDICATION HISTORIES

Traditionally patient medication histories are taken in the Emergency Department by the admitting Medical Officer. A full drug history aids diagnosis and helps identify the reason for admission; provides the physician with the information to decide further treatment options in reference to both therapeutic and adverse responses to drugs in the past; decreases the incidence of avoidable adverse drug reactions and prevents reintroduction of a previously ineffective drug.\(^5^3\)

However, the information obtained in Emergency Departments may be incomplete. This could be for several reasons:\(^5^3,5^4\)

1. Inability to contact the general practitioner due to an “after hours” admission.
2. An incomplete medication history in a GP referral letter. This has been reported by several New Zealand studies. In 1993, Kelly reported only 38% of GP referral letters to the Emergency Department of Christchurch hospital contained medication records.\(^5^5\) A more recent study by Crausaz and Lee found that although 73% of referrals contained a medication history only 27% of all referral letters contained accurate medication histories.\(^5^6\)
3. The patient may be unable to recall the names of current medications or provide an accurate description of the medication.
4. Details are often transcribed from labels of drug containers brought to hospital but these are no longer current or accurate.
5. Patients may transfer medication into different bottles, therefore the labels do not correspond to the contents.
6. The patient may be reluctant to tell the doctor that he/she is not taking the medication as directed.
7. Self-medication may be omitted as the patient may regard it as relatively unimportant.
8. An allergic reaction may be inappropriately ascribed to a particular drug.\(^5^3\)

A second medication history may improve the accuracy of the initial history. Descriptions of methods used to obtain medication histories reported in the literature were found to be often limited and variable. Truitt et al\(^5^7\) described a review of systems (ROS) approach using a systematic listing of symptoms with corresponding drug therapy as a guide. This method did well in identifying non-prescribed medications but led to
10.8% of medications unidentifiable because it relied on patients knowing names, colour, size, marking and strengths of their medications. In comparison the "control method" used tablet containers in conjunction with information from family or caregivers. A disease-orientated approach was also taken by Dawson et al\textsuperscript{58} but the method was not elaborated on in their report. Other investigators used a structured form\textsuperscript{59,60} providing specific questions on prescribed and non-prescribed medication, a questionnaire\textsuperscript{61,62} or a combination of structured form and a series of questions.\textsuperscript{63,64} Some did not describe their method of obtaining a history\textsuperscript{65} and it has been suggested that often the individual's professional judgement was used as a guide.\textsuperscript{57} This raises the question of preventing inter-investigator variability especially if the study is conducted in a number of different hospitals.\textsuperscript{65,66}

An extensive search of the literature did not reveal any study evaluating the efficacy of different medication histories. Some studies have reported that pharmacists obtained a more detailed history than doctors.\textsuperscript{64,67-69} However, the admitting doctors were often not aware of the study being conducted. This reinforces the comment made by Truitt et al that for a true comparison of history-taking, both parties should use the same tool i.e. history-taking method.\textsuperscript{57}

It is now well accepted that a full medication history is an integral part of a Pharmaceutical Care Plan for the patient in hospital\textsuperscript{70} or in the community setting.\textsuperscript{71} Published studies comparing a second full drug history with the documented drug history from admission have revealed a rate of discrepancies varying from 14-96\%.\textsuperscript{65,66,72,73} A second history can also help identify OTC medications nutritional or herbal supplements, the recording of which is often overlooked.\textsuperscript{73,74}

The most common discrepancies noted in all studies were that of the non-recording (omission) of medications or the recording of medications that were no longer in use (commission). Other common errors included differences in dose, frequency of administration\textsuperscript{65,72,75} and incorrect dose form.\textsuperscript{65} The most common categories of drugs involved with errors reported were: paracetamol and codeine,\textsuperscript{63,66,73,76} NSAIDs,\textsuperscript{63,65,72,75,76} cardiovascular drugs,\textsuperscript{63,65,66,75} diabetes medication,\textsuperscript{63,65,66} respiratory drugs,\textsuperscript{63,65,72} and CNS drugs.\textsuperscript{63,65,72,75,76} Several studies have also highlighted that a full drug history may reveal
previously undocumented drug allergies or adverse drug reactions\textsuperscript{59,62,65,68} thus providing important background information for patient management.

The clinical significance of drug history discrepancies was questioned by several groups with varying results. While only 11\% of discrepancies found by Dawson and Gray\textsuperscript{58} were deemed to be clinically significant, Akwagyriam et al\textsuperscript{62} and McCrudden and colleagues\textsuperscript{65} have reported a much higher rates of 66\% and 70\% respectively.

1.3 AUSTRALASIAN STUDIES

A review of Australian studies dated 1988-1996 revealed that 1.6-3.6\% of public hospital admissions were likely to be drug-related.\textsuperscript{77} These studies included a six month prospective study by Larmour et al who reported 1.6\% of admissions to all areas of the hospital were due to an ADE.\textsuperscript{30} Just over half (53\%) of these admissions were over 70 years of age and drug interactions contributed to 30\% of cases. Similarly, in 1996, Dartnell and colleagues over a 30-day period reported a 2.7\% incidence of ADE-related admissions, 75\% of these being admitted to medical wards.\textsuperscript{34} A retrospective review of discharge summaries of patients from medical unit over a 12-month period also found the incidence of definite and probable ADE-related admissions to be 2.7\%.\textsuperscript{78} Chan et al reported an increased incidence of ADE-related admissions (30.4\%) was also reported in a group of patients 75 years and over.\textsuperscript{36} This study found that non-compliance and omission or cessation of medication contributed to 26\% of these admissions. The Quality of Australian Health Care Study found 1.8\% of hospital admissions were associated with ADEs and that 5-8\% of admissions to a medical ward were due to an ADE.\textsuperscript{79} Wai and colleagues also reported drug-related problems contributed to 10.6\% of admissions to a Sydney cardiology unit.\textsuperscript{80}

In 1972, a six-month New Zealand study within a group of Dunedin hospitals looked at the incidence of adverse drug reactions.\textsuperscript{81} In a total of 9,104 admissions, 0.3\% or 28 patients were considered to have been admitted due to an ADE. This study relied on the medical and nursing staff to note the possibility of an ADE in a drug administration book for further scrutiny. Therefore those ADEs that were the cause of an admission may have been overlooked and therefore underreported in comparison to those that actually
occurred at the ward level. A similar incidence rate was found by Davis et al in 2001. This study involved a retrospective review of 6579 New Zealand medical records and found that 12.9% of admissions were associated with an adverse event. The rate of drug ADE over all specialities was found to be 1.5%. The study reported 19.6% of adverse events were deemed to have occurred outside the hospital. Using these figures it could be estimated that ADEs contributed to 0.3% of hospital admissions.

Discrepancies in medication histories have also been reported. McCrudden et al interviewed 580 patients from three different Sydney hospitals and found 169 discrepancies in the medication histories of 120 patients, a rate of 20.6%. The added information provided was deemed to be clinically significant in 70% of cases. Variances in admission histories have also been reported in smaller studies by Taylor and Peterson and Leung and Lewis. The former reported 57% of surgical patients in the study had a variance in their recorded medication histories, the latter identified 200 previously unrecorded medications in 151 patients. Both these studies also stressed the added advantage that the full medication history aided the pharmacist in identifying a wide range of drug-related problems that could be addressed during the admission.

The use of nutritional supplements and other complementary medicines has also been found to be underreported.

1.4 AIMS

The opinion of local physicians, obtained anecdotally, is that the number of ADE-related admissions is higher than that reported in the literature. There has not been a New Zealand study that directly questions the incidence of admissions that are due to an ADE. Similarly, the influence of obtaining a full medication history on the identification of these ADEs has not been reported. A three-month prospective study to ascertain the incidence of ADE-related admissions was conducted at Hutt Valley Hospital over the months of June-September 2003. This medication history study was conducted concurrently and had the following aims:

- To determine the accuracy of the medication histories obtained during the ADE-admission incidence study by comparing the medication histories taken by the
investigating medical registrar (NA) or clinical pharmacist (RC) with that documented in the patient drug notes and drug chart during the admission process.

- To classify any discrepancies that may be identified during this process.
- To identify and classify the medications involved.
- To determine whether any of the positively-identified ADEs were related to "omitted" information from the initial drug histories.
CHAPTER 2: METHODS

2.1 PATIENT SELECTION

All patients admitted to one of three acute medical teams within the Hutt Valley District Health Board over a three month period during June to September 2003 were considered for this study. Patients included all those admitted weekdays and during the weekends. Those admitted for elective procedures, transferred from another ward within the hospital and cases of intentional overdose were excluded. Patients, family and caregivers were provided with a patient information sheet within twenty four hours of admission and their consent obtained before inclusion in the study. (See Appendix 1). Patients who were seriously ill, unable to participate due to dementia, a lack of family support, those who were unable to communicate due to speech or language problems and those who declined to participate were excluded.

2.2 MEDICATION HISTORIES

All consenting patients/family were interviewed by the investigating clinical pharmacist (RC) or medical registrar (NA) using a series of set standardised questions to obtain a full medication history. (See Appendix 2). Medication histories were conducted at the patient's bedside after full admission to the ward.

Questionnaire

A medication history questionnaire was designed by the investigators as a full validated questionnaire was not found in the literature. Questions were designed to ascertain the maximum information about the patients prescribed and OTC medication. The investigators had the benefit of consulting the admission notes and were thus able to ask open ended questions, prompt the patient accordingly or challenge any information provided in order to obtain as accurate history as possible. Information was gained on patient demographics including age, sex, ethnicity and living status. Questions were also asked on their smoking status and alcohol intake. Alcohol intake was recorded as regular (daily or at least three to four times a week), occasional or not at all. Details of previous allergies and adverse reactions or sensitivity to medications were recorded. A full medication history was obtained including all prescribed medications taken on a regular and as required basis, OTC usage including herbal or alternative medications and any
traditional medicines. Information was also gathered on whether any of the medication had been started or stopped, or dose changed in the three weeks prior to the admission. Only those medications that had been used in the two to three weeks prior to the admission were considered for the study purposes. Clarification of any medication or dose was confirmed by a phone call to the patient's community pharmacy. Questions were asked on medication compliance to determine whether non-compliance leading to treatment failure was the reason for admission.

After the first acute admitting day for the medical team (Day 2 of the study), the investigators discussed the questionnaire, the information being obtained and the data collection recording methods. No changes to the questionnaire were deemed necessary but the data-recording sheet required the space for the medication list to be expanded. Concerns were raised on how to identify medication described by physical description only. Those medications still unidentifiable after a call to the patient's community pharmacy were excluded from the list.

2.3 ANALYSIS OF RESULTS

All case notes and both medication histories were screened by the clinical pharmacist and medical registrar to ascertain whether an ADE was the reason for the admission. The Naranjo algorithm (Appendix 3) was used to ascertain the probability of an ADE having occurred and the ADEs subsequently confirmed by two physicians. ADEs were rated according to type and severity. The clinical pharmacist compared the initial medication history found in the admission notes and drug chart with the second history and after confirmation of the differences notified the medical team of the discrepancies found.

Those discrepancies that were intentional, i.e. changes to medication that had been specifically mentioned were excluded. The total number of discrepancies between age group and sex were compared. Discrepancies were identified, noted and classified. The medications involved were also classified according to the therapeutic classifications in the British National Formulary (BNF). Paired t tests or t tests where appropriate were used to ascertain significance of any differences.
The histories of those that were involved with a positively identified ADE-related admission were then reassessed to determine if any of the second history information was useful in confirming an ADE. The study was approved by the Wellington Ethics Committee. (See Appendix 4).
CHAPTER 3: RESULTS

3.1 PATIENT SELECTION AND DEMOGRAPHICS

Within the three month period a total of 424 patients were admitted under the care of the medical team. Forty two patients were excluded from the study. Ten patients were admitted because of intentional overdose, 13 admissions were planned or internal transfers and 19 patients refused to participate. A further sixty two patients, aged 16-88 years, were not included because of an inability to communicate with the patient or family during the course or their stay. Forty seven percent (29) of these patients were discharged within 48 hours of their admission or were transferred to other wards or hospitals. Seventy five percent of these "short-stayers" were under 65 years of age. Eight patients died before contact and five were not interviewed due to language problems. A further 12 were excluded because the patients were too unwell, demented and/or the family was not available to be interviewed. The remaining eight exclusions were for a variety of reasons including being asleep, absent from the ward for diagnostic tests and being "boarders" on non-medical wards of the hospital. Eighty percent of the patients who died, had language difficulties, were demented or too unwell to be interviewed were over 65 years of age.

A total of 320 patient histories were obtained. This patient population included 136 males aged 17-93 years and 184 females aged 16-97 years with a mean age 63.7 years. (See Table 1). Fifty eight percent of these patients were over the age of 65 years, of which 2.7% did not take any prescribed medication before admission to hospital.

<table>
<thead>
<tr>
<th>TABLE 1: Patient demographics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male n = 136 (42.5%)</td>
</tr>
<tr>
<td>Age (years) mean ± sd (range in years)</td>
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</tbody>
</table>
3.2 MEDICATION USAGE

Medication usage is summarised in Table 2.

TABLE 2: Medication usage

<table>
<thead>
<tr>
<th></th>
<th>Male n = 136</th>
<th>Female n = 184</th>
<th>Total n = 320</th>
</tr>
</thead>
<tbody>
<tr>
<td>No of patients taking</td>
<td>124</td>
<td>170</td>
<td>295</td>
</tr>
<tr>
<td>prescribed medications (%)</td>
<td>(91.2)</td>
<td>(92.4)</td>
<td>(92.2)</td>
</tr>
<tr>
<td>No. of patients taking OTC/alternative medicines (%)</td>
<td>65</td>
<td>101</td>
<td>166</td>
</tr>
<tr>
<td></td>
<td>(47.8)</td>
<td>(54.9)</td>
<td>(51.8)</td>
</tr>
</tbody>
</table>

3.3 MEDICATION HISTORIES

PRESCRIBED MEDICATION

A total of 320 sets of patient histories were obtained. The structured interview revealed these patients were regularly taking a total of 1797 prescribed medications. The number of prescribed items identified during the admission process was 1508. The average number of medications identified in the second history was significantly higher than the average number of medications recorded in the first history: 5.6 ± 4.31 items versus 4.71 ± 3.93 items respectively (p<0.001).

The difference between the number of medications identified in each history was highly significant for males, females and for the age groups 64 years and under and those over 65 years. Comparisons of the average number of medications and the differences between the histories can be found in Table 3.
TABLE 3: Average number of prescribed medications identified in medication histories

<table>
<thead>
<tr>
<th></th>
<th>History 1</th>
<th>History 2</th>
<th>Difference between histories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average no. of medications (± sd)</td>
<td>4.71 ± 3.93</td>
<td>5.60 ± 4.31</td>
<td>0.90 ± 1.53 p&lt; 0.001*</td>
</tr>
<tr>
<td>total no. histories n = 320</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average no. of medications: male histories n = 136</td>
<td>4.47 ± 3.51</td>
<td>5.30 ± 4.15</td>
<td>0.92 ± 1.55 p &lt; 0.001*</td>
</tr>
<tr>
<td>Average no. if medications: female histories n = 184</td>
<td>4.89 ± 4.22</td>
<td>5.78 ± 4.44</td>
<td>0.90 ± 1.52 p &lt; 0.001*</td>
</tr>
<tr>
<td>Average no. of medications: patients 64 years and under n = 134</td>
<td>2.87 ± 2.79</td>
<td>3.67 ± 3.45</td>
<td>0.82 ± 1.36 p &lt; 0.001*</td>
</tr>
<tr>
<td>Average no. of medications: patients over 65 years n = 186</td>
<td>6.04 ± 4.11</td>
<td>7.00 ± 4.35</td>
<td>0.97 ± 1.64 p &lt; 0.001*</td>
</tr>
</tbody>
</table>

*paired student t test

OTC MEDICATION

One hundred and sixty six (51.8%) of the patients interviewed were found to have regularly used an OTC/alternative medication in the weeks prior to admission. A total of 335 OTC products were identified by the investigators during the medication history interview. This compares with 29 products identified during the admission process.

The most commonly used OTC products were analgesics (24%), herbal supplements (25%), cough and cold preparations (16.8%) and vitamins and minerals (18.5%). The most commonly bought analgesic was paracetamol and 47 different types of herbal supplements were identified. There were also nine traditional medicines from Maori, Tongan and Chinese cultures identified.

Approximately half the study population (54.6% of females and 47.8% of males) had taken an OTC/alternative medication prior to admission to hospital. The females interviewed took significantly more OTC products than the males. The mean number of
OTC items was found to be $1.23 \pm 1.56$ items (range 0-8) versus $0.8 \pm 1.18$ items (range 0-9) respectively ($p<0.01$)*. * student t test

Those patients aged 64 years and under also took significantly more OTC products than those aged over 65 years old. The mean number of items of OTC products identified were $1.40 \pm 1.6$ products (range 0-9) versus $0.8 \pm 1.23$ products (range 0-6) respectively ($p<0.001$)*. (*student t test).

3.4 DISCREPANCIES IN PRESCRIBED MEDICATION

Two hundred and twenty nine (71.5%) of the 320 medication histories obtained contained one or more discrepancies. A total of 669 discrepancies were found with the mean number of discrepancies per patient found to be $2.89 \pm 2.1$ (range 0-12). The mean number of discrepancies was significantly different between male and female patient groups ($p<0.001$)* and those patients over and under 65 years old ($p<0.001$)*. (See Table 4).

**TABLE 4**: Discrepancy numbers by patient groups

<table>
<thead>
<tr>
<th>Patient group</th>
<th>Discrepancies found (mean ± sd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total patient group</td>
<td>$2.89 \pm 2.1*$</td>
</tr>
<tr>
<td>Male patients</td>
<td>$3.42 \pm 2.48*$</td>
</tr>
<tr>
<td>Female patients</td>
<td>$2.42 \pm 1.58*$</td>
</tr>
<tr>
<td>Patients under 65 years old</td>
<td>$2.39 \pm 1.68*$</td>
</tr>
<tr>
<td>Patients over 65 years old</td>
<td>$3.23 \pm 2.3*$</td>
</tr>
</tbody>
</table>

* student t test $p<0.001$. 
The discrepancies were categorised into:
"omission error" - medications that were currently being taken by the patient but not identified during the admission process
"wrong dose" - the medication was correctly identified but the dose differed
"commission error" - the medication was identified and charted but not indicated any longer
"dose missing" - the medication was identified correctly but the dose was not documented
"wrong dose form" - the wrong dose form was identified or not identified at all

The most common discrepancies found were those of "omission error", "wrong dose" and "commission error".

The frequency of these discrepancies can be found in Table 5.

<table>
<thead>
<tr>
<th>Type of discrepancy</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Omitted drugs</td>
<td>376 (56.2)</td>
</tr>
<tr>
<td>Dose wrong</td>
<td>90 (13.4)</td>
</tr>
<tr>
<td>Drugs charted no longer in use</td>
<td>87 (13)</td>
</tr>
<tr>
<td>Dose missing</td>
<td>58 (8.7)</td>
</tr>
<tr>
<td>Dose form wrong or not identified</td>
<td>58 (8.7)</td>
</tr>
<tr>
<td>Total</td>
<td>669 (100)</td>
</tr>
</tbody>
</table>

**ERRORS OF OMISSION**

The most common discrepancy found between the two medication histories was that regular medications were omitted.

More than half (50.7%) of patients less than 65 years and 58.3% of patients over 65 years had one or more omission. Patients under 65 years old had significantly fewer items omitted than those over 65 years: 1.78 ±1.07 items omitted versus 2.35 ± 1.58 items omitted (p< 0.001- student t test). The most common groups of drugs that were omitted are those involved with the central nervous system, gastrointestinal, respiratory and cardiovascular systems. The omissions included 54 incidences of omitted analgesics, 20
sedatives and antidepressants, 39 inhalers for asthma or CORD treatment, 5 diabetic medications, 20 NSAIDs, six eyedrops used to treat glaucoma and one incidence of warfarin was not identified as being taken. Skin preparations, laxatives, glyceryl trinitrate spray and vitamins were also frequently underreported.

DOSE WRONG

A total of 89 variances in dose were identified. The doses of frusemide, ACE inhibitors, calcium channel blockers and antidepressants were found to be commonly reported as being taken but at a dose different to that identified. Of concern is that there were also nine diabetic medications charted with the wrong dose.

ERRORS OF COMMISSION

Sixty seven (21%) of patients had an error of commission. A total of 87 drugs were identified during the admission history that were no longer being taken by the patient. These were most commonly analgesics, antidepressants and ACE inhibitors.

DOSE MISSING

The inability to identify and record the dose of respiratory inhalers was an ongoing problem.

DOSE FORM

Missing dose form poses a problem in identifying which form of the drug may be required. The most common drugs involved with this discrepancy were aspirin and dipyridamole. Diltiazem, verapamil and carbamazepine also featured in this discrepancy group.

DRUG CLASSIFICATION GROUP

When the incidence of discrepancies was analysed by BNF drug group classification, the drugs most commonly involved the cardiovascular, central nervous, respiratory and gastrointestinal systems. The drug classifications the discrepancies are summarised in Table 6.
Those identified with an ADE were significantly older and took more regular medications. However there was no significant difference in the number of discrepancies or omissions in the number of medications identified in the second medication history interview.

The 37 adverse drug events identified involved 44 medications including four non-prescription medications. The majority of the medications associated with ADEs were diuretics, centrally acting drugs, NSAIDs, Cox-2 inhibitors, warfarin and aspirin. Non-prescribed medications included: OTC purchased aspirin, St Johns Wort, flurbiprofen lozenges and dehydroepiandrosterone (DHEA) recommended for a young lady who subsequently developed benign intracranial hypertension. Alcohol was also a factor in two admissions. Despite the non-significance in the number of discrepancies or omissions between the two groups of histories, a second medication history did reveal further information that helped identify an adverse drug event had occurred. Some examples are listed below.

- Patient 1 was admitted with above normal serum theophylline levels and seizures. She admitted that she had taken twice the prescribed dose of theophylline because she thought it would work better.
- Patient 2 regularly took warfarin and when on a course of antibiotics often had problems maintaining an appropriate INR. While on a recent course of antibiotics, his INR was noted to have risen to 6 but to compound this he was counter-prescribed some flurbiprofen (Strepfen) lozenges and his INR on admission was 9.
- Patient 3 had been prescribed tramadol 100mg SR twice daily for a torn muscle. The patient had a "few beers" watching the rugby at the pub with friends, then went home and took some tramadol. He was admitted to hospital with hallucinations and was still shaky 36 hours later. On interviewing, the patient admitted to having taken a double dose of tramadol SR and was found to also take St John's Wort. Both medications could have contributed to the drug-alcohol interaction and the subsequent symptoms.
- Patient 4 was admitted to hospital with a severe asthma attack. The second interview revealed the patient had taken three doses of diclofenac prescribed for her arthritis.
- Patient 5 was admitted with a gastrointestinal bleed, had a duodenal ulcer found on endoscopy and on interviewing was discovered to have been taking aspirin.
TABLE 6: Drug classification of the different discrepancy types.

<table>
<thead>
<tr>
<th>BNF Drug Group classification</th>
<th>Omitted drugs</th>
<th>Dose wrong</th>
<th>Committed drugs</th>
<th>Dose missing</th>
<th>Dose form</th>
<th>Total no. of discrepancies for group (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastrointestinal system</td>
<td>52</td>
<td>10</td>
<td>18</td>
<td>3</td>
<td>2</td>
<td>83 (12.7)</td>
</tr>
<tr>
<td>Cardiovascular system</td>
<td>53</td>
<td>26</td>
<td>10</td>
<td>3</td>
<td>51</td>
<td>141 (21.3)</td>
</tr>
<tr>
<td>Respiratory system</td>
<td>44</td>
<td>9</td>
<td>12</td>
<td>23</td>
<td>1</td>
<td>89 (13.3)</td>
</tr>
<tr>
<td>Central nervous system</td>
<td>82</td>
<td>22</td>
<td>25</td>
<td>11</td>
<td>3</td>
<td>143 (21.3)</td>
</tr>
<tr>
<td>Infection</td>
<td>15</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>19 (2.8)</td>
</tr>
<tr>
<td>Endocrine</td>
<td>20</td>
<td>9</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>32 (4.8)</td>
</tr>
<tr>
<td>Gynaecological/ urinary tract</td>
<td>9</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>13 (2.0)</td>
</tr>
<tr>
<td>Malignant disease and</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>2 (0.3)</td>
</tr>
<tr>
<td>immunosuppression</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hormone</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2 (0.3)</td>
</tr>
<tr>
<td>Nutrition and blood</td>
<td>26</td>
<td>8</td>
<td>8</td>
<td>5</td>
<td>1</td>
<td>50 (7.5)</td>
</tr>
<tr>
<td>Musculoskeletal and joint</td>
<td>27</td>
<td>4</td>
<td>3</td>
<td>6</td>
<td>0</td>
<td>40 (6.0)</td>
</tr>
<tr>
<td>disease</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eye</td>
<td>9</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>11 (1.6)</td>
</tr>
<tr>
<td>Ear, nose and oropharynx</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>4 (0.6)</td>
</tr>
<tr>
<td>Skin</td>
<td>35</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>38 (5.7)</td>
</tr>
<tr>
<td>TOTALS</td>
<td>376</td>
<td>90</td>
<td>87</td>
<td>58</td>
<td>58</td>
<td>669 (100)</td>
</tr>
</tbody>
</table>

ALCOHOL USE

More than half (170) of the patients interviewed regularly drank alcohol. Of these, 21% of patients over the age of 65 years were found to be regular alcohol drinkers.
ALLERGIES

Thirty two (10%) of the original patient medication histories did not have any indication of allergies or sensitivities documented. The second interviews revealed 37 extra sensitivities or reactions to medications. Many of these were not true allergies. Due to the subjective nature of this information missed allergy data was not included in the discrepancy count. Fortunately no patient that missed having an allergy or sensitivity noted was prescribed medication that may have caused an adverse drug event.

3.5 ADE IDENTIFICATION

From the ADE study, 37 ADEs were positively identified. This group included 21 females and 16 males. This equates to 8.7% of the total admissions to the medical team over the study period were associated with an adverse drug event. Comparative data of the two groups can be found in Table 7.

TABLE 7: Comparative data of the ADE and non-ADE related admissions.

<table>
<thead>
<tr>
<th></th>
<th>ADE ADMISSION n = 37</th>
<th>NON-ADE ADMISSION N = 283</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years ± sd)</td>
<td>72 ± 16.9</td>
<td>62.8 ± 20*</td>
</tr>
<tr>
<td>Mean number of medications identified History 1 (± sd)</td>
<td>5.83 ± 3.73</td>
<td>4.56 ± 3.94*</td>
</tr>
<tr>
<td>Mean number of medications identified History 2 (± sd)</td>
<td>7.35 ± 3.75</td>
<td>5.38 ± 4.34*</td>
</tr>
<tr>
<td>Mean difference in number of medications (± sd)</td>
<td>1.43 ± 1.62</td>
<td>0.84 ± 1.5*</td>
</tr>
<tr>
<td>Mean number of total discrepancies (± sd)</td>
<td>2.56 ± 2.08</td>
<td>2.93 ± 2.1</td>
</tr>
<tr>
<td>Mean number of omissions (± sd)</td>
<td>2 ± 2.08</td>
<td>2.16 ± 1.45</td>
</tr>
</tbody>
</table>

*P<0.01 student t test
CHAPTER 4: DISCUSSION

4.1 STUDY COMPARISONS

Direct comparison with many of the similar studies investigating the discrepancies in medication histories and their significance is difficult due to differences in design and methodology. Several studies only interviewed patients over the age of 65 years and involved small numbers of patients. Chung et al and others excluded patients from nursing homes or extended care facilities as patient records were deemed to be complete and error free. This is contrary to this current study's findings. Frank and colleagues only considered the elderly patient suitable for interviewing if a mini-mental exam found the patient to be competent to participate in the interview. No such screening of patients was done during this study with family or caregivers being included in the interview if necessary. This current study considered all patients of all ages initially providing a complete population sample.

Discrepancy rates reported also vary depending on inclusion criteria. Beers, Frank and Bedell included OTC medications in the rate of discrepancies reported but acknowledged that this dropped dramatically if OTC products were excluded. Other studies often included patients from both medical and surgical services, or the incidence of discrepancies found in the Emergency Department. The rate of discrepancies found in this current study (71.5%) was higher than that found by Beers (60%) and Bedell (61%). The large number of OTC medications that were not identified in the first medication history during this current study was not included as an "omission" error and therefore did not contribute to this figure.

In contrast McCrudden et al reported a much lower rate of 21%. They reported that omission errors contributed to 31% of the discrepancies and the number of patients with a commission error was also lower. Their report does not identify the proportion of surgical to medical patients in the population sample nor the age of the patients. McCrudden’s team of investigators also only interviewed weekday admissions. No attempt was made to compare the discrepancy rate between weekdays or weekends. This current study included those acutely admitted on weekends when staffing levels were very different and doctors had already worked a long week. This could easily have contributed to an
increase in discrepancies. Junior doctors were also very aware that they made more charting errors on the six and seventh nights in their week of night duty.

The study conducted by Lau et al in 2000\textsuperscript{63} however only included acute medical admissions and patient numbers, age and average number of medications were similar to that found in this study. Sixty one percent of all patients had one or more medications not recorded. However, it should be noted that the investigators only interviewed three patients, randomly selected per day, and excluded those under 40 years of age, those who stayed less than two days and those who did not use any medication. This may have skewed the results. They also did not consider errors of dose regimen or ask about OTC drug usage. The comparison of results can be seen in Table 8.

<table>
<thead>
<tr>
<th>TABLE 8: Study comparison.</th>
<th>Lau et al\textsuperscript{63}</th>
<th>Current study</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of study</strong></td>
<td>2-year prospective</td>
<td>3-month prospective</td>
</tr>
<tr>
<td><strong>Patient selection</strong></td>
<td>Limited to three patients/day</td>
<td>All patients included</td>
</tr>
<tr>
<td><strong>Type of patient</strong></td>
<td>Acute medical admission</td>
<td>Acute medical admission</td>
</tr>
<tr>
<td><strong>Number of patient histories</strong></td>
<td>304</td>
<td>323</td>
</tr>
<tr>
<td><strong>Average age</strong></td>
<td>71.5 ± 12.8 (range 40-92)</td>
<td>63.7 ± 19.8 (range 16-97)</td>
</tr>
<tr>
<td><strong>Average number of medications in hospital record</strong></td>
<td>4.1 ± 3</td>
<td>4.71 ± 3.93</td>
</tr>
<tr>
<td><strong>Omission error</strong></td>
<td>26%</td>
<td>45.5%</td>
</tr>
<tr>
<td><strong>Commission error</strong></td>
<td>2.7%</td>
<td>4.8%</td>
</tr>
<tr>
<td><strong>Most common drug classes in omission and commission errors</strong></td>
<td>1 Central nervous System</td>
<td>1. Central Nervous system</td>
</tr>
<tr>
<td></td>
<td>2. Cardiovascular</td>
<td>2. Gastrointestinal</td>
</tr>
<tr>
<td></td>
<td>3. Musculoskeletal</td>
<td>3. Respiratory</td>
</tr>
<tr>
<td></td>
<td>4. Gastrointestinal</td>
<td>4. Cardiovascular</td>
</tr>
<tr>
<td></td>
<td>5. Endocrine</td>
<td>5. Nutrition and blood</td>
</tr>
<tr>
<td></td>
<td>6. Respiratory</td>
<td>6. Skin</td>
</tr>
</tbody>
</table>
4.2 QUESTIONNAIRE AND METHODOLOGY

It was not the intention of this study to differentiate the results between the investigators nor the specific comparison of history taking methods but to ascertain the significance of the extra information that the investigators were able to obtain in relation to ADE identification.

In this study, the investigating pharmacist and medical registrar used a set format of open-ended questions and a printed form for recording results thus reducing inter-investigator bias. They were not blinded to the original history taken during the admission process and so were able to use memory-jogging questions to clarify any discrepancies. However, the medical registrar did acknowledge that he was disadvantaged when identifying medication from a patient's description. This may have led to some discrepancies in the naming of medication. To counter this, the latest dispensing record from the patient's community pharmacy was used to clarify the medication names.

4.3 LIMITATIONS AND BIAS

Time constraints on the investigators to conduct the interviews on a number of patients before they were discharged home, or being available for interviewing when family were visiting resulted in 14% of patients being excluded. Both the investigators were involved with the everyday care of the patients but nonetheless missed the opportunity to interview a number of patients particularly those discharged from the "Short Stay Unit" and some of those discharged over the weekends. However with 86% of patients included it is unlikely that this small number of omissions would have had a major impact on results.

The difference in the environment in which the histories were taken may have influenced the number of medications identified during the interviews. During admission, the medical registrar is busy organising diagnostic tests, X-rays and reviewing numerous patients. Interviews may therefore be clouded by "external noise". Moreover, the patient and family may be too upset or unable to provide much information. In contrast, the second interview was conducted later, often the next day when the patient was feeling
better and recall may have been triggered by the absence of regular medication from the medication received during the morning drug round. It should also be acknowledged that for an "after hours" admission the medical registrar was unable to confirm a medication history from the patient's GP or community pharmacy whereas the investigators were able to benefit from the availability of this information.

The investigating medical registrar and other members of the medical team were often involved in the admission process. All knew that the study was being conducted. This knowledge may have influenced the initial medication history that was taken. When asked, none of the medical team believed this to have occurred as "admission days were always busy" and "there was never extra time to consciously change their normal practice". Nonetheless, it could be argued that these doctors unconsciously took a more detailed medication history during the admission process. What's more, they were given regular feedback of any discrepancies found.

The accuracy of the second history obtained could also be questioned. Chung et al.\textsuperscript{85} questioned the ability of patients over 65 years old to recall their medication in the Emergency Department. Only 15.5\% of patients aged 65 years and over were able to correctly identify all their prescription medication, doses, frequency of dose and indication for use. They also found that as the number of medications increased the likelihood of missing a medication increased. This increasing trend was also seen by Hancock et al.\textsuperscript{87} In the current study the number of currently used medications may have been overestimated when the history relied on information provided from the community pharmacy and the patient was not able to clarify what medications and doses they actually took. The use of a third source of medication history verification in all cases could have limited this source of error. Nevertheless, the investigators identified a large number of omitted and committed drugs.
4.4 SOURCES OF DISCREPANCIES

It was apparent that from the admitting histories that the medication lists were derived from a variety of sources. These included medication bottles or packets, patient or family history, GP letter, medication cards, and former discharge summaries - all of which have the potential to contain one or more errors and conflicting information.

It was found that medication charts provided from nursing homes often lacked clarity and were often incomplete especially when trying to identify dose form or dose. Yellow medication cards often contained multiple changes, deletions and additions, missing doses and dose forms, hindering the true picture of medication usage. Where the dose form of the medication was missing this may have led to a wrong preparation being given by the nursing staff or may have resulted in a missed dose while clarification was sought. Unlike aspirin and dipyridamole where it was possible to determine the dose form from the dose prescribed, clarification of the dose form for diltiazem, verapamil and carbamazepine is necessary as these medications are available in short and long-acting forms, have several fully funded brands available and the brands are not interchangeable.

Discrepancies can also arise from the delay in transmission of information of medication changes to the GP and can result in repeat prescribing of previous medications. This problem was identified during the current study. During an admission, a patient had been changed to diltiazem LA180mg tablet once daily, but the pharmacy had continued to dispense diltiazem SR 90mg twice daily as per the GP's prescription. On readmission it was assumed that the patient was taking the long-acting form of the medication and this was charted. This clearly highlights the advantage of a discharge pharmacist checking for discrepancies in discharge summaries, medication cards and discharge prescriptions. In addition, if a medication is omitted from the admitting history and drug chart, it may not appear on the discharge summary or patient medication card and the GP may incorrectly assume that the omitted drug was stopped in hospital intentionally. Communication with the community pharmacy over medication changes in addition to the GP receiving a discharge summary promptly after the patients' discharge would also help eliminate this cycle of errors.
One case also highlighted the complications of medication changes when the patient is dealing with numerous doctors that may regularly change current prescriptions. The patient was still taking medication from old blister packs packaged two weeks prior to a medication change having been made. The community pharmacist who blister-packages the medication for the patient had not been kept informed of the prescription changes.

4.5 ALLERGY INFORMATION

The documentation of drug allergies or sensitivity to medication was poorly done. The incidence of lack of allergy documentation in this study was similar to that found by McCrudden et al (8.3%) and Akwagyriam also noted an increase in allergies after a second interview. It was fortunate that during the course of the study that no patient was prescribed a medication that they were sensitive to. Despite some of the new information being considered subjective due to the patient's perception that a specific medication has caused the symptoms experienced and regardless of whether the information is interpreted as a true allergic episode or an adverse effect, recording the implicating agent and resulting symptoms in a database would provide doctors with useful prescribing information.

4.6 OTC MEDICATIONS

This study revealed that there is a wide range of OTC medications used that the doctors are unaware of. Constipation, for example, may be perceived as "part of growing old" rather than a side effect of prescribed medication. Therefore the patient may purchase an OTC remedy because of easier access to the community pharmacy, the inability and/or cost of obtaining an appointment with the GP or deciding that the problem is not severe enough to seek the GP's advice. Unbeknown to the patient, the OTC medication may contain drugs already in their prescription medication. There is also the potential for a drug-herbal interaction or the possibility of an OTC product exacerbating an underlying disease state. Over half the patients interviewed had used an OTC product prior to admission. This is similar to that found by Batty who reported OTC usage of 32% by patients over the age of 65 years. Twenty three percent had used analgesics, 29% a gastrointestinal product and 21% nutritional agents. McElnay found that the most commonly used OTC purchases were analgesics (17.5%), cough and cold
preparations (14.7%) and laxatives (11.5%). Moreover 24% were already taking prescribed medications for the same condition.\textsuperscript{6}

In contrast, a Finnish study reported back that only 17% of the population were regular users of OTC products.\textsuperscript{89} Variances between studies are inevitable as the number of government subsidized medications vary between country to country and year to year. During several of the second history interviews, patients admitted to hospital with a gastrointestinal bleed had been taking aspirin purchased over the counter. Only 29 OTC products were identified in the initial admission history. Many patients may not realize the potential significance of this information, and would only supply it if asked.

Analysis of the study data for the number of potential interactions between prescribed and concurrent OTC medications was outside the scope of this study but could be explored further. It also highlights the importance of the community pharmacist’s need to be vigilant when counter-prescribing medications as seen with the patient admitted with a raised INR and who had been taking flurbiprofen lozenges he had bought over-the-counter.

\textbf{4.7 COMPLIANCE}

Non-compliance is well-recognised as a drug-related problem and is a common reason for admission.\textsuperscript{27,31,37,42,43,46,80} Therefore the inclusion of compliance questions in the questionnaire was necessary to help ascertain whether the admission resulted from non-compliance, deliberate changes in dosing or an ADE. Many of the patients interviewed used memory aids, or blister packaging to ensure compliance and denied regular forgetfulness of medication-taking. No further checking of patients’ medication containers was done to confirm this. However the interviews revealed a number of common scenarios. These included:

- double dosing leading to unintentional overdose
- the prescription had run out the month before but the patient had not renewed it.
- the patient did not realize that the medication was ongoing and that it should be repeated
- the patient could not afford a new prescription
This part of the interview was also extremely useful in highlighting specific needs of individual patients and those that could benefit from supervision of their medication taking by the hospital-employed Clinical Care Co-ordinator.

4.8 ALCOHOL USE

During this study all patients were questioned over alcohol use. Of the patients aged 65 years and over, 21.5% of the patients were found to be regular alcohol drinkers. Although this rate is less that reported by Adams, the patients involved in this study were found on average to take a larger number of medications that their younger counterparts. The people in this age group were more likely to be taking medication classed as "high risk" for an alcohol-drug interaction. These medications include antihypertensives, aspirin, NSAIDs, H₂-blockers, sedatives, narcotics, warfarin and drugs used to treat congestive heart failure. Although alcohol usage reported was not found to be high overall, the findings of this study serve as a timely reminder for pharmacists and doctors to counsel patients of the potential problems of an alcohol-drug interaction.

4.9 ADE INCIDENCE

The incidence of ADE-related admissions found in this study is similar to that found in the literature. Some admissions were found to be true adverse drug events while other admissions were a result of medications and a change in disease state. For example, a patient continued to take a diuretic while vomiting resulting in dehydration and their subsequent hospital admission. Age, number of medications and sex were also found to be contributing factors.

Without doubt, identification of some ADE-related admissions was missed due to the inability to interview patients or family. Often two or three attempts were made to interview the patient by the investigators but ongoing commitments to interview new admissions made further follow-up difficult. Eighty percent of the patients who died, had language difficulties or were too unwell or demented to be interviewed were over 65 years of age. This study found that this age group was more likely to be admitted due to an ADE than their younger counterparts. Since there was no significant difference in the number of discrepancies or omissions found in the histories between the ADE-related and the non-related ADE-related admission groups, further study of all "missed" patient
admission histories could determine the incidence of "missed ADEs". However the inability to find out the use of OTC medications by these patients would cloud the true result.

The numbers found were small and do not lend themselves to extensive comparative analysis. However, the drugs implicated with the ADE-related admissions were also similar that previously reported. \(^{30-33,46,50,51}\) Several patients were on the combination of ACE inhibitor, diuretic and NSAID- a combination which has been highlighted as a "dangerous combination" and implicated in a significant number of reports of drug-induced renal failure to the Adverse Drug Reactions Advisory Committee (ADRAC)\(^{91}\). The admissions exemplify the need for caution when prescribing this combination of drugs.

4.10 THE FUTURE

In order to improve the accuracy of medication histories, it has been suggested that a database containing patients' prescribed and OTC medications become established. This database would be accessible to approved health practitioners. Any changes to medication would be made accordingly on the database and highlighted. The information would be available immediately and would not rely on traditional methods of communication and the subsequent delays. This concept however would require further discussion, development and elimination of medico-legal issues. The development of electronic medical records may partially solve the problem.

The use of clinical pharmacists in medication history taking extends beyond helping in identification of an ADE-related admission. Their presence on ward rounds has been shown to reduce medication errors and inpatient adverse drug events.\(^{92-95}\) The pharmacist becomes involved in therapeutic discussions, therapeutic choices, advising on dose adjustments and therapeutic drug monitoring and facilitates the supply and administration of newly charted medications.\(^{96}\)

Clinical pharmacists in Canada, Great Britain, Ireland and Australia are becoming actively involved in the concept of Seamless Pharmacy Care.\(^{97-99}\) This concept involves maintaining continuity of medication management between the primary and secondary
health services. The pharmacists are involved in preparation and screening of discharge prescriptions,\textsuperscript{100-102} improving communication to GPs regarding medication changes following discharge,\textsuperscript{97,100,103,104} and community follow-up.\textsuperscript{104,105} A Medication Liaison Service (MLS) has also been established at two Queensland, Australian hospitals.\textsuperscript{106} MLS provides the preparation of a comprehensive medication history by a clinical pharmacist on admission which is confirmed with the patients or caregivers and community health professionals; the use of this information by all hospital medical, nursing and pharmacy staff; a full medication review and the communication on discharge of medication changes to the general practitioner and patient.

Seamless Pharmacy Care results in decreased drug-related morbidity, increased medication compliance and improved satisfaction with the continuity of their care.\textsuperscript{107} The development of this concept of seamless pharmacy care in New Zealand extending the current practice of many hospital clinical pharmacists would include the taking of medication histories during the admission process and active involvement with the discharge process improving communication with the GPs and community pharmacies regarding medication changes. This activity may well result in a reduction in ADE-related admissions and adverse events occurring in hospital.
CHAPTER 5: CONCLUSION

With the aid of a full medication history many discrepancies can be identified and corrected thus reducing morbidity, preventing a possible adverse event occurring during a hospital stay, and shortening length of stay. Moreover, the extra information obtained may aid clinicians in identifying an adverse drug event may have been the cause for admission.

Clinical pharmacists are familiar with everyday dispensed medications, their doses and forms, common side effects, drug interactions and OTC medications. Their expertise in this field is often overlooked and pharmacists could play an important role during the admission process to ensure a complete medication history is obtained and drug related problems identified early in the patient's admission to hospital.

This study has also identified areas where improved communication with GPs and community pharmacies during the discharge process could help improve medication management and strive towards "seamless pharmacy care".
REFERENCES

1. Bradley CP, Bond C. Increasing the number of drugs available over the counter: arguments for and against. Brit J Gen Pract 1995; 45:553-56.


74. Cockayne NL, Duguid M, Shenfield GM. The recording of complementary medicine use in medication histories of hospital inpatients. [online] [1 page] available at www. vep.monash.edu.ascept/data/CockayneNL.pdf accessed 3 May 2003


83. Taylor GR, Peterson G. Drug related problems and medication history variances identified during an evaluation of clinical pharmacy services on outcomes of hospitalisation for surgical patients. Australian and New Zealand Hospital/Healthcare Pharmacy 1st combined NZHPA and SHPA Conference Christchurch New Zealand 9-11 August 2002.


100. Norris CM, Thomas V, Calvert PS. An audit to evaluate the acceptability of a pharmacist electronically prescribing discharge medication and providing information to GPs. Pharm J 2001; 267:857-859.


APPENDIX 1

MEDICATION HISTORY QUESTIONNAIRE
The following information will be obtained

PATIENT DEMOGRAPHICS:
Patient Name, age sex ethnicity NHI number and will be assigned a Research Number.

SOCIAL STATUS
• Do you live alone, with someone or in a rest home?
• Do you smoke? If yes, how much?
• Do you drink alcohol? If yes how much and how often?

PRESCRIBED MEDICATIONS:
• What are your current medications? Information may be obtained from a verbal history, Yellow Medication Card, patients' medication containers brought to hospital, or confirmation from the patients' pharmacy. Drug names, dose forms, regular dose and frequency are required.
• Have you stopped any of these medications in the last 14 days? If yes, which ones?
• Have you started any new medication or had the doses changed of regular medication in the last 14 days? If yes, which ones?
• Have you had any drug allergies or experienced a bad reaction to any medication in the past?

NON-PRESERVED MEDICATION:
• Do you purchase any medications or complementary medicines from a pharmacy, health food shop, supermarket or the internet? If yes, please list these.
• If yes, have you taken any of these on a regular basis in the last 14 days? If yes, what and how much.

COMPLIANCE:
• Do you look after your own medication or does someone help you with it?
• Do you have your medication blister packed or put in a dosette box by a pharmacy, friend or family member?
• Do you sometimes forget to take some medication? If yes, how often?
• Are there any situations where you decide not to take your medication or change how you take your medication?
• Do you have a problem reading the medication labels or opening medication containers?

It may be necessary to contact your GP or dispensing pharmacy to clarify information. Is this okay? Which pharmacy dispenses your medication?

THANK YOU FOR YOUR PARTICIPATION IN THIS INTERVIEW
ADVERSE MEDICATION EVENTS RELATED ADMISSION STUDY

PATIENT INFORMATION SHEET

Medications can cause adverse reactions due to variety of reasons. Sometimes these reactions could contribute to hospital admissions. These adverse reactions could be due to traditional western medicines or herbal remedies. Some of these reactions cannot be prevented and others may be potentially preventable. Overseas studies suggest that approximately 5% of the medical admissions could be medication related.

We are planning to look at adverse medication events contributing to medical admissions at Hutt Hospital. The study will involve interviewing all patients admitted to hospital under one medical team over 3-month period to obtain a full medication history. If we could identify potentially preventable events we may be able to avoid them in the future.

The principal investigators, Dr Niranjan Arachchi, Senior Medical Registrar, or Rachael Cooke, Clinical Pharmacist will ask your permission for participation in this study. Both of them are normally involved in your care at Hutt Hospital. They will request a short interview with yourself or your caregiver. They will ask a series of questions to obtain a full list of the medications that you are currently taking, including those prescribed and purchased from pharmacies, health food shops or supermarkets. A review of your case notes and further information may be sought from your retail pharmacy or general practitioner. Information obtained during this interview may improve your current medicines management.

This study has received approval from the Wellington Ethics Committee. None of the documents that could identify you will leave the hospital campus nor be used in any study reports. Data will be stored in secure areas within the Hutt hospital. All paper data identifying you will be shredded at the conclusion of the study and study data kept secure until ten years after publication of study findings.
You have no obligation to participate in this study, and your acceptance will only be considered on the completion of a signed consent form from yourself or caregiver. You will be given a copy of this information sheet and a consent form. You will be able to withdraw from the interview at any time. If you are not able to speak English we may be able to provide an interpreter.

Please feel free to ask for further information regarding this study before signing your consent.

Investigators:  Dr Niranjan Arachchi  Medical Registrar  
Dr Sisira Jayathissa  Medical Consultant  
Rachael Cooke  Clinical Pharmacist  
Wellington Ethics Committee  (04) 918 5185

I, ___________________________ of ___________________________ have read the above information leaflet on the Adverse Medication Events Related Admission Study and understand the content. I had ample time to ask questions regarding the study, which were answered to my satisfaction.

I hereby consent to the researchers having access to my records held by my General Practitioner and/or pharmacy for clarification purposes.

I hereby agree to participate in the study myself /or agree to participate on behalf of my ___________________________ Mr/Mrs/Ms ___________________________

Signed (Patient/Next of kin/Guardian) ___________________________

Date
### APPENDIX 3

#### NARANJO CLASSIFICATION CRITERIA

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
<th>Don’t Know</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Are there previous conclusive reports on this reaction?</td>
<td>+1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2. Did the adverse events appear after the suspected drug was administered?</td>
<td>+2</td>
<td>-1</td>
<td>0</td>
</tr>
<tr>
<td>3. Did the adverse reaction improved when the drug was discontinued or a specific antagonist was administered?</td>
<td>+1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4. Did the adverse reaction reappear when the drug was readministered?</td>
<td>+2</td>
<td>-1</td>
<td>0</td>
</tr>
<tr>
<td>5. Are there alternative causes (other than the drug) that could on their own have caused the reaction?</td>
<td>-1</td>
<td>+2</td>
<td>0</td>
</tr>
<tr>
<td>6. Did the reaction reappear when the placebo was given?</td>
<td>-1</td>
<td>+1</td>
<td>0</td>
</tr>
<tr>
<td>7. Was the drug detected in the blood (or other fluids) in concentrations known to be toxic?</td>
<td>+1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>8. Was the reaction more severe when the dose increased, or less severe when dose was decreased?</td>
<td>+1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>9. Did the patient have a similar reaction to the same or similar drug in any previous exposure?</td>
<td>+1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10. Was the adverse event confirmed by any objective evidence?</td>
<td>+1</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Naranjo Score

<table>
<thead>
<tr>
<th>Definite (ADE &gt;= 9)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Probable (ADE 5-8)</td>
<td></td>
</tr>
<tr>
<td>Possible (ADE 1-4)</td>
<td></td>
</tr>
<tr>
<td>Doubtful (&lt;=0)</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX 4

Approval for the investigators to conduct the ADE-related admission incidence study and concurrent medication history study was sought from the Wellington Ethics Committee, Wellington, New Zealand. Approval was granted on 21 May 2003.