EFFECTS OF A MEDICATION REMINDER CALENDAR ON MEDICATION COMPLIANCE IN OLDER ADULTS

A thesis presented in partial fulfilment of the requirements for the degree of Master of Arts in Psychology at Massey University

June Barbara Greyvenstein
2001

ABSTRACT

The present study aimed to investigate whether the provision of an individualised medication reminder calendar would improve medication compliance, by acting as a cognitive aid for older adults, who may be suffering the mild memory deficits which tend to be the usual concomitants of normal ageing. The present study also examined medication compliance and error rates and their relationship with the amount of daily medication taken by participants, as well as with selected demographic and socio-economic factors. A convenience sample of community dwelling participants (N = 50), aged between 55 and 84 years (M = 71) who were prescribed an average of five daily medications, was randomly assigned to either calendar or control groups. Medication compliance was assessed via two pill counts conducted, on average, seven and a half weeks apart. The results showed that participants using the calendar and those in the control group did not differ in terms of compliance measures. The average rate of compliance with medication for the sample was 97%. The mean number of errors made by participants during the interval between pill counts was 19 (79% errors of omission and 21% errors of commission). Multivariate analysis indicated that the number of daily tablets taken was positively associated with the number and types of errors made. Women were less compliant than men, while participants of lower socio-economic status made more errors of commission. Discussion of these results focused on the non-representativeness of the sample and the difficulties associated with obtaining volunteers. Possible directions for future medication compliance research were discussed.

ACKNOWLEDGEMENTS

Firstly, I would like to express my indebtedness to my two supervisors, Dr. Nancy Pachana and Dr. Nik Kazantzis, who provided much needed emotional, practical and intellectual support during the conceptualisation, planning, execution and writing up of this research project.

Secondly, I am extremely grateful to the eighteen general practitioners who volunteered their assistance despite heavy work loads and a consequent singular lack of spare time.

A huge thank you is due to the research assistants who accompanied me on pill counting expeditions, especially to Jill Pratt, whose enthusiasm, diligence and importantly, competence in mental arithmetic, ensured accuracy during the lengthy data collection process. Her willingness to help, often at short notice, was greatly appreciated.

Thanks are also owed to my husband Peter and daughters Tenille and Zara, for their support during my years as a student. I hope I am forgiven for my ill temper when things did not proceed entirely as I had planned.

And finally, I would like to express my heartfelt thanks to the fifty marvellous participants who volunteered their time in order to help me with this project. It was a privilege to be welcomed into their homes and some of the baking I was able to sample was truly exceptional.

TABLE OF CONTENTS

Page

CHAPTER FIVE : METHOD

CHAPTER SIX : RESULTS

Page

CHAPTER SEVEN : DISCUSSION

Page

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE : INTRODUCTION

"Drugs don't work if people don't take them." (Everett Koop, Surgeon General of the United States of America, 1984).

Overview of Medication Compliance

The definition of medication compliance commonly cited in the literature, is that it is the extent to which a person's medication taking behaviour coincides with medical advice (Haynes, 1979). Similarly, Meichenbaum and Turk (1987, p.27) define it as the "correct consumption of prescribed medication". Consequently, medication non-compliance is the failure to take medication in the way prescribed by the physician. The use of the term "compliance" may be questioned, and it has been justifiably criticised for placing the responsibility for compliance squarely on the patient, implying that non-compliance is a "failure" on the part of the patient alone (Mindel & Kail, 1989). However, the term is ubiquitous and its use in the context of this report does not represent any underlying value judgements by the author. Additionally, primarily for convenience, the term "adherence" is used interchangeably with "compliance" in this report.

Non-compliance with medication may be related to dosage (taking an incorrect amount), drug taking method (taking it on an empty stomach instead of with a meal) or to timing (taking medication at incorrect intervals or erratically). Dosage errors which involve under-compliance, that is, taking less medication than is prescribed, are referred to as errors of omission for the purposes of this study. Dosage errors which involve over-compliance, that is, taking more medication than is prescribed, are referred to as errors of commission for the purposes of this study. Failing to present prescriptions to a pharmacy is another common form of non-compliance, and it has been estimated that in the United States about 20% of prescriptions are not filled (Berg, Dischler, Wagner, Raia, & Palmer-Shevlin, 1993).

Many studies indicate that a large proportion of non-compliance is the result of taking less medication than is prescribed (e.g., Col, Fanale, & Kronholm, 1990; Gravely & Oseasohn, 1991; Kruse, Koch-Gwinner, Nikolaus, Oster, Schlierf, & Weber, 1992; Law & Chalmers, 1976; Leirer, Morrow, Pariante, & Sheikh, 1988; Park, Morrell, Frieske, & Kincaid, 1992; Salzman, 1995; Spagnoli et al., 1989). Such under-compliance may lead to the hoarding of unused and possibly unidentifiable tablets, an unsatisfactory and potentially dangerous situation. Saved tablets may be used at a later stage, perhaps subsequent to their "use-by" date, or shared with others. In fact, 43% of Buckalew and Buckalew's (1995) census-based sample confessed to having used other people's medication. By comparison, a New Zealand study (Burt & Cooper, 1984) found a lower incidence of prescription "sharing" in their sample, with 8% of prescribed medicines having been used previously by at least one other person. Five percent of Kendrick and Bayne's (1982) sample gave away unused drugs to others.

While medication non-compliance is found across all age groups, the consequences for older patients tend to be more serious than those for younger patients. This is due to an increased sensitivity to drugs as a result of age-related physiological changes (Richardson, 1986), combined with the often long term and substantive consumption of drugs (polypharmacy) due to chronic and multiple disorders. Advancing age is associated with poorer health status and approximately 80% of the older adult population of New Zealand currently experiences one or more chronic illnesses (Millar, Flett, Kazantzis, Long, & MacDonald, 1999). Ageing is also associated with the use of more medications (Chrischilles, Segar, & Wallace, 1992), with pharmacotherapy the most frequently utilised treatment modality in older adults (Cooper, 1990).

In sum, it is the combination of these three factors, namely age-related physiological changes, the increased likelihood of suffering from chronic disease and polypharmacy, which makes medication compliance a major issue in the health care of older persons.

Medication Compliance and Older Adults

Age Related Physiological Changes

One of the most important consequences of age-related physiological changes and their relationship with medication intake, is that the effects of many drugs tend to be amplified with age. Older adults tend to have a narrower therapeutic window than younger adults, as the beneficial dosage level of a drug and a potentially adverse dosage level are not widely separated (Richardson, 1986). This smaller margin of error is especially relevant in medication non-compliance where errors of commission or timing occur. Gravely and Oseasohn (1991) found that 30% of their non-compliant participants had taken more than 110% of their medication. Such findings may be due to the mistaken belief by some patients that taking more of a drug will speed recovery (Salzman, 1995). Physiological changes at organ, tissue and cell level due to primary or "normal" ageing (excluding the presence of disease) may affect all phases of medication intake, namely drug absorption, distribution, metabolism and excretion.

Drug Absorption

Certain age-related changes have the potential to alter the absorption of certain medications. These include a decrease in the output of gastric acid, resulting in a concomitant decrease in drug solubility, and a reduction in the level of mesenteric (intestinal) blood flow. In addition, there is a reduction in the size of absorbing surfaces and impairment in the enzyme systems responsible for intestinal epithelial membrane transport (Potempa & Folta, 1992).

Drug Distribution

There are two main age-related changes that affect drug transportation. The first is a reduction in total body water and in lean body mass per kilogram and an accompanying increase in body fat. The influence of such changes varies according to

the type of drug ingested and its solubility. For instance, drugs with high lipid solubility will be stored for longer periods in older adults due to the replacement of muscle by fat. This longer storage time affects a drug's peak concentration and half life and may result in drug toxicity or adverse reactions if too great a dose is taken. The half life of a drug is the time taken for the concentration of that drug to decrease by a half, and is useful for calculating when repeat doses should be given in order to maintain a steady state concentration (Galbraith, Bullock, & Manias, 1994). Sedative-hypnotic drugs, such as barbiturates and benzodiazepines are absorbed by body fats, causing prolonged action in older adults, especially for those that are overweight. In fact, Bliss (1981) states that in older adults, the half life of diazepam is as long in hours as the patient's age in years. Conversely, drugs which are relatively water soluble and lipid insoluble, such as acetaminophen (paracetamol) may have a decreased distribution in older adults compared to the young (Greenblatt, Sellers, & Shader, 1982).

A second age-related change affecting drug distribution is a reduction in serum albumin (a major protein contained in blood plasma), which affects drugs that bind to protein in the blood. Lower levels of available protein increase the amount of "free", and hence active, protein binding drug in the plasma. Therefore, the pharmacological effect of such a drug tends to be magnified in older, compared to younger, patients (Bliss, 1981). Examples of drugs which bind to albumin in their transport around the body include warfarin (an anti-coagulant), sulphonureas (which lower blood sugar levels), salicylates (e.g., aspirin) and phenylbutazone (a non-steroidal anti-inflammatory analgesic agent), which are all drugs commonly prescribed to older adults (Bliss, 1981). When two or more of these drugs, for example, warfarin and aspirin, are taken simultaneously, and where plasma albumin levels are reduced, aspirin will be protein bound at the expense of warfarin. The potential consequences of the resultant increase in the amount of warfarin in the blood may include death (Galbraith et al., 1994).

Drug Metabolism and Excretion

Most drugs are eliminated by the kidneys or the liver, although a few are eliminated via the lungs, saliva or skin. Kidney function, especially glomerular filtration rate and renal blood flow, reduces with age and as many as half of functioning nephrons may be lost by age 75. Older persons may therefore be susceptible to toxic drug effects relating to drugs which are excreted by the kidney, like digoxin, lithium and cimetidine (Greenblatt et al., 1982; Potempa & Folta, 1992). Liver function may also decrease with age (Pesznecker, Patsdaughter, Moody, & Albert, 1990).

Consequently, although there is great variability in the rate and magnitude of ageing amongst individuals, and among different body systems and organs in the same individual, these age-related physiological changes make it apparent that a dose of medication appropriate for a younger adult is often an overdose for an older patient (Bliss, 1987). Thus dosage or timing errors in medication may have serious consequences.

Chronic Diseases

In earlier centuries, humans died primarily of infectious diseases such as measles, smallpox, typhus, tuberculosis, influenza, cholera, gastro-enteritis and diphtheria, or in epidemics (e.g., bubonic plague), with few surviving into what we now regard as "old age". Slow-developing causes of death like cardiovascular or cerebrovascular disease, cancer, or respiratory diseases such as emphysema were not common, and it was only during the late 1930s that chronic diseases began to supersede infectious diseases as major causes of death (Birren & Schroots, 1996).

As chronic diseases, by their nature, develop slowly over the lifespan, older adults are more likely than younger adults to suffer from them. For example, the incidence of heart failure in the general population ranges from one to five cases per 1,000 per annum, but is up to 40 cases per 1,000 for persons who are over 75 years of age (Cowie et al, 1997). In New Zealand, older adults are about three times more

likely to suffer from disabilities than their working-age counterparts, and are generally more likely to suffer from medical conditions like hypertension, diabetes or other long-term illnesses (Statistics New Zealand, 1998). About 73% of older adults participating in a New Zealand study suffered from two to four chronic conditions, with arthritis, hearing and sight impairments and hypertension the most common (Millar et al., 1999). Thus, in general, the health of older adults is more fragile than that of younger persons (Richardson, 1986). Medication plays an important role in controlling such diseases in the long term, serving to decrease morbidity and prolong life.

Polypharmacy

Polypharmacy occurs when multiple drug therapies are required (Potempa & Folta, 1992). As the likelihood of suffering chronic diseases requiring medication increases with age, polypharmacy is a reality of life for many older adults (Gien & Anderson, 1989). The extent of drug use differs within the older adult population, depending on whether or not persons are hospitalised, living in long term care institutions or dwelling in the community. As expected, the highest use of medication tends to be by hospitalised or institutionalised older adults. Studies have shown that, on average, residents of an inpatient facility are prescribed over eight medications concurrently (Avorn, Dreyer, Connelly, & Soumerai, 1989; Beers et al., 1988; Lamy, 1980). Marcantonio and colleagues (1999) found discharged hospital patients to be prescribed an average of seven medications. This is about double the prescription rate of older persons who are not institutionalised (Ostrom, Hammarlund, Christensen, & Plein, 1985).

Seventy five percent of ambulatory, community dwelling older adults in the United States of America take at least one prescription medication daily (Lamy, 1989, as cited in Potempa & Folta, 1992). Similarly, a 1994 study which analysed data from a sample of 6,171 older adults, found 82% of the sample to be using prescription

medication (Willcox, Himmelstein, & Woolhandler, 1994). This concurs with earlier large studies which found between 75% to 89% of older adults to be on prescription medication of some kind (Law & Chalmers,1976; Skegg, Doll, & Perry, 1977). Estimates of the numbers of prescription drugs taken by persons over age 65 living in the community vary widely. For instance, Gravely and Oseasohn (1991), in a study of previous patients of a Veteran's Administration Hospital, found them to be on an average of 11 pills per day. Interestingly, one subject was on 19 medications and swallowing 43 pills per day. In general, the range seems to be from one to seven medications per individual, with an average of around three or four (Cohen, Rogers, Burke, & Beilin, 1998; Chrischilles et al., 1992; Conn, Taylor, & Kelley, 1991; Helling, Lemke, Semla, Wallace, Lipson, & Cornoni-Huntley, 1987; Kendrick & Bayne, 1982; Law & Chalmers, 1976; Spagnoli et al., 1989). Additionally, non-prescription drug use is common in the older adult population. Studies find that the volume of non-prescription drugs used is about twice that of prescription drugs (Dunnell, 1973; Wadsworth, Butterfield, & Blaney, 1971, as cited in Gien & Anderson, 1989).

Medication Non-Compliance as a Cause for Concern

The potential adverse results of medication non-compliance are numerous and the consequences widespread. As far as the individual is concerned, these may include suffering prolonged illness, undergoing unnecessary medical procedures, being hospitalised or having to move from an independent living situation to a residential care facility.

Illness relapse or disease exacerbation may follow non-adherence (Phillips, 1988) as for all drugs there is a minimum effective concentration below which there will be no therapeutic effect (Galbraith et al., 1994). Absence from work, emergency care, hospitalisation and in some cases death, may also result from medication non-compliance (Perri, Martin, & Pritchard, 1995). Physicians may alter prescriptions, or

send the patient for further and unnecessary diagnostic procedures, not realising that the lack of success in treatment is due to non-compliance rather than inappropriate prescribing. An unsuccessful therapeutic outcome may compromise the quality of the relationship between patient and practitioner. Additionally, such consequences of medication non-compliance have clear financial implications for the individual.

Data from the New Zealand population indicate that despite chronic illness or disability, many older persons prefer to remain in their own homes, as opposed to entering residential care facilities, for as long as possible (Isaacs & Spoonley, 1994). In addition, McDonald-Smith (1997) found that community dwelling older adults living in the Manawatu had better objective quality of life than those living in rest homes. Moreover, higher rates of depression have been found in persons living in assisted living settings compared to those in the community at large (Grayson, Lubin, & Van Whitlock, 1995). In order to remain living at home, older adults need to demonstrate competence in abilities critical for living independently. The ability to manage medications is commonly cited as one of these essential activities (Willis, 1996). Another important precipitator of loss of independence is suffering a fall and the incorrect use of, for instance, sedative and psychotropic drugs, may increase the risk of falling among older adults (Simoneau & Leibowitz, 1996; Thwaites, 1999). According to national data for 1997 to 1998, 25% of all hospitalisations due to injury or poisoning were due to accidental falls (New Zealand Health Information Service, 1999).

The societal implications of medication non-compliance by individuals may include the waste of its resources and the evolution of organisms which are resistant to certain drugs. Professional expertise and time are wasted when physicians' instructions are not followed, although there is preliminary evidence to suggest that physicians' advice is far more likely to be followed by older adults than is advice from non-physicians such as social workers or nurses (Shah, Maly, Frank, Hirsch, & Reuben, 1997). Similarly, health system resources are squandered when drugs purchased are

not consumed. In addition, clinical drug trials may be placed in jeopardy when an unsuccessful therapeutic outcome is the result of non-compliance rather than due to negative effects of the drug (Matsui et al., 1994). Furthermore, the non-purchase of prescribed drugs may adversely affect the profitability of the pharmaceutical industry, and reduce its contribution to national taxes (Perri et al., 1995).

Failure to complete a course of antibiotics may result in the evolution of resistant strains of micro-organisms. The more virulent bacteria may survive the first few days of treatment and upon the cessation of medication intake begin to multiply (Meichenbaum & Turk, 1987). In this way, not only the individual, who may suffer a relapse, but the whole population, is placed at risk, especially where non-compliance relates to communicable diseases such as tuberculosis. Therefore, it is apparent that medication compliance has potential benefits which extend to both the individual and society. A great deal of research into medication compliance has eventuated over the decades. There were more than 14,000 published papers listed on Medline alone in the mid-nineties (Donovan, 1995). Many of these studies have focused on medication compliance issues relating to older adults.

Compliance Levels Among Older Adults

The large quantity of research cited above has produced a correspondingly large range of findings. There are differing views about where the boundary should be drawn between medication compliance and non-compliance, complicating comparisons between different studies (Marston, 1970). Table 1 summarises the findings of a selection of studies carried out between 1970 and 1999. These studies were obtained subsequent to computer searches of the PsycINFO and Medline databases, using the following key words: *medication compliance, medication adherence, drug compliance, drug adherence.*

Table 1

Examples of Medication Compliance Studies Listed According to Year Published

Authors and year published	*N*	Age of participants	Definition of compliance	% compliant	Method used to measure compliance
Wandless & Davie (1977)	46	64-93 (*M* = 77)	Making no medication errors	20%	Pill counts
Kendrick & Bayne (1982)	31	65 or over (*M* = 79)	Percentage of prescribed medication taken	57%	Pill counts
Black, Brand, Greenlick, Hughes, & Smith (1987)	551	60 and over (*M* = 72)	Taking 80-120% of prescribed doses	80 – 90%	Self report, pill count and urine test
Spagnoli et al. (1989)	802	Over 65	(a) Taking all prescribed drugs correctly (b) Taking 75-100% of prescribed drugs	(a) 60% (b) 69%	Self report
Col et al. (1990)	315	Over 65 (*M* = 77)	Taking medication in prescribed doses	67%	Self report (upon hospital admission)
Conn et al. (1991)	(a) 178 (b) 98	Over 65	Percentage of pills taken each week	(a) 92% (b) 88%	Self report and a few pill counts
Gravely & Oseasohn (1991)	249	Men over 64	Taking 80 – 110% of drugs	27%	Pill counts

(Table 1 continues)

(Table 1 continued)

Authors and year published	*N*	Age of participants	Definition of compliance	% compliant	Method used to measure compliance
Botelho & Dudrak (1992)	59	65 and over	Above 80%	45.3%	Pill counts
Kruse et al. (1992)	18	*Mdn* = 76	Percentage of prescribed doses taken	73%	Continuous electronic monitoring
Park et al. (1992)	61	60 and over	Making no medication errors	89%	Bar codes
Bame, Petersen, & Wray (1993)	1,230	*Mdn* = 59	Meeting standardised criteria established for dialysis patients	50%	Urine and blood tests
Lorenc & Branthwaite (1993)	50	Over 70	A compliance ratio of 90 -110%	60-68%	Pill counts
Monane, Bohn, Gurwitz, Glynn, & Avorn (1994)	7247	Outpatients 65 –99	Taking 100% of medication over a 12 month period	10%	Prescription refill records
Rich, Gray, Beckham, Wittenberg, & Luther (1996)	156	Discharged hospital patients over 70 (*M* = 79)	Percentage of medication taken correctly	85%	Pill counts
Atwood et al. (1996)	40	47-73 (*M* = 65)	Average daily pill intake (1 pill daily)	97.4%	Self report

(Table 1 continues)

(Table 1 continued)

Authors and year published	*N*	Age of participants	Definition of compliance	% compliant	Method used to measure compliance
Choo et al. (1999)	286	Over 18 years	(a) Percentage of prescribed doses taken (b) Percentage of doses taken at the correct time	(a) 92% (b) 63%	Electronic monitoring, pill counts and self report

Table 1 shows that compliance levels cited in the literature vary markedly, ranging from 10% to 97%. However, the consensus is that, on average, about half to two thirds of patients are compliant (Wright, 1993). Average compliance levels among elderly patients do not appear to differ significantly from those of younger adults (Law & Chalmers, 1976; Wandless & Davies, 1977). Nevertheless, although older adults may generally not make more drug errors than younger adults, the adverse consequences of non-compliance may be more severe and less easily detected or resolved (Green, Mullen, & Stainbrook, 1986).

The great variability in findings of compliance levels may, in part, be due to the lack of a consistent operational definition of compliance. Spagnoli et al. (1989) point out the absence of any agreed definition of the "non-compliant patient" and indeed, studies have defined this arbitrarily (see Table 1). The proportion of prescribed medication which must be correctly ingested in order for a patient to be judged compliant, continues to be the focus of debate. As Phillips (1988) pointed out, if compliance is defined too rigidly, the slightest deviation is interpreted as non-compliance. For example, an overly rigid definition of compliance would be one requiring the patient to take 100% of prescribed medication, at exactly the prescribed times, and in exactly the

prescribed way. Controversially, Phillips suggests that in many short term illnesses, taking between 40% to 60% of the prescribed medication may be sufficient. Gordis (1979) lends some support to this argument by reporting that paediatric patients taking penicillin for prophylactic reasons, need only comply with their regimens one third of the time in order to significantly reduce their risk of infection. In the case of long term illnesses such as hypertension, Sackett and Snow (1979) state that hypertensive patients who consume a minimum of 80% of their medication, are generally found to exhibit systematic decreases in blood pressure levels. They feel that "compliance" in relation to anti-hypertensive drugs may consequently be defined as taking at least 80% of prescribed medication. Thus, some suggest that the definition of compliance should be related to the minimally acceptable levels of medication intake that produce the desired clinical response.

In summary, there is little agreement among medical professionals about the level of compliance required to achieve a desired outcome (Meichenbaum & Turk, 1987). Individuals vary widely in their absorption and metabolism of, and response to, drugs. Adequate levels of a drug in the body may not be achieved for some patients, and the desired therapeutic outcome would consequently be unlikely. Of course, clinical outcome is often the result of factors other than, or additional to, medication intake (Perri et al., 1995).

Compliance Theories

In their seminal publication "Facilitating Treatment Adherence", Meichenbaum and Turk (1987) suggest that while a substantial body of research into non-compliance exists, this nevertheless lacks both methodological sophistication and a well-validated, integrative theory. Indeed, Nichol, Venturini and Sung (1999), in their assessment of the methodology used in research on patient compliance with medications, found that 31% of the articles they studied had omitted to state either the compliance measure or the criteria for compliance.

There are a variety of theoretical models or concepts which have been advanced as explanations for non-compliance with medication regimens. One prominent theoretical formulation is the Health Belief Model (HBM; Janz & Becker, 1984) which, as its name suggests, has as its core concept the idea that beliefs about health guide decisions and actions. Health beliefs include a person's perceived threat of a disease (their susceptibility to it, and its severity or seriousness), plus their perception of the effectiveness of behaviour to counteract this threat (the efficacy of the treatment available and its perceived benefits or barriers). Barriers may include practical issues like the expense of medication or other therapies, or anticipation of unpleasant side effects of drugs, but may also involve psychological obstacles, such as anxiety. Thus, individuals are likely to engage in a particular health behaviour, such as medication compliance, if they believe themselves susceptible to a particular serious illness or condition and if they believe the benefits of the action taken to counteract the condition or illness outweigh the costs of doing so (Conner & Norman, 1998).

According to this model, decisions relating to medication compliance are acted upon after weighing up potential benefits and risks. In their review of 46 studies, Janz and Becker (1984) found that perceived barriers appeared to be the most powerful predictors of health related behaviour, followed by susceptibility, benefits and severity, in descending order. These studies provided empirical support for the HBM dimensions as important contributors to the explanation and prediction of health related behaviour. However the Health Belief model has been criticised on the grounds that it assumes that decisions relating to compliance are arrived at in a rational manner, excluding the possibility that irrational or distorted health beliefs may influence behaviour. For instance, research has established a link between poor adherence to a diabetic regimen and the extent of irrational health beliefs (Christensen, Moran, & Wiebe, 1999). Examples of irrational health beliefs may include the belief that medicine is only necessary in acute illness, misconceptions about the nature or prognosis of a disorder, denial of illness, or a lack of understanding about the concept

of prophylaxis. These beliefs may be the result of faulty or inadequate information, misunderstandings, cultural myths or negative distortions (Meichenbaum & Turk, 1987).

A second theoretical model for medication compliance is the concept of health locus of control (HLOC), which originates from Rotter's (1966) distinction between internal and external locus of control. A person who believes that outcomes are dependent wholly or partially on their own actions, is said to have an internal locus of control. Conversely, someone who believes that outcomes are largely dependent on external forces, or the actions of others, is said to have an external locus of control (Conner & Norman, 1998). Medication compliance and other health promoting behaviours seem more likely in persons with an internal locus of control, as they may be less fatalistic than those with an external locus of control. Woodward and Wallston (1987) suggest that as older generations tend to be subservient to health professionals, they may be less likely than younger adults to feel capable of controlling their health themselves. Additionally, older persons may be less likely to perceive that they have any control over their health as they are more likely to be chronically ill (Deeg, Kardaun, & Fozard, 1996). Research has tended to support a weak positive relation between internal HLOC and the performance of health promoting behaviour, although findings have been inconsistent (Conner & Norman, 1998). For example, several studies have correlated participant medication compliance with scores on the Multidimensional Health Locus of Control scale (Wallston & Wallston, 1982). This scale measures individuals' belief that their health is a function of their own behaviour, chance or powerful others such as health professionals. One such study (Raiz, Kilty, Henry, & Ferguson, 1999) found that individuals who believed that health outcomes were controlled by powerful others were more likely to take medications exactly as prescribed. However, Gravely and Oseasohn (1991) tested the 249 veterans in their sample using this scale, and scores did not significantly predict compliance.

CHAPTER TWO : REASONS FOR MEDICATION NON-COMPLIANCE

The large quantity of research into medication non-compliance has established that a great many interrelated, overlapping and interacting factors are associated with medication non-compliance. In fact, Wright (1993) claims that the reason many physicians tend to ignore medication compliance issues is precisely because such complex sets of behaviours are involved. Indeed, Sackett and colleagues (1976, as cited in Phillips, 1988) claim that research indicates that about 250 variables contribute in some way to non-compliance with medication or other treatment regimens prescribed by physicians.

Demographic and Socio-Economic Factors

While demographic factors implicated in medication non-compliance are, by their nature, largely immutable, they are of interest nevertheless in attempting to understand the phenomenon. Although demographic variables such as gender, ethnicity or age and socio-economic factors like income, education and living arrangements have not been found to greatly influence compliance (Haynes, Taylor, & Sackett, 1979), nevertheless some relationships have been established.

Studies find that older women tend to take more drugs, both prescribed and non-prescribed, than older men (Cohen, Rogers, Burke, & Beilin, 1998; Chrischilles et al., 1992; Helling et al., 1987; Law & Chalmers, 1976). However, research into the relationship between gender and non-compliance has yielded mixed findings. For instance, Blackwell (1972) found non-compliance to be higher in women, while Col and colleagues (1990) found that females had a higher risk of hospitalisation due to non-compliance. Gray et al. (1996) found males to have a higher risk of incorrect inhaler use. Although some research has found men more likely to be compliant with anti-hypertensive drugs than women (Daniels, Rene, & Daniels, 1994), other studies have

demonstrated otherwise. For instance, neither the large SHEP pilot study into hypertension (Systolic Hypertension in the Elderly Program; Black et al., 1987), nor the extensive study into compliance with congestive heart failure therapy, involving 7,247 elderly outpatients (Monane et al.,1994), found any gender differences in compliance.

Findings in regard to the relationship between ethnicity and medication compliance have been inconsistent. For instance, several studies (e.g., Black et al., 1987; Curtin, Svarstad, & Keller, 1999; Gravely & Oseasohn, 1991; Rich, Baldus Gray, Beckham, Wittenberg, & Luther, 1996) found Whites to have higher medication compliance rates than Hispanic or Black Americans. However, Monane et al. (1994) found comparable rates of compliance between Black and White Americans, although the Hispanic participants in their study were more likely to be non-compliant. Such ethnic variations in compliance are likely to be the result of language or communication difficulties due to cultural differences rather than ethnicity itself (North, 1983).

Age does not appear to be systematically related to medicine consumption until 65 years of age, when intake of prescription medicines tends to increase (Dunnell, 1973). Numerous studies have shown that the greater the number of drugs prescribed, the greater is the reduction in patient compliance (e.g., Col et al., 1990; Gravely & Oseasohn, 1991; Gray, Mahoney, & Blough, 2001). Not only are older adults more likely to be suffering from chronic conditions requiring multiple prescription medications, but they are also more likely to self medicate (Crooks & Christopher, 1979, as cited in Gien & Anderson, 1989). Older adults are more at risk of complications as a result of the misuse of drugs than are younger adults (Richardson, 1986). The consequences for the "oldest-old" (those aged 85 and over), whose health may be expected to be the most fragile, are likely to be the most severe. Interestingly, Monane et al. (1994) found that participants in their study who were aged over 85 had the highest rates of compliance, a finding the authors suggested may have been due to the greater likelihood of their having caregiver assistance with their medication.

The link between medication compliance and socio-economic status is not straightforward. For example, while Blackwell (1972) found the relationship between socio-economic factors and compliance to be inconclusive, other studies have found the cost of medication to be an important influence on compliance (Moser, 1995). A well-documented correlation exists between poverty and ill health (Adler et al., 1994). Indeed, a survey into the use of health care services in New Zealand found people on low incomes used more health services than those in higher socio-economic groups (New Zealand Health Information Service, 1995). The poorest older adults are thus the most likely to suffer from multiple chronic illnesses requiring prescription medication (Potempa & Folta, 1992). Economic constraints may play a part in medication compliance where under-adherence results from a desire to save money by "stretching" the prescription, and indeed, a United States study has found that about a third of the under-use of medication by patients aged over 65 years, was due to an inability to afford it (Frisk, Cooper & Campbell, 1977, as cited in Cooper, 1990). In New Zealand, older adults have lower average annual incomes than their working age counterparts, with older women receiving lower incomes than older men. The average income of older Maori, Pacific Islanders and Asians is lower than that of the total population of older adults (Statistics New Zealand, 1998). Approximately 20% of superannuitants rely solely on New Zealand Superannuation (Prime Ministerial Task Force for Positive Ageing, 1997), which in 1996 was about $10,720 per annum for a single person living alone, compared to the median annual income for all adults of $15,600 per annum (Statistics New Zealand 1998).

As far as the relationship between education and medication compliance is concerned, findings suggest that they are positively correlated. For instance, Leistyna and Macaulay (1966) found that patients of higher socio-economic and educational status had above average compliance rates. Similarly, Daniels and colleagues (1994) found a significant positive relationship between education and compliance in their study of 403 hypertensives. According to the 1996 census, 48% of older men and 57%

of older women have no formal qualifications and few progressed beyond the fifth form at school, although about 31% of older men and 18% of older women do have a tertiary qualification of some sort (Statistics New Zealand, 1998).

The positive correlation between education and medication compliance rates may be the result of greater knowledge and understanding of the benefits of completing a course of medication on the part of those with more education (Meichenbaum & Turk, 1987). Better educated patients may be more likely than their less educated counterparts to feel at ease with, and less intimidated by their general practitioner, as well as more able to ask appropriate questions. As Meichenbaum and Turk (1987) point out, patients rarely tell physicians that they do not understand them, due to embarrassment, fear of appearing stupid or because they "...may not know what they do not know" (p.115). Additionally, Brody (1980, as cited in Meichenbaum & Turk, 1987) observed that physicians tend to provide more information to patients of higher socio-economic status than to patients of lower socio-economic status, thus encouraging compliance among the former.

Research has established a link between the living arrangements of older adults and medication compliance, as studies have found non-compliance to be greater in those living alone (Col et al., 1990; Barat, Andreason, & Damsgaard, 2001; Lorenc & Branthwaite, 1993; Rich et al., 1996). The greater longevity of women means they tend to make up a greater proportion of the older adult population (57% of over-65s; Statistics New Zealand, 1997) and to outlive their husbands. Almost three-quarters of older adults living alone are women (Statistics New Zealand, 1998), which may place them at greater risk of medication non-compliance than older men. North (1983) found that the more serious instances of compliance failure in her sample of tuberculosis patients, were among those patients who did not have the support of family. Emotional, social or practical support may be particularly important when the medication regimen is prolonged, complex or unpleasant. Willis (1996, p.302) suggests

that significant others may serve as a "cognitive prosthesis in problem-solving situations, such as medication adherence."

Other variables cited in the research literature as contributors to medication non-compliance in older adults include the disappearance or lack of symptoms, unpleasant side effects and dissatisfaction with the physician. Compliance may vary depending on the nature of the setting, while non-compliance may be the result of a lack of knowledge about the prescribed therapy, unclear instructions by the physician, a lengthy or complex treatment regimen, or the consequence of physical and sensory deficits, psychological problems or cognitive and memory deficits. These variables are discussed in the sections which follow.

Disappearance or Lack of Symptoms

The fact that symptoms have attenuated or disappeared and the patient feels better, often leads to a cessation of medication intake, contrary to the physician's instructions (Spagnoli et al., 1989). In Buckalew and Buckalew's study (1995), 60% of subjects indicated they tended to stop taking medication once they felt better. Parental inability to comply with medication instructions for their children is commonly explained by the child appearing better (Phillips, 1988). Low adherence rates are especially prevalent when patients have chronic disorders with no immediate risk or discomfort, where prevention rather than symptom relief or cure is the aim (Meichenbaum & Turk, 1987). Non-adherence is especially dangerous in hypertension, often a symptomless disease, but one with potentially lethal consequences, such as a stroke or kidney failure (Perri et al., 1995).

In a review of several studies into the relationship between symptoms and medication compliance (Haynes et. al., 1979), the authors highlighted that, contrary to expectation, none of the studies they reviewed indicated that compliance improved markedly as severity of symptoms increased. A study by Vincent (1971) is illustrative. It involved patients with glaucoma who were warned to use eye drops daily otherwise

blindness might ensue. Despite such a potentially dire consequence, there was no significant increased tendency towards compliance in many patients; 54% were non-compliant. Similarly, Richards, Fortune, O'Sullivan, Main and Griffiths (1999) found that their non-compliant patients rated their condition (psoriasis) to be more severe than compliant patients. Therefore, even potentially dangerous health implications may not improve medication compliance.

Unpleasant Side Effects

The unpleasantness of side effects is a powerful motivator in medication non-compliance and is commonly cited by patients as their reason for ceasing medication intake (Conrad, 1985; Maddox, Levi, & Thompson, 1994). It may be expected therefore, that compliance levels would vary according to the particular drug or disorder involved. Side effects of medication for asymptomatic conditions like hypertension, are less likely to be tolerated than those produced by medication which relieves symptoms (Meichenbaum & Turk, 1987). Compliance rates for anti-hypertensive drugs are low, and their disagreeable side effects, which may include extensive diuresis, dry mouth and gout (for diuretics) and coughing and dizziness (for ACE inhibitors), may be among the reasons for their discontinuance (Stromberg, Brostrom, Fridlund, Dahlstrom, & Fridlund, 1999).

In a large sample (N = 802) Spagnoli et al. (1989) found fear of side effects to be the most common cause of non-compliance across a range of drug types, about a third of which were cardiovascular drugs, including anti-hypertensives and diuretics. Wolfe and Schirm (1992) found a primary reason for non-compliance in their sample of older adults to be an upset stomach. The presence of side effects may also explain the finding by Kendrick and Bayne (1982) that vitamins and iron pills were taken with greater regularity than more important drugs such as cardiovascular medication.

Nevertheless, despite their unpleasant nature, some side effects are tolerated more than others. A study by Conrad (1985) found that side effects of an epilepsy

medication which impaired social skills, such as slurred speech, impaired memory, slowed mental functioning or drowsiness, were more likely to be the reason for non-compliance than other side effects including swollen and bleeding gums, sore throat, pimples or a rash.

Interestingly, side effects are sometimes incorrectly attributed to medication. A study by Atwood and colleagues (1996) in which all participants were placed on a placebo-only regimen for an initial four week period, nevertheless resulted in complaints about side effects. For instance, two participants claimed the "medication" kept them awake at night. Additionally, it was during this four week placebo period that the *majority* of participant-reported adverse side effects occurred. Therefore, compliance may be adversely affected by the incorrect attribution of symptoms to medication.

Dissatisfaction with Physician

Patient dissatisfaction with communication in the doctor-patient interaction may affect health by reducing the degree of commitment to the treatment regimen or medical advice, and thus impact directly on recovery (Hall, Roter, & Rand, 1981; Meichenbaum & Turk, 1987; Stromberg et al., 1999). In the fast-paced world of the 21st century, heavy workloads and economic constraints are likely to limit the time made available to their patients by physicians, which may result in patients feeling "short-changed". In fact, during consultations between New Zealand's first Minister for Senior Citizens (Margaret Shields) and older persons at 22 public meetings across the country, doctors were criticised for being in too much of a rush and not always being helpful (Senior Citizens Unit, 1990).

Decreased satisfaction with the interpersonal manner of physicians correlated with lower medication compliance in a study of 333 older adults (Harris, Luft, Rudy, & Tierney, 1995). Physicians may sometimes be perceived by patients as being quick to write prescriptions, and in such instances non-compliance with medication may be the consequence of a patient's belief that the prescription was not required in the first

instance (Fincham & Wertheimer, 1988). Unfortunately, older patients may feel deferential towards health professionals, and consequently less likely to question them (Lipton, 1989).

Interestingly, research has shown that many patients, particularly those who are not well educated or who are highly concerned about their health, often judge the technical competence or expertise of their general practitioners by their communication skills (Ben-Sira,1980). The ability of the health care practitioner to empathise is especially highly valued by patients (Suchman, Markakis, Beckman, & Frankel, 1997). In a New Zealand study of compliance in persons suffering from tuberculosis, North (1983) found that patients felt their practitioners did not adequately recognise and deal with their subjective experiences of suffering such a serious and stigmatising illness, leaving them with unresolved anxieties and uncertainties. The challenge to physicians is to balance their expertise and authority with their patients' need for empathy and compassion (Coe, 1997).

Nature of the Setting

Research has established differences in medication compliance according to the setting. For instance, Blackwell (1972) found that drug default rates were lowest among inpatients, higher among day patients and highest among outpatients at the same hospital. Monane and colleagues (1994) established that nursing home residents are generally more compliant than outpatients, as staff tend to administer their medications. Nevertheless, Rosenblatt and Spiegel (1988, as cited in Davison & Neale, 1994) found that 29% of United States nursing homes failed to administer drugs according to physician's instructions. Thus, drug non-compliance among older adults is a problem not limited to those living in the community.

Lack of Knowledge about Prescribed Therapy or Unclear Instructions

Medication compliance may be adversely affected by a lack of knowledge about the therapeutic regimen or due to unclear instructions being provided by the medical

practitioner or pharmacist. With regard to providing patients with information about their prescribed regimen, Meichenbaum and Turk (1987) remind practitioners that the term "doctor" comes from the Latin word "docere" which means *to teach*. Studies have supported a relationship between poor knowledge by a patient of a prescribed regimen and non-compliance and Miller (1997) feels older adults are often disadvantaged in this respect. Lack of knowledge about treatment contributes more to non-compliance than a lack of knowledge about the disorder (Dunbar & Agras, 1980). For instance, Frisk, Cooper and Campbell (1977, as cited in Cooper, 1990) found a lack of patient knowledge about prescribed therapy to contribute to almost half of under-use of medication and adverse drug reactions or interactions. Parkin, Henney, Quirk and Crooks (1976) found 51% of patients discharged from hospital were subsequently non-compliant with their medication, and that 70% of these did so due to non-comprehension or the lack of a clear understanding of their drug regimen. Over a quarter (29%) of Kendrick and Bayne's (1982) sample had an understanding of their medication instructions at odds with what was written on the drug label. Spagnoli and colleagues (1989) found poor understanding of treatment to be the reason that 16.5% of their sample of 802 older adults were non-compliant with their medication. These findings emphasise the need for simple and clear communication between doctor and patient regarding the medication regimen.

For instance, some medications like tricyclic antidepressants, have an initial pronounced sedative effect, which wears off over a period of days (New Ethicals Catalogue, 1999). If these initial side effects have not been explained to patients, they may stop taking a drug before it has had sufficient time to work. Thus, where the patient's time frame for a salient outcome differs from that of the health professional, medicine may be judged to be ineffective and consumption terminated (Conrad, 1985). Research has indicated that most physicians underestimate the amount of information patients want to receive (Meichenbaum & Turk, 1987). The need for straightforward communication of relevant information is especially important as it appears that, on

average, between 70 and 100% of older adults living in the community personally manage their own medicines (Kendrick & Bayne, 1982; Law & Chalmers, 1976; Spagnoli et al., 1989).

However, the relationship between medication or treatment information and compliance is not consistent. The study by Col et al. (1990) found patients with a partial knowledge of their medication regimen to be at higher risk of hospitalisation for non-compliance than those with no recall. The authors suggest that an explanation for this finding may be that patients with no recall may be more likely to seek assistance than those with partial recall.

As far as instructions about medication are concerned, those which appear clear cut and simple to the physician or pharmacist, may not always be so for the patient. Davison and Neale (1994) cite the case of an older woman who had been prescribed antibiotics, with accompanying instructions that these should not be taken before or after meals. The patient believed that she was therefore unable to eat at all while taking this medication. The writer is familiar with a tragedy in Durban, South Africa, where an elderly African woman was prescribed medication and told to make certain that she took *all* the pills (that is, that she should complete the course). Unfortunately she took this to mean that all the pills should be taken simultaneously, and was found deceased in her room the following morning. These examples illustrate the extreme importance for physicians to customise the information they provide according to the patient's comprehension level (Meichenbaum & Turk, 1987).

Length of Treatment Regimen

Studies have found differences in compliance levels between short and long term medication regimens. Compliance with short term regimens, while better on average than that for long term regimens, is still far from excellent. Sackett and Snow (1979) found average compliance to be 62% for short term regimens and 54% for longer term regimens. Patient compliance with medication for chronic diseases such as

hypertension and diabetes is generally poor, with only about 50% of patients adhering to long term programmes of diet and drugs (Richardson, 1986). Compliance levels relating to prophylactic medications are even lower, with an average of 30 to 35% (Meichenbaum & Turk, 1987).

Studies also indicate that there is a robust non-compliance curve, that is, compliance levels decline consistently over time (Phillips, 1988). Hence, not only are compliance levels likely to be lower for long term compared to short term regimens, but they are likely to decline progressively over the duration of the treatment. An early study (Ireland, 1960, as cited in Phillips, 1988) into compliance with tuberculosis medication after discharge from hospital, found that almost 100% of patients were compliant two months after discharge. However, this had dropped to about 50% at 15 months and to below 30% at 24 months. Similarly, Kruse and colleagues (1992) found that compliance declined as time passed, despite their participants being required to take medication only once daily. It can be concluded that the lengthier the medication regimen, the more prone it is to attritional risk (Phillips, 1988).

Complexity of Medication Regimen

Research has uncovered a strong link between the complexity of a medication regimen and medication errors. Indeed, Meichenbaum and Turk (1987) claim that they can state with extreme confidence, that the more complex the demands of the treatment, the poorer the rates of adherence. Studies have established that there is a positive relationship between non-adherence rates or medication errors and the number of pills prescribed daily (e.g., Col et al., 1990; Gravely & Oseasohn, 1991). For instance, Spagnoli and colleagues (1989) found 73% of patients taking only one or two drugs to be fully compliant, but only 37% of those taking five or more drugs were correctly taking them all. Likewise, Kendrick and Bayne (1982) found adherence for one medication to be 65%, decreasing to 54% with four drugs and 47% with six drugs. However, other studies have failed to find a correlation between compliance and the

total number of drugs prescribed (e.g., Kruse et al., 1992), while Monane and colleagues (1994) found compliance rates to be *higher* in patients taking multiple medications. Monane et al. suggest that the prescription of multiple medications may imply greater severity of illness, motivating patients to comply.

A critical factor in compliance may be the overall complexity of the medication regimen rather than the actual numbers of pills taken. For instance, two patients may both be taking the same number of pills per day, but one may take them all at breakfast, while the other may have to take them at different periods throughout the day, or comply with more complicated instructions, such as needing to cut pills in half, taking alternating doses or avoiding certain foods (Conn et al., 1991). A complicated medication regimen with many drugs to be taken at different times may tax the memory capacity of some older persons (Gien & Anderson, 1989). Botelho and Dudrak (1992) found that frequency of drug administration affected medication adherence in their sample, with mean adherence for once or twice daily drugs to be 72%, while drugs to be taken three or four times daily had a mean adherence rate of 54%. Eisen, Miller, Woodward, Spitznagel and Pryzybeck (1990) found adherence to hypertensive medication improved from 59% on a three times daily regimen to almost 84% on a once daily regimen. Unfortunately, biological requirements such as the need to maintain constant levels of a medication in the blood, may not always permit once-daily dosing (Atwood et al., 1996).

Physical and Sensory Deficits

Research suggests a link between medication non-compliance and physical and sensory deficits. In New Zealand, approximately 44% of older women suffer from a physical disability, as do about 36% of older men, compared to about 11% of working age women and about 9% of working age men (Statistics New Zealand, 1998). Many drugs are dispensed in packages or containers which present difficulties to older persons with disabilities. For instance, declines in motor dexterity, the result perhaps

of arthritis, Parkinson's disease or hemiparesis, may cause difficulties opening medication containers with press-on caps (that is, "child-proof" ones) as opposed to ordinary screw tops. Small tablets may be difficult to pick up; liquid medicine dispensed in a large bottle may be difficult to shake or measure out (Gien & Anderson, 1989). A study by McIntire, Angle, Sathees and Lee (1977) found that one-third of the community dwelling older adults in their sample were unable to reliably remove their tablets from child-proof containers. As a consequence, 9% of these participants discontinued use of the medication, while the remaining 91% made alternative arrangements, such as permanently leaving the top off the container or placing pills in different containers. As drugs should generally be kept out of the light in a tightly shut container and not mixed with other drugs, such strategies are far from ideal. Similarly, Kendrick and Bayne (1982) found 63% of their sample to have difficulty with child-proof containers. Equally concerning is the finding that almost a quarter of the participants in a study by Atkin, Finnegan, Ogle and Shenfield (1994) were unable to open a 7-day medication organiser especially designed for older adults. Some frail older adults may even find blister packs difficult to use, struggling to press out the blisters, a problem which can be solved by the use of a toothpick (Ware, Holford, Davison, & Harris, 1991).

About a quarter of elderly persons in New Zealand suffer from vision or hearing deficits (Statistics New Zealand, 1998). Hearing impairments have obvious implications for understanding information or instructions provided within a medical consultation or by the pharmacist. The vision deficits which commonly accompany normal ageing may impair the ability to read labels on medication containers or package inserts, many of which are in small print (Miller, 1997). Additionally, deficits in colour vision due to ageing may result in difficulty distinguishing among pills once they have been removed from their containers. Kendrick and Bayne (1982) found that 58% of their sample (M = 79 years) identified pills of differing shades of yellow as being the same. Such findings stress the necessity for physicians to always assess the ability of their older patients to physically comply with their medication regimens (Thwaites, 1999).

Psychological Problems

Anxiety has been implicated in medication non-compliance. Research suggests that anxiety may interfere with information processing and recall during the patient-doctor interaction, and in this way act as a barrier to a patient's understanding of a treatment regimen (Meichenbaum & Turk, 1987). Medical information may be unfamiliar and is often anxiety producing (Richardson, 1986), although anxiety appears to have a curvilinear relationship with recall of medical information, with moderate anxiety associated with significantly better recall compared to either low or high anxiety (Ley, 1979). Interestingly, Lorenc and Branthwaite (1993) found that fear of an illness was inversely related to compliance in their sample. They suggest that higher levels of fear may have caused some participants to deny they were ill, with correspondingly poorer medication compliance the result. Anxiety may however be a side effect of medication (Cohen, 1991).

Like anxiety, depression may also affect medication non-compliance. Depression is a common emotional problem, and Butler, Lewis and Sunderland (1991) suggest that the prevalence of mild depression among older adults may be as high as 20% to 31%. The Christchurch Psychiatric Epidemiology Study (Oakley-Browne, Joyce, Wells, Bushnell, & Hornblow, 1989) unfortunately did not obtain data for persons aged 65 years and older, but did however ascertain that dysthymia rates became more frequent with increased age. While depression in an older adult may suggest a need for pharmacological treatment, it also has the potential to influence drug taking behaviour due to the impaired emotional state of the patient. Depressed persons may be apathetic and not interested in actively maintaining their health. Depression may also detrimentally affect cognitive functioning and in this way impact upon medication compliance. Gravely and Oseasohn (1991) found a significant positive relationship between scores on the Self Rating Depression Scale (Zung & Durham, 1965, as cited in Gravely & Oseasohn, 1991) and medication non-compliance in their

sample of 249 veterans. Similarly, Carney, Freedland, Eisen, Rich and Jaffe (1995) found compliance among a depressed group of older cardiac patients to be poorer than that in a comparable group of non-depressed patients (45% versus 69%).

Physical illness is also a risk factor for depression (Blazer, 1982; Husaini, 1997) and there are numerous diseases that may exacerbate or produce depressive symptoms such as Parkinson's disease, congestive heart failure, or diabetes (Eisdorfer, Cohen, & Veith, 1981). Additionally some medication, such as anti-hypertensives, hormones, corticosteroids or anti-Parkinson's drugs, may produce depression as a side effect, and in this way indirectly influence medication adherence (Davison & Neale, 1994; Eisdorfer et al., 1981; Potempa & Folta, 1992; Salzman, 1995) or result in further medication being prescribed to treat such depression. Medications may also aggravate a pre-existing depression or produce side effects, such as lethargy, which resemble and may be confused with depression (Davison & Neale, 1994). Therefore, the link between depression and medication non-compliance is not straightforward.

Cognitive Deficits

While information processing and response speeds tend to decrease with advancing age (Birren & Schroots, 1996; Woodruff-Pak, 1997), additional cognitive deficits are by no means an inevitable concomitant of old age. Nevertheless, as far as cognitive deficits in healthy older adults are concerned, studies have found that compared to younger adults, they tend, on average, to show diminished scores on the non-verbal elements of intelligence tests, although verbal scores may be similar or superior to those of young adults (Hashtroudi, Johnson, & Chrosniak, 1990). Thus older adults may be disadvantaged in the use of information that differs from a traditional verbal format, such as pictorial labels on medication (Morrell, Park, & Poon, 1990). Interestingly, in a Canadian hospital study, multivariate analysis indicated that scores on the Block Design Test, a non-verbal subtest of the Wechsler Adult Intelligence Scale – Revised (WAIS-R; Wechsler, 1981) were a significant predictor of

the ability of participants (*M* = 79 years) to remember to request medication at the appropriate time (Palmer & Dobson, 1994).

Comprehension of information and instructions relating to medication is an obvious pre-requisite for medication compliance. Morrell et al. (1990) found that older adults made significantly more errors on comprehension of prescription drug labels than younger adults (21% versus 14%). Researchers have suggested that some older adults may have difficulty with the comprehension of text when inferences are required, for example, inferring when exactly medications should be taken when instructions require it to be taken "twice" or "three times a day". Kendrick and Bayne (1982) found only 22% of their sample were able to provide a correct answer when asked how many tablets they would take in one day, if instructions were to take one tablet every six hours. Because of the potentially reduced ability of some older adults to draw inferences from oral and written information, medication instructions and labels should always be as explicit as possible (Park et al., 1992).

The ageing population and growing numbers of the "oldest-old" in the community, are likely to mean an increase in the rates of dementia, such as that caused by Alzheimer's disease, which has increasing age as its greatest risk factor. The prevalence of dementia in New Zealand is almost eight percent for all persons aged over 65 years of age, but it is estimated that prevalence more-or-less doubles every five years between 60 and 90 years. Approximately 40% of older adults aged over 90 suffer from dementia. These rates are similar to those of other countries (Campbell, McCosh, Reinken, & Allan, 1983). As it is often some time before a diagnosis of probable Alzheimer's disease is reached, this disease may affect medication taking behaviour for long periods before it becomes evident, especially when sufferers live alone. Higher rates of Alzheimer's disease have been found in women (Rocca et al., 1991; Snowdon, 2001) as have higher rates of medication non-compliance (e.g., Blackwell, 1972; Col et al.,1990). In summary, the greater possibility of cognitive impairment with advancing age, when combined with polypharmacy, may

place some older adults at increased risk of medication non-compliance (Fitten, Coleman, Siembieda, Yu, & Ganzell, 1995).

Memory Deficits

Mild memory losses are, regrettably, a part of normal ageing and indeed, memory decline is an almost universal complaint among older adults (Woodruff-Pak, 1997). For example, Morrell et al. (1990) found that the older adults in their sample (*M* = 71 years) recalled less information overall relative to young adults (*M* = 19 years). Simply forgetting is a frequent cause of non-compliance and one which is commonly cited by elderly patients. Almost 11% of Spagnoli and colleagues' (1989) sample of 802 older adults cited forgetfulness as a reason for non-compliance, and many other studies support this finding (e.g., Col et al, 1990; Conn et al., 1991; Wolfe & Schirm, 1992; Richardson, 1986). Interestingly, a 1992 survey (O'Connell & Johnson) found that 61% of older adults surveyed remembered to take their medication by memory alone.

The process of ageing differentially affects short term, long term and prospective memory. Short term memory includes immediate span and working memory. While the former tends to remain fairly stable with advancing age, age-related decrements have been consistently noted in working memory, or the ability to simultaneously store and process concepts (Smith, 1996). Research suggests that this may be the result of reduced processing efficiency (Salthouse & Mitchell, 1989). Anxiety may also further reduce the capacity of working memory by interfering with the processing of task relevant information. Additionally, older adults may suffer lapses of concentration, due to a lowered ability to inhibit or suppress task-irrelevant information, placing further stress on the processing capacity of their working memory (Filipp, 1996; Smith, 1996).

As far as long term memory is concerned, it has been suggested that older adults have difficulties organising and integrating information in long term memory, as

they engage in less elaborate processing of information than younger adults (Smith, 1996). Compared to the young, older adults have a tendency to under-estimate the amount of time required to study or rehearse material sufficiently to correctly recall it. For example, Morrell et al. (1990), gave the participants in their sample unlimited time to study medication instructions. The mean study time of the young adults in their sample was 657 seconds compared to 450 seconds for older adults, resulting in consistently manifested poorer recall by the older adults. The authors suggest that this may be due to an incorrect assessment by the older adults of the task as simple, resulting in insufficient effort being expended in order to properly encode into memory the presented information.

The fact that omission errors are so common in non-compliance, suggests that a prospective memory component may be especially important. Prospective memory includes the processes and strategies used to remember to perform future actions, such as remembering to take pills at a certain time (Woodruff-Pak, 1997). Experimental studies show that younger adults outperform older adults in tests assessing prospective memory, and that the performance of older adults worsens when the prospective event is complex or time, as opposed to event, based (Einstein, Holland, McDaniel, & Guynn, 1992; Smith, 1996). Therefore, difficulties may be anticipated when a medication regimen includes a requirement to take medication outside of meal or bed times, as these events tend to serve as environmental cues and reduce the cognitive load.

Studies have also found that, compared to younger adults, older adults have greater difficulty discriminating between performed and imagined activities (Cohen & Faulkner, 1989). This has implications for medication compliance where, for instance, older adults may imagine that they have taken their medication and later have difficulty determining whether they did in fact do so. A chart with check-off spaces, thus allowing self monitoring, may be useful in such cases (Black & Scogin, 1998).

CHAPTER THREE : ASSESSMENT AND INTERVENTIONS

Assessment

Prior research has employed a wide variety of measures to assess medication compliance, using either direct, indirect or a combination of methods. Direct methods include biochemical assessments, such as blood, stool or urine tests. Indirect methods include the use of self report measures, electronic or computerised monitoring, bar code reading technology, pill counting, medication refill records, therapeutic outcome and physician estimates. Examples of studies utilising such methods are discussed in the following sections.

Biochemical Measures

The blood serum levels of drugs or the presence of an excreted medication or its metabolite in urine or stools may be established via laboratory tests. Alternatively a harmless tracer "tag" or "marker" may be added to a medication, and its levels assessed by urine, stool or blood examination. Despite the accuracy of these tests, there are many drugs whose presence is unable to be detected using such methods. The timing of a blood or urine test is also critical and determined by the half life of the drug. To further complicate matters, there are wide individual variations in the way drugs are absorbed, distributed, metabolised or excreted by the body (Meichenbaum & Turk, 1987). Additionally, the dichotomous nature of many of the tests (i.e., a substance is found to be either present or absent), means that small variations in compliance cannot be detected (Black et al., 1987). Furthermore, such tests may be regarded by patients as being invasive, inconvenient, time consuming and costly.

Self Report Measures

Self report measures such as gaining information via interviews or questionnaires, are commonly used to assess medication compliance (e.g., Conn et al., 1991). Such measures are inherently problematic, especially where memory limitations are suspected, and tend not only to be susceptible to recall bias, but to give higher estimates of compliance (Berg, Dunbar-Jacob, & Rohay,1998; Black et al., 1987; Col et al., 1990; Gravely & Oseasohn, 1991; Isaac & Tamblyn, 1993; Ryan, 1999). Defensiveness, social desirability bias, or the desire of the patient to please the person who is requesting information about their level of compliance, whether this be general practitioner, researcher, relative or caregiver, may result in compliance errors being under-reported. For instance, one study has determined that compliance based on patient claims was 82%, but when urine samples for the same patients were analysed, actual compliance was 58% (Gordis, Markowitz, & Lilienfeld, 1969). Isaac and Tamblyn (1993) found compliance assessed by self report to be almost 90% in their sample, but pill counts revealed average compliance rates of about 68%. Having an additional person such as a spouse or caregiver report on a patient's medication intake may increase accuracy. Likewise, asking a patient about medication compliance in a non-judgemental manner, perhaps by telling them that 100% compliance is rare, may increase the likelihood of truthfulness. Without objective verification however, the veracity of self report measures of compliance may often be in doubt and accordingly, they should be regarded as potentially inflated.

Electronic and Computerised Compliance Monitoring

Continuous electronic monitoring has been used to assess compliance in several studies (e.g., Choo et al., 1999; Kruse, et al., 1992; Matsui et al, 1994; Norell, 1979). The Kruse et al. study (1992) used childproof pill containers incorporating a micro-processor in their caps, which recorded each opening and closing of the cap, and the time this was done. Similarly, Carney and colleagues (1995) provided subjects

with blister packs where an electronic chip recorded the date and time of each tablet's removal. Micro-electronic bar-coding technology has also been used in research studies. It is similar to that used in supermarkets and records the type of medication taken, as well as the dosage, the date and the time. Studies using bar codes required patients to scan their medication prior to taking each pill (Leirer et al., 1988; Park et al., 1992).

However, such methods, while sophisticated, measure use of medication dispensers, not actual pill ingestion. Patients can remove and throw away medication (Perri et al., 1995). In fact, Epstein and Cluss (1982) suggest that mechanical methods may offer little advantage over manual pill counts. Additionally, electronic pillboxes are extremely expensive, costing about US$60 (Stephenson, 1999).

Pill Counting

Pill counting has been commonly used to assess medication compliance in prior research. There are several limitations to pill counting as a method of compliance assessment, the first of which is the necessity to assume that absent medication has been taken by the patient (Meichenbaum & Turk, 1987; Rich et al., 1996). Consequently, there is the potential to significantly overestimate true compliance rates. Second, where errors of commission appear to have occurred, a pill count gives no information about whether the missing pills were actually swallowed by the patient or were lost, thrown away or given to others (Black et al., 1987). Third, pill counts provide no information about the timing of doses or the pattern of medication taking, unless they are done frequently and at short intervals. The pill count process may be subject to error if there is no system of quality control (Black et al., 1987). It is also extremely difficult to perform a pill count unobtrusively or surreptitiously, should this be required (Perri et al., 1995). Another disadvantage is that "as needed" medication like analgesics or benzodiazepines, has to be excluded from pill counts. Although under-compliance would not be an issue in this instance, over-compliance may be.

Nevertheless, despite these disadvantages, rates of non-adherence assessed by pill counts have been found to be comparable to those found in studies using sophisticated electronic pill counting devices (Botelho & Dudrak, 1992).

Prescription Refill Records

Pharmaceutical medication refill records can be used to estimate medication compliance. For instance, Monane et al. (1994) investigated the prescription refill records from a ten year period (1981-1991) of 7,247 outpatients, in order to establish their compliance with digoxin therapy. Patients were monitored for a 12 month period starting when they initially commenced digoxin. Using prescription refills to assess compliance has the advantage of eliminating an observer effect, as compliance may be unobtrusively monitored. However, a disadvantage of this assessment method is that patients may not always return to the same pharmacy to have their medication supplies renewed. Compliance with short term medications such as antibiotics, which tend not to be renewed, cannot be assessed. Additionally, having a prescription refilled does not necessarily mean that the patient will actually ingest the medication (Perri et al., 1995).

Therapeutic Outcome

At first glance, therapeutic outcome seems a sensible indicator of compliance. Although relationships have been established between non-compliance and treatment failure, clinical improvement does not always appear to be systematically related to compliance. Many other variables such as culture, lifestyle, education and socio-economic status, not to mention accuracy of diagnosis and efficacy of prescribed treatment, may play a role in outcome (Perri et al., 1995). Symptoms may sometimes remit naturally. For example, in a study of hypertensive patients, Sackett (1979) found that 12% of patients whose hypertension was previously uncontrolled, became controlled without being adherent (defined as taking over 80% of prescribed

medication). Thus, the desired therapeutic outcome was obtained in non-compliant patients. Likewise, only 40% of adherent patients had diastolic blood pressures of below 90mmHg, conventionally the level above which blood pressure levels become of concern. Thus, for these patients adherence did not ensure the desired outcome. Interestingly, in a large study (Coronary Drug Project Research Group, 1980) the desired clinical outcome was more likely to be achieved by adherers than non-adherers, but this occurred *even when adherers were adhering to a placebo.* Assessing medication compliance via therapeutic outcome is therefore problematic, as it cannot be presumed that patients who recover from an illness have done so as the result of adherence to their medication regimens.

Conclusion

All compliance assessment methods therefore have both advantages and disadvantages, making it difficult to nominate any particular method as superior to all others. Therefore, there is no "gold standard" for measuring non-compliance (Meichenbaum & Turk, 1987). Consequently, the use of a combination of methods seems the most ideal, although this is not always practical, given the time and financial restraints that plague most research projects.

Interventions

Given that so many variables have been implicated in medication non-compliance, a great number of interventions have been designed in an attempt to raise compliance levels. These interventions include simplification of the medication regimen, monitoring of medication by a pharmacist, improving knowledge and providing clear instructions, improving labelling and packaging, reducing the cost of medication, providing reinforcement, and the use of memory training or memory aids.

Medication Regimen Simplification

Medication regimens may be simplified by a reduction in the number of drugs prescribed, or by tailoring the drug regimen to events such as meals. As discussed, compliance levels tend to reduce as the number of prescribed drugs increases (e.g., Gravely & Oseasohn, 1991; Kendrick & Bayne, 1982). The fewer the drugs prescribed, the less likely are errors or memory lapses to occur. A once daily dosage, where possible, is ideal and compliance has improved substantially in studies where this has replaced a three-times-daily requirement (Eisen et al., 1990). Compliance rates as high as 97% have been found in once daily regimens (e.g., Atwood et al., 1996). However, it should be remembered that a potential disadvantage with once daily regimens is that should a patient forget a dose, 24 hours of therapy will be missed (Berg et al., 1993). Tailoring the drug regimen to habitual events in the patients' lives has been shown to improve compliance (Atwood et al., 1996). It is easier for a patient to add new behaviours to his or her everyday repertoire than to change behaviour patterns which are long-standing (Marston, 1970). Thus, when additional medication is prescribed, compliance is likely to be enhanced if the required time of its ingestion is in line with the existing regimen.

Pharmacist Monitoring of Regimen

Various studies have made use of pharmacists in an endeavour to limit non-compliance. McKenney (1979) found that as little as two to four minutes of a pharmacist's time spent explaining the treatment regimen to a patient, improved compliance. Using information from physicians, staff or family members, Gehres (1986) identified non-compliers in a rest home and provided them with weekly home visits by a pharmacist to monitor and simplify medication, as well as provide counselling and positive reinforcement. While an average 92% compliance rate was achieved, the expense of such an approach may render it impractical.

Improving Communication in the Doctor/Patient Relationship

As highlighted in Chapter Two, poor patient/physician communication has often been implicated in non-compliance with prescribed treatment. Indeed, Miller (1997) declares that the quality of the patient-physician interaction has the greatest influence on compliance. As also outlined in Chapter Two, the unpleasantness of side effects often causes medication to be discontinued, but as Hatfield (1994) points out, many side effects are of limited duration. Pointing out their transitory nature to the patient may encourage persistence. In a study into compliance with anti-depressants, Maddox et al. (1994) found that the 11% of their sample who stopped taking their tablets due to a "lack of effect", had only taken them for a mean time of one week, far too short a period for any therapeutic effect to become evident. This may indicate that the practitioner did not inform these patients about the expected time between medication commencement and a desired outcome.

Forewarning patients about possible side effects has not been shown to be detrimental to adherence rates. In fact, research indicates that drugs are more likely to be discontinued when side effects are unexpected and hence alarming (Meichenbaum & Turk, 1987). However, in a study by Ascione and Raven (1975), approximately 20% of physicians who participated in a practitioner survey did not wish patients to be told about the potential side effects of their prescribed medication, in case they became too anxious. Meichenbaum and Turk (1987) recommend that health professionals ask their patients about compliance, as they are unlikely to raise the topic themselves.

Improving Knowledge and Providing Clear Instructions

Clear instructions and information about prescription medication should be given to an older patient and, where necessary or appropriate, also to the spouse, relative or caregiver. Studies have shown that compliance can be improved by giving patients both verbal and written instructions (Kim & Grier, 1981). While it may be difficult to strike a balance between providing too much versus too little information,

generally the fewer the number of instructions given, the greater the recall (Meichenbaum & Turk, 1987). Studies have also found a strong primacy effect in the recall of medical information. Additionally, statements that are perceived as more important tend to be better recalled. Recall of medication instructions can therefore be encouraged by presenting these either before other information or stressing their importance (Ley, 1979). Concrete instructions are also more likely to be remembered than more abstract information (Richardson, 1986). Jargon should be avoided in both written and verbal instructions (Kazis & Friedman, 1988).

Morrow, Leirer and Sheikh (1988) suggested an individualised instruction sheet for each medication, noting its technical and common names, purpose, when and how to take it, food and drugs to avoid, interactions, possible side effects and what to do about them. As sound as this idea is in principle, the necessity for a large data base of drug information, appropriate software and the increased time required for the production of such a schedule each time a drug is prescribed for an older patient, suggests this idea may in many cases exceed the bounds of affordability or practicality. However, many pharmacies in the United States have begun providing such information to all customers regardless of age (N. Pachana, personal communication, 12 June, 2000). Prior to discharge from hospital, patients should be taught how and when to take their medication and made responsible for it before discharge, so that potential problems may be discovered and remedied. Departing patients should also be provided with cards indicating their medical history and listing details of their prescription medication (Berg et al., 1993).

Improved Labelling and Packaging

Improving labelling and packaging may assist in medication compliance. Labelling on containers should, where possible, be in large letters, with simple but clear instructions using everyday language. "As directed" or "as before" instructions are not

advisable (Bliss, 1981). Unfortunately, any suggested improvements in labelling are, of course, constrained by the small size of most medication containers.

Monthly or weekly blister packs have been shown to enhance compliance by reducing medication errors. Ware and colleagues (1991) conducted a study at Auckland hospital, where older patients were given either calendar packs or conventional medication bottles upon discharge. While both groups experienced a gradual decline in compliance over time, compliance rates for the experimental group were consistently higher than those of the non-intervention group. Similarly, Haskitt (1989, as cited in Berg et al.,1993) found 77% of patients using blister packaging combined with written instructions to be compliant (defined as taking 90% or more of prescribed medication) compared to only 28% of controls using a regular prescription container. However, not all drugs are suitable to be blister packed (for instance, effervescent or moisture sensitive tablets); some need to be kept separate from other drugs, or may be too large to fit into the compartments of a blister pack (Corlett, 1996).

Such disadvantages also apply to medication organisers, some of which have sliding lids that may prove difficult for some frail older patients. There is a potential for mistakes to be made during the loading of medication organisers, such as by confusing two similarly coloured tablets. Organisers tend to be limited to four daily compartments, usually breakfast, lunch, dinner and bedtime, and as such, may not be appropriate for complicated medication regimens. For example, should a pill which needs to be taken at mid-morning be placed in the "breakfast" or "lunch" compartment? There is also a danger that should "as required" (PRN; pro re nata) medication be placed in a dispenser, it may be taken unnecessarily (Corlett, 1996).

Reducing the Cost of Medication

As outlined in Chapter Three, cost may be a reason for non-compliance (Col et al., 1990). Prescribing generic rather than brand name drugs is likely to reduce costs and limit non-compliance where this is due to financial constraints. In New Zealand

26% of prescriptions are written generically (Pharmaceutical Management Agency Ltd., 1999). However, where there is a State funded health system as in New Zealand, cost is probably less likely to play a role in medication non-compliance than in countries like the United States of America.

Reinforcement

Tangible (e.g., financial incentives) and intangible (e.g., praise) rewards have featured in attempts to increase medication compliance. For example, Haynes and colleagues (1976) reinforced hypertensive patients for having diastolic blood pressures below 90 mmHg by giving them a credit ($4) at each visit towards ownership of a cuff and stethoscope to assess their own blood pressure. Although compliance among participants in this study increased from about 45% to about 66%, this improvement could not be attributed to reinforcement alone as other interventions were included simultaneously. In any event, the long term maintenance of behavioural changes induced by reinforcement has not been demonstrated (Meichenbaum & Turk, 1987).

Memory Training and Aids

Memory training may prove useful in reducing non-compliance. In a simulated medication compliance study, subjects in the intervention group were taught mnemonic techniques and were distinguished from the control group by 90% compliance compared to 68% (Leirer et al., 1988). Teaching older adults to use more elaborate encoding strategies may improve the likelihood of correct recall of their medication regimen (Smith, 1996).

Where forgetfulness is suspected as the primary cause of non-compliance, the use of external cognitive aids serving as memory cues or prompts has been found to be among the most effective behavioural strategies to enhance medication compliance (Miller, 1997). Cues are likely to be especially valuable when medication is stored out of sight and thus does not itself serve as a memory prompt. Prior research has

investigated a range of memory aids including voice mail recording, dose counters, alarms and medication calendars or charts. For instance, in a simulated study, Leirer, Morrow, Tanke and Pariante (1991) successfully reduced non-adherence to a mere 2.1% for a complex medication schedule, by using a recorded telephone reminder. Fulmer et al. (1999) enhanced cardiac medication compliance in a sample of older adults with congestive heart failure, via daily telephone reminder calls.

Dose counters contained within bottle caps are available to enhance medication compliance. Each removal and replacement of the cap moves the indicator forward, thus serving as a reminder that medication has or has not been taken (Lipton, 1989). In a study by Perri et al. (1995), which compared prescription refill data three months before and after the introduction of such a device to some of their participants, compliance was improved in the intervention group by 5%.

As far as the use of alarms is concerned, Lipton (1989) discusses the use of bottle caps, operated via a silicon chip, which have a light and an alarm, pre-programmed to go off at pre-determined intervals. Ringing and flashing continues until the cap is removed. In 1989 the cost of these bottle caps was US$15.00, which would make them prohibitively expensive, especially for patients on multiple medications. The downfall of aids involving alarms is that they require correct programming; the small buttons on a watch may be beyond the physical capabilities or visual acuity of a frail older adult. Indeed, setting an alarm may well be beyond the capabilities of older adults with cognitive deficits.

Memory aids which require little cognitive input on the part of the patient, such as medication reminder calendars or charts may be of most assistance to older adults on a complex medication regimen, or to those who are cognitively impaired and thus require support to comply with their medication regimen. Southam and Dunbar (1986) suggest that the literature does not support the superiority of complex mechanical equipment over cheaper and simpler reminder charts or stickers, in reducing medication errors and omissions. Several studies have found the use of reminder

charts or cards detailing the regimen to reduce errors (e.g., Park et al., 1992; Raynor, Booth, & Blenkinsopp, 1993; Wandless & Davie, 1977). Additionally, self monitoring may be a powerful compliance enhancement strategy and is a useful way for the health professional to involve patients as collaborators in their treatment regimen, rather than as passive recipients of treatment (Meichenbaum & Turk, 1987). Self monitoring via a daily tear-off calendar, where a page was torn off after each day's pills were taken, was effective in reducing errors of omission in a population of older adults (Wandless & Davies, 1977).

CHAPTER FOUR : OBJECTIVES OF THE PRESENT STUDY

Chapter One discussed some of the reasons why medication non-compliance is cause for concern. In fact, Balkrishnan (1998) suggests that despite being well documented and discussed, medication compliance remains a poorly understood health behaviour. The non-compliant older patient places his or her health, financial resources and independence at risk, all of which have financial implications for society, especially so where there is a taxpayer-funded health system, as in New Zealand. In common with developed countries around the world, New Zealand has an ageing population and concerns have been raised about the stress that the increased proportion of older adults, compared to future taxpayers, will place upon the health system.

The Ageing Population

While "aged 65 and over" is the most ubiquitous definition of the "older adult" population, gerontologists tend to divide those over 65 years of age into three groups; the "young-old" (65-74), the "old-old" (75-84) and the "oldest-old" (over 85) (Davison & Neale, 1994). In 1996, persons over 65 years of age represented about 11.7% of the New Zealand population, an 11.3% increase since the 1991 census. However, between 1976 and 1996 the proportion of individuals aged 65 years and over increased by 53.6%, compared to a 16.6% increase in the total population. Additionally, the population of older adults is projected to more than double between 1996 and 2027, when it is projected to rise from .43 million to .87 million, while by 2051 it is expected to number 1.13 million and comprise about 25% of the population (Statistics New Zealand, 1997).

This increase in the number of older adults in the population is due to a combination of factors including decreased infant mortality, declining birth rates, and

improvements in average life expectancy. For instance, between 1956 and 1996, life expectancy at birth improved by about six years, from 68 to 74 years for men and from 73 to 79.5 years for women (Statistics New Zealand, 1998). In addition to these gender differences, there are ethnic differences, as on average, Maori tend not to live as long as New Zealanders of European extraction (Pearce, Pomare, Marshall, & Borman, 1993). In 1996, only 3.9% of older adults in New Zealand identified themselves as Maori, compared to about 15% of the general population, with life expectancy at birth for Maori men being 69.5 years and for Maori women 74.5 years (Statistics New Zealand, 1998).

In addition to the generalised ageing of the population, a larger proportion of older adults are surviving into "oldest-old" age than in earlier decades, and significant changes within the age structure of the population of older adults are expected. In the five years between the 1991 census and that in 1996, the proportion of persons aged 65-74 increased by 9.1%, with the 75-84 age group increasing by 12% and the 85 years and over group increasing by 24.2%. Future projections indicate that while the 75-84 age group is expected to almost treble its numbers between 1996 and 2047, those aged 85 years and over are expected to increase in number more than six-fold, from 38,463 in 1996 to 255,000 in 2051, when they will account for about 22% of the population of older adults (Statistics New Zealand, 1998). This increase in the number of older adults, and especially in the number of the "oldest-old", has obvious ramifications for the utilisation of health services and is likely to strain available societal resources.

The financial implications of the ageing population for New Zealand's health resources are numerous. These are likely to include increased expenditure on medicines, hospitals and residential care subsidies. Compared to the young, older adults suffer more chronic illnesses, take more medicines and have longer and more frequent hospitalisation periods (Greenblatt et al.1982). The Iowa 65+ Rural Health Study (Helling et al., 1987), which surveyed 3,467 community dwelling individuals aged

65 years and older, found that mean prescription and overall drug use increased significantly with increasing age. In New Zealand, average per capita annual health costs increase dramatically across the population of older adults, from about $3,000 per person aged 65-74 years, to about $5,500 per person aged 75-84 years and between $9,000 for men and $10,400 for women for persons aged 85 and over (Ministry of Health, 1996, as cited in Prime Ministerial Task Force for Positive Ageing, 1997). The age-specific hospitalisation rate for those aged 65 years and over has increased from 36,475 per 100,000 in 1995 to 40,903 per 100,000 in 1997/98 (New Zealand Health Information Service, 1999), a rate increasing in parallel with the growing number of "oldest-old" in the population. In 1994, while New Zealanders aged 65 and over comprised about 12% of the total population, they accounted for 40% of all health costs (McDonald, n.d.).

A survey in the United States during the 1970s (Warheit, Arey, & Swanson, 1976) found that although, at that stage, older adults made up about 11% of the population, they consumed 25% of all prescribed medicines. Similarly in the United Kingdom in 1975, older adults who made up about 12% of the population at that stage, were responsible for about 30% of the National Health Service expenditure on prescriptions (Crooks, 1975). Vestal (1990, as cited in Potempa & Folta, 1992) projects that by the year 2030, drug expenditure for older adults in the United States may constitute 35 to 45% of the national total.

Many studies have linked medication non-compliance to hospital admissions. One such study estimates that about 10% of all hospitalisations and nearly one quarter of all nursing home admissions are due to the inability of patients to manage or follow drug therapy (McKenney & Harrison, 1976). Similarly, a study by Col et al. (1990) found non-compliance to be the cause of about 11% of the 315 hospital admissions of older patients in their sample. In New Zealand in 1997/98, there were 8,458 public hospital discharges (all ages) subsequent to the "adverse effects of medicines" (New Zealand Health Information Service, 2000). The cost of such admissions to the health

system is significant, with one study suggesting that non-adherence added $20 billion annually to the United States of America's health care bill (Tucker, 1993, as cited in Fitten et al., 1995). Other estimates of the cost to the United States of America have been as high as $100 billion per annum, if increased hospital and nursing home admissions, lost productivity, premature deaths and excessive treatments associated with non-compliance are taken into account (National Pharmaceutical Council, 1992, as cited in Miller, 1997).

Compliance with medication thus has the potential to reduce health expenditure dramatically. For instance, hospital readmissions were reduced by almost a third in a study by Rich and colleagues (1996), which compared a control group with an intervention group, where the latter received extensive education designed to enhance compliance with medications. A British study (Martin, 1996) suggests that compliance with aspirin as a prophylactic measure for patients with heart problems would cost about £250 annually per patient, compared to costs of about £5,000 to treat a patient suffering a heart attack in hospital.

Another major contributor to the increased cost of health care for older people in New Zealand is expenditure on residential care services, such as long term rest home or hospital care. However, this is largely due to the high costs associated with the provision of such care, rather than the result of large numbers of older adults actually being in residential care (McDonald, n.d.). It is estimated that only about 7% of people aged over 65 will ever need residential care, and most older adults are community dwelling, caring for themselves or being cared for by others, usually relatives. The cost to New Zealand of the Residential Care Subsidy is about $450 million per annum (Shipley, 1996). Remaining independent in their own home, or "ageing in place" is the overwhelming preference of older adults, who commonly express fears about being a burden on others and losing their independence (Prime Ministerial Task Force for Positive Ageing, 1997; Statistics New Zealand, 1998). It is

less expensive for the New Zealand taxpayer to provide up to 34 hours per person of home based assistance to maintain older adults in their own homes, as opposed to placing them in a rest home (McDonald, n.d.). As mentioned, the ability to cope with medication is essential for independent living.

In summary, research suggests that the greater the proportion of older adults in the population, the greater the potential cost of health services for New Zealand taxpayers. It is imperative to avoid wasting current health resources, which should be utilised more effectively (Prime Ministerial Task Force for Positive Ageing, 1997). Encouraging compliance with medication is likely to be a small step towards this goal.

Aims of the Present Study

From the preceding discussion, it is apparent that numerous interacting variables have been implicated by research as contributors to medication non-compliance. As it is such a complex and multi-dimensional phenomenon, individuals are likely to differ in their reasons for non-compliance with their medication regimens. For interventions to be effective, these underlying reasons need to be established and strategies customised accordingly. A customised approach is especially important with older adults due to their heterogeneity. For example, reducing the regimen complexity of a non-compliant patient will only be effective if complexity is indeed the reason for their non-compliance rather than, perhaps, forgetfulness. In fact, forgetfulness is one of the myriad of variables implicated in medication non-compliance and has been cited as the most common cause of errors of omission in older adults (e.g., Col et al., 1990; Park et al., 1992). "Forgetting", resulting in unintentional under or over-compliance was therefore the focus of the present study, which anticipated that the mild memory deficits, which are the usual concomitants of normal ageing, may sometimes affect medication compliance in older adults. Specifically, this study investigated whether the provision of a memory cue, in the form of an individualised "medication calendar"

enhanced compliance with prescription drug regimens involving multiple drugs. For the purposes of this study, polypharmacy was operationally defined as taking three or more different prescribed medications per day, as in the studies by Conn et al. (1991), and Gray et al. (2001).

As discussed, Spagnoli et al. (1989) pointed out the absence of any agreed definition of the non-compliant patient, and consequently definitions of "compliance" vary widely in the literature. Table 1 shows that correctly ingesting anything between 75% to 120% of prescribed medication has been deemed to be compliance by previous studies (e.g., Black et al., 1987; Gravely & Oseasohn, 1991; Spagnoli et al., 1989). For the purposes of this study, compliance was operationally defined as taking between 90 to 110% of prescribed medication. Lorenc and Branthwaite (1993) state that this is the range "normally accepted as compliant" (p. 487).

Previous research has established that compliance for prescriptions issued by specialists is higher than for prescriptions issued by general practitioners. This may be due to the fact that referrals to specialists generally involve higher costs for the patient, imply more severe problems and hence may increase motivation to comply (Spagnoli et al., 1989). For these reasons, the present study concentrated on compliance with prescriptions relating to medication prescribed by general practitioners only. Although forgetting as a reason for medication non-compliance was the main focus of this study, there were several additional questions of interest, and specific research questions and hypotheses are listed in the following section.

Specific Research Questions and Hypotheses

The main hypothesis of the present study was that those individuals in the sample who were provided with an individualised medication reminder calendar would, on average, achieve higher rates of compliance with medication regimens and make fewer medication errors. Reminder calendars contained medication details and

provided check-off spaces to tick once medication had been ingested. The physical presence of the calendar was expected to reduce errors of omission by serving as a memory prompt, while the ability to self monitor by ticking was expected to reduce errors of commission. In addition to the main hypothesis, there were several subsidiary topics that were of interest in this study.

Average Overall Compliance Rates

The present study was designed to establish the average medication compliance rate, in a sample of the community dwelling older population taking multiple medications. It was hypothesised that, with the advent of blister packaging and sophisticated medication organisers, and the increased awareness of the problems resulting from non-compliance, these rates would be somewhat higher than the average 50 to 66% commonly cited in the literature.

Relationship Between Amount of Daily Medication and Compliance

Previous studies have demonstrated an inverse relationship between the amount of medication consumed daily and compliance rates (e.g., Gravely & Oseasohn, 1991; Spagnoli et al., 1989). Therefore, it was hypothesised that the greater the number of tablets consumed daily, the lower the compliance rate and the greater the medication error rate would be.

Demographic and Socio-economic factors

As previous research is inconsistent regarding the relationship between demographic and socio-economic factors and compliance, the present study was designed to investigate the relationship between compliance levels and demographic and socio-economic factors, particularly gender, age, ethnicity, education, income and living arrangements. These variables were chosen as they have been the focus of previous research, as outlined in Chapter Two.

Strategies for Remembering to Take Medication

The present study was also designed to investigate the methods or strategies commonly used by community dwelling older adults to remember to take their daily medication. As mentioned in Chapter Two, previous research has indicated that about 61% do this by memory alone (O'Connell & Johnson,1992).

Usefulness of Medication Calendars

Finally, the study intended to gain feedback from users about the usefulness of the individualised medication calendars, and to solicit suggestions from them for its improvement. It was anticipated that the majority of calendar users would rate them as useful and easy to use.

CHAPTER FIVE : METHOD

Sample

Selection Criteria

Sample participants were required to be aged 55 years or older and ingesting three or more different prescription medications daily. No other exclusion criteria were used. Although 65 years and older is the age grouping most commonly used to define older adults (Davison & Neale, 1994), the present study deviated from this familiar age criterion in the hope of attracting Maori participants, who, on average, live for about five years less than Pakeha New Zealanders and are thus under-represented in the older age groups (Statistics New Zealand, 1998). Many researchers find it extremely difficult recruiting Maori as participants in research projects (Health Research Council, 1999). Thus, in the interests of equity and ease, all persons over the age of 55 years meeting the criteria for selection, were eligible to participate.

Participant Recruitment Procedure

As in many other medication compliance studies (e.g., Atwood et al., 1996; Botelho & Dudrak, 1992; Lyndon & Russell, 1990; Maddox et al., 1994; Spagnoli et al., 1989), general medical practitioners were deemed to be the most appropriate intermediaries in the search for participants. A mailing list of general practitioners in the Auckland area was constructed using the "Registered Medical Practitioners and Medical Centres" section of the Auckland telephone directory (1999). Where indicated, specialists were excluded from this list, as were practitioners living outside Auckland. Letters inviting general practitioners to participate in the study were individually addressed and signed in order to maximise the possibility of a positive response, and a copy of the information sheet intended for potential participants was attached (see

examples in Appendix A). The letter briefly described the objectives and method of the study and indicated what would be required of practitioners who agreed to participate. Also included was a "Registration of Interest" form, along with a postage paid addressed envelope so that practitioners could indicate their interest in participating. Interested practitioners were asked to provide an estimate of the number of patients to whom they were willing to forward information sheets.

Invitation letters were sent out to 732 practitioners. Eight were returned due to incorrect addresses, and 17 practitioners indicated that they were unsuitable for the study, being either retired or specialists. One hundred and fifty three "Registration of Interest" forms were returned to the researcher, representing a 21% total response rate. Eighteen general practitioners (2.5%) were prepared to assist. Of the 136 "Registration of Interest" forms received, 17 cited work overload or lack of time as a reason for non-participation.

Despite the poor response, it was decided to continue with the proposed method of obtaining participants for two reasons. Firstly, the 18 practitioners who had volunteered to assist had between them requested 170 information sheets for distribution to patients. Consequently, the target of a minimum sample size of 50 participants did not seem to be an unreasonable expectation. Secondly, as this was the method approved by the Massey University Human Ethics Committee, any changes would require a complete re-submission of the proposal, a cumbersome and time-consuming procedure.

In addition to participants recruited through general practitioners, "word of mouth" participants were included, after consultation with School of Psychology staff. An additional 21 participants joined the study in this way. Two participants withdrew from the study due to illness. In total, 50 participants took part in this study; 20 in the experimental group and 30 in the control. The unequal division into groups was the result of a decision to limit the number of participants with medication calendars to 20,

due to the cost involved. While the size of this sample was not ideal, it is similar to prior medication compliance research (e.g., Haynes et al., 1976; Kendrick & Bayne, 1982; Park et al., 1992; Wandless & Davie, 1977).

Ethical Issues Concerning Participants

The present study was reviewed and approved by the Massey University Human Ethics Committee and was conducted in accordance with the ethical standards contained in the New Zealand Psychological Society's Code of Ethics. In order to maintain confidentiality, all participants were allocated a code number. As data were received, they were entered into a computer and all original documents placed in a locked safe, together with the master code details.

No potential harm to participants was envisaged, although the possibility existed that, upon receiving a request to participate which had been forwarded or handed to them by their general practitioner, some patients may have felt an obligation to agree to do so. However, the Information Sheet emphasised the voluntary nature of participation, indicated that participants could withdraw from the study at any time, and could do this without endangering their rights or access to service from their medical practitioner in any way whatsoever.

Research Design

Design and Allocation to Groups

In the present study, participants were randomly assigned to either the experimental group (Group A, whose members received a medication calendar) or to the control group (Group B, whose members did not receive a calendar). Medication compliance was assessed for all individuals and the two groups were compared for any differences.

Allocation to groups occurred subsequent to the receipt of consent forms in the mail. Participants were assigned systematically to experimental or control groups in an alternating fashion, with the first participant assigned to Group A, the second to Group B and so on. Where a participant withdrew from the study, the next participant to volunteer was placed in the group which had suffered such attrition.

Measurement of Medication Compliance

Two methods were employed in the present study to assess medication compliance, namely the calculation of an overall compliance ratio, and the calculation of a total error rate. The compliance ratio for a particular medication was established by calculating the number of pills that had been taken by the participant (or were presumed to have been taken), dividing this by the number of pills that should have been ingested according to the general practitioner's prescription and multiplying the result by 100 (Lorenc & Branthwaite, 1993). This procedure was repeated for all prescribed medications. Overall compliance ratios were then calculated by combining individual medication ratios and dividing by the total number of medications prescribed, as has been done in prior research (e.g., Botelho & Dudrak, 1992; Conn et al., 1991; Rich et al., 1996).

However, the drawback of a compliance ratio is that where a participant takes too much of one medication, and too little of another, these errors will balance each other out and produce a compliance ratio of 100%. For this reason, an additional measure of compliance was calculated, namely total error rate, calculated by adding up the number of medication mistakes made (Wandless & Davie, 1977). For instance, each tablet that had not been ingested as prescribed was counted as one mistake. Total errors were subdivided into errors of omission, operationally defined as taking fewer tablets than had been prescribed, and errors of commission, operationally defined as taking more tablets than had been prescribed.

Compliance Assessment : Pill Counting

As the use of electronic monitors, bar coding or other expensive devices was beyond the means of the present study, the pill counting method was deemed to be the most suitable way to establish compliance ratios and error rates. Pill counts are frequently used in studies on medication compliance (e.g., Botelho & Dudrak, 1992; Choo et al., 1999; Kendrick & Bayne, 1982; Lorenc & Branthwaite, 1993; Rich et al., 1996) and this method has been discussed in Chapter Three.

Two pill counts were conducted. The length of time between pill counts has varied widely in the literature from about 30 days (Rich et al., 1996) to 14 days (Gravely & Oseasohn, 1991; Park et al., 1992). Park and colleagues (1992) found adherence rates to be lower in the second week of their study, suggesting that observation may have had an effect during the first week. Based on this finding, it was anticipated that the longer the period between inventories, the less likely it would be for an observer effect to occur. For this reason and due to practical considerations, a minimum time gap of at least six weeks between pill counts was proposed for the present study. The resultant average number of days between pill counts was 52 (M = 52.04, Mdn = 50, SD = 6.25) but intervals ranged from 37 days to 64 days. No significant relationship was found between the length of the interval between pill counts and any of the compliance measures.

Materials and Apparatus

Materials and apparatus used in the present study included a drug inventory form, the medication calendar, a brief sociodemographic questionnaire and a general questionnaire. The latter related to the usefulness of the medication calendar, and how easy it was to use, and requested information about medication reminder strategies used by participants (for examples, see Appendix B). A pharmacist's pill counting tray was used to conduct drug inventories.

The primary function of the medication calendar was to serve as a memory prompt, and as such, it was considered necessary to print it on brightly coloured paper to increase its prominence. Apart from its purpose as a memory cue, the calendar also provided information about medication (what to take, how much to take and when to take it) and allowed for self monitoring by providing a check-off space to tick after each dose had been taken. A large font (size 14) was used to make it easy to read. The calendar was printed on thin cardboard with a page for each week, attached to a brightly coloured clip board, with a pencil and re-useable adhesive (e.g., Bostik "Blu-tak") provided for those participants who wished to secure it to a wall, cupboard door or refrigerator. An example of a medication calendar is included as Figure 1.

MEDICATION CALENDAR

Patient's Name :		**Doctor's name :**	
Address:		**Telephone No:**	

MEDICATION LIST

BREAKFAST	DINNER	BEDTIME
1.Ismo 20 **- take 1 tablet** ***2.Solprin 300mg*** **- take ½ tablet** ***3.Pantoprazole 40mg*** **- take 1 tablet** ***4.Viskaldix*** **- take ½ tablet**	***1.Pantoprazole 40mg*** **- take 1 tablet** ***2.Viskaldix*** **- take ½ tablet** ***3.Multivite*** **– take 2 tablets**	***1. Doxepin*** **- take 1 tablet** ***2. Zopiclone*** **- take 1 tablet if required**

PLEASE TICK IN APPROPRIATE BOX WHEN MEDICATION HAS BEEN TAKEN:

DATE	Breakfast √	Dinner √	Bedtime √
WEEK 10 - 16 APRIL 2001			
Monday 10 APRIL			
Tuesday 11 APRIL			
Wednesday 12 APRIL			
Thursday 13 APRIL			
Friday 14 APRIL			
Saturday 15 APRIL			
Sunday 16 APRIL			

Figure 1. Example of Medication Calendar

Data Collection Procedures

Collection of Prescription Medication Information

Consent forms were posted by participants directly to the researcher, in a free-post envelope. Upon receipt, copies of these were sent to the appropriate general practitioner, together with a short note of thanks and a request that details of the patient's prescription medication be forwarded to the researcher. Prescription medication information was faxed to a facsimile machine to which the researcher alone had access, thus ensuring confidentiality.

Prescription medication information was used to compile the medication reminder calendars for those participants who had been randomly allocated to the experimental group. Faxed prescription medication information was verified telephonically with these participants. Verification was necessary as the prescription medication information provided by general practitioners did not usually indicate the time of day the patient took the medication (e.g., "once daily" could be morning, noon or night, or "in the morning" could be upon waking, before or after breakfast). Sometimes the practitioner had provided the generic name of a drug, while the patient was more familiar with its "trade" name. For self-referred participants, prescription medication information was taken directly from pharmacists' labels on medication containers.

Collection of Medication Compliance Information

Appointments to see participants in their homes were arranged subsequent to the receipt of details of their current prescription medication from their general practitioner. At this initial visit, a brief summary of the study's purpose and method was presented, and any questions by participants were answered. Participants were

informed whether they were in the experimental or control group, and it was emphasised that this allocation was by chance alone. Participants were then requested to produce all their medication, including refills not yet opened, in order for it to be counted.

Prior to the actual drug inventory, dosages and other information provided upon container labels (e.g., the number of tablets provided, date dispensed, number of repeats remaining, etc.) were carefully noted. Medication calendars were checked with the participant to ensure their correctness and completeness, and their purpose explained. Participants were requested to keep their calendars in a place where they would serve as a visual reminder to take their medication, and to make a tick in the appropriate place on the calendar once this had been done, in order to self monitor their medication taking behaviour.

The pill count was conducted using a pharmacist's counting tray, disposable rubber gloves and a clean plastic knife. Its accuracy was verified by a research assistant, who was always present. Various medications were not included in drug inventories, most commonly due to their unsuitability for counting purposes. These included insulin administered by self injection; "as required" medication, such as analgesics; medication for acute conditions such as antibiotics; hormone patches; medication in liquid form; and non-prescription medication (e.g., vitamins or herbal remedies).

Approximately seven weeks later, a final drug inventory was conducted. Second appointments were usually arranged for the same time of day as the initial interview, to avoid complicating the counting process. Participants were requested to fill in the two questionnaires, thanked for their assistance and informed that they would, in due course, receive feedback in the form of a brief summary of the objective,

method and findings of the study. Subsequent to completion of data collection and analyses, and once the study had been written up in thesis form, this summary was compiled and forwarded with a thank you letter to all participating general practitioners as well as to all participants (for examples, see Appendix C).

Sample Characteristics

Participants in the present study were from the greater Auckland area, which contains just under one-third of the population of New Zealand, or just over one million people (Statistics New Zealand, 1996). Participants were aged between 55 and 84 years, with an average age of about 71 years (M = 70.70, Mdn = 72.00, SD = 8.12). There were 18 (36%) men and 32 (64%) women. New Zealand Europeans made up the bulk of the participants (84%, N = 42). Two (4%) participants were British, four (8%) were South African, one (2%) was Dutch and one (2%) was Maori. Most participants were retired (80%, N = 40). Only a small proportion were in full time employment (8%, N = 4) or in part time employment (8%, N = 4) with the remaining two (4%) receiving sickness benefits. Of the male participants, 15 (83%) were retired, as were 25 (78%) of the female participants.

Almost two thirds (N = 31) of the sample had an annual income below $15,000, while 14% ($N$ = 7) received between $15,000 and $24,999. Three participants (6%) received between $25,000 and $34,999 per annum, while the remaining nine (18%) received $35,000 or more. The educational qualifications of study participants are summarised in Table 2. It is noteworthy that almost half (48%) had tertiary qualifications.

Table 2

Education qualifications of study participants (N = 50)

Education level	*n*	%
No formal school qualification	11	22
Proficiency examination	3	6
School certificate	5	10
Sixth form certificate	5	10
Bursary	2	4
Trade certificate or diploma	13	26
Undergraduate degree	6	12
Postgraduate degree	5	10

The sample was evenly divided in terms of living arrangements, with half living alone and half living with their spouse. Of those living alone, three lived in "granny flats" attached to the home of a relative. More males than females were married (72%, 38%, respectively) and more females than males were living alone (62%, 28%, respectively).

The average number of drug types prescribed on a daily basis for participants by general practitioners was five (M = 5.02, Mdn = 4.50, SD = 1.87), with a range of 2 to 10. This translated into participants ingesting an average of seven (M = 6.93, Mdn = 6.00, SD = 4.01) tablets or capsules daily, with a range of 2 to 19. A wide range of drugs was prescribed for sample members by their general practitioners, with 23 participants (46%) being prescribed aspirin in some form or another (e.g., Solprin, Cartia, Aspro). Anti-hypertensive drugs also predominated, with the diuretics Bendrofluazide and Frusid being prescribed to 19 participants (38%). Only a few psycho-active drugs were prescribed, with just four participants (8%) taking sleeping

pills (i.e., Halcion or Imovane) and nine (18%) taking anti-depressants (e.g., Aurorix, Nortriptyline, Dothiepin HCl).

Subsequent to consultation with a pharmacist, drugs were categorised using the Anatomical Classification Guidelines (European Pharmaceutical Marketing Research Association, 2000) and the New Ethicals Catalogue (1999). Table 3 summarises the main categories of drugs prescribed to participants, plus the number and types of errors associated with each class.

Table 3

Categories of drugs prescribed to participants and associated number and types of medication errors (N = 50)

Drug category	No. of times pres-cribed	Total no. of errors made	Errors of omission (% of total errors)	Errors of commission (% of total errors)
Cardiovascular system	148	98	66(67)	32(33)
Alimentary tract and metabolism	36	28	17(61)	11(39)
Central nervous system	20	14	5(36)	9(64)
Musculo-skeletal system	19	9	7(78)	2(22)
Genito-urinary/sex hormones	10	11	7(64)	4(36)
Systemic hormonal preparations	6	3	0(0)	3(100)
Respiratory system	3	3	29(67)	1(33)
Dermatologicals	2	2	0(0)	2(100)
Blood and blood forming organs	2	1	0(0)	1(100)

Statistical Analyses Procedures

Lotus 123 for Windows (Release 4) and the Statistical Package for the Social Sciences (SPSS) for Windows (Version 9.0) were used to describe and analyse data. There were no missing values. The minimum acceptable significance level (p) was set at the conventionally accepted level of .05. All tests conducted were two-tailed as direction was not consistently predicted. Statistical results relating to the main hypothesis of the study were presented first, followed by those relating to the secondary hypotheses.

Main Hypothesis

Testing the main hypothesis involved a comparison of the experimental and control groups in terms of the compliance measures. Descriptive statistics relating to compliance measures (mean, median, standard deviation and range) were presented for both groups. Groups were compared according to differences in the compliance measures of compliance ratio and total error rate, with the latter subdivided into errors of omission and commission.

As the experimental and control group differed in size, with 20 participants in Group A and 30 participants in Group B, non parametric tests were conducted to assess for significant differences. Mann Whitney U tests were applied to assess whether any differences between group means on the dependent variables (the compliance measures) were statistically significant. For the purposes of testing the subsidiary hypotheses of the study, experimental and control group participants were combined into a single sample.

Subsidiary Hypotheses

Overall Medication Compliance

Overall medication compliance was assessed by calculating the average compliance ratio and total error rates (subdivided into errors of omission and commission) for the entire sample. Descriptive statistics (the range, mean, median and standard deviation) were presented for each dependent variable.

Relationship between Amount of Daily Medication and Compliance

Due to the necessity to create a linear variable for use in the remaining analyses, a compliance deviation score was used instead of compliance ratio. A compliance deviation score is the absolute amount by which a compliance ratio differs from 100. Thus, the higher the score, the greater the extent of non-compliance, unlike in a compliance ratio where 100% indicates perfect compliance and both higher and lower scores indicate non-compliance (Lorenc & Branthwaite, 1993). As both independent and dependent variables were continuous, Pearson's correlations (Pearson's r) were conducted to measure the association between the compliance measures and the number of daily tablets prescribed.

Relationship between Demographic and Socio-economic Factors and Compliance

Pearson's correlations were established between age and the compliance measures, as all variables were continuous in nature. Spearman's correlations (r_s) were calculated between the compliance measures and the ranked variables of income, education and employment status. As far as the relationships between compliance measures and gender and living arrangements were concerned, the use of non-parametric tests was considered advisable due to the uneven numbers resulting from grouping participants according to these variables. Gender differences in

compliance deviation score and total errors (subdivided into errors of omission and commission) were ascertained and Mann Whitney *U* tests applied to assess whether such differences were significant. Similarly, differences between participants according to living arrangements were assessed for significance via Mann Whitney *U* tests.

In order to assess the possibility of confounding among independent variables, bivariate correlations between them were ascertained. Depending on the nature of the variables, either Pearson's *r*, Spearman's r_s or Cramer's *V* correlations were established. As confounding was indicated, multivariate analyses were conducted to ascertain whether any of these demographic and socio-economic variables were independent predictors of compliance. The statistical technique of multiple regression was employed to do so and a standard "all-in" approach was adopted.

Assumption testing prior to data analyses revealed that the data generally met the guidelines required for multiple regression to be a legitimate method of statistical analysis. Multicollinearity was not present, there were no significant outliers and linearity of residuals plus independence of error residuals was demonstrated. However, as far as the requirements for normality and homoscedasticity were concerned, the data were not entirely satisfactory. Nevertheless, it was decided to continue with the regressions, as these are robust assumptions, and if not met tend to weaken, but not invalidate analyses (Tabachnick & Fidell, 1989)

As far as the ratio of cases to independent variables was concerned, guidelines suggest an ideal of twenty times more cases than predictors, with a minimum of at least five times more cases than independent variables (Tabachnick & Fidell, 1989). Due to the small overall sample size ($N = 50$) a decision was made to select five independent variables to enter the regression analyses, based on previously significant bivariate correlations. The independent variables chosen to enter the analyses were age, gender, number of daily tablets, income and education.

Multiple regression was initially performed twice, once using compliance ratio (converted to compliance deviation score) as the dependent variable and again using total error rate as the dependent variable. Thereafter, a further two regression analyses were conducted, splitting total error rate into errors of omission versus errors of commission and using these as dependent variables respectively. For each model in turn, adjusted R^2 was stated, together with the degrees of freedom, the test statistic (F) and the significance level (p) of the regression equation. Unstandardised co-efficients (B), standard errors of beta (SEB) and standardised co-efficients (ß) for individual variables were presented in table form.

Strategies for Remembering to Take Medication

The different types of medication reminder strategies employed by participants were described in table form. Strategies were organised on an ordinal scale according to levels of sophistication and Spearman's correlations established between them and the compliance measures.

Usefulness and Ease of Use of Medication Calendars

The responses of participants in the experimental group to a questionnaire item, ranked on a Likert-type scale, regarding the usefulness of the medication calendar were ascertained. Spearman's correlations between usefulness rankings and the medication compliance measures were established. The usefulness ranking was also correlated with the amount of daily medication. A second questionnaire item ascertained the participants' responses to a question regarding how easy the medication calendar was to use. Spearman's correlations between the ease of use rankings and the medication compliance measures were established.

CHAPTER SIX : RESULTS

Aims and Objectives

As stated previously, the main purpose of the present study was to investigate the extent to which individually constructed medication reminder calendars would improve medication compliance rates in a sample of older adults taking three or more prescription drugs daily. As discussed in Chapter Four, several subsidiary topics were also to be investigated. These included the assessment of average medication compliance rates in the sample, plus the establishment of relationships between the amount of daily medication, selected demographic and socio-economic variables and medication compliance measures. Furthermore, the study wished to ascertain the strategies employed by participants to remember to take their medication, as well as investigate the usefulness of medication calendars for those participants who used them.

Main Hypothesis

The main hypothesis of the present study was that those individuals in the sample who were provided with an individualised medication reminder calendar (the experimental group; Group A) would, on average, achieve higher rates of compliance with medication regimens and make fewer medication errors than those who were not (the control group; Group B). Thus, groups were compared according to average compliance ratio and total error rates. Additionally, total error rate was sub-divided into errors of omission versus errors of commission and groups compared accordingly.

Average Compliance Ratio

A participant's compliance ratio was established by calculating the number of pills that had been taken (or rather, were presumed to have been taken) for a particular medication, dividing this by the number of pills that had been prescribed and

multiplying by 100 to arrive at a compliance ratio for that drug (Lorenc & Branthwaite, 1993). This procedure was repeated for all medications prescribed to a participant. Finally all the compliance ratios thus calculated were combined and divided by the total number of medications prescribed, to arrive at the overall compliance ratio for the participant.

The average compliance ratio of the participants in the experimental group (Group A; $N = 20$) was 98% ($M = 97.50$, $Mdn = 98.50$, $SD = 3.81$), ranging from 90% to 104%. The average compliance ratio of the participants in the control group (Group B; $N = 30$) was 97% ($M = 96.77$, $Mdn = 98.50$, $SD = 5.68$), ranging from 82% to 109%. A Mann Whitney U test established that the compliance difference between the control and experimental groups was not significant; $U\ (48) = 286.00$, $p = .78$. Thus, the provision of an individualised medication calendar to participants in the experimental group, did not result in an average medication compliance ratio which was significantly higher than that of the control group.

Total Error Rate

The total error rate was calculated by adding up the number of mistakes. Total error rate was subdivided into mistakes of omission (operationally defined as taking fewer tablets than had been prescribed) or commission (operationally defined as taking more tablets than had been prescribed).

The mean total error rate for the experimental group (Group A) did not differ significantly from that of the control group (Group B), as both groups made an average of 19 errors (Group A: $M = 18.95$, $Mdn = 14.00$, $SD = 16.41$; Group B: $M = 18.95$, $Mdn = 11.50$, $SD = 19.91$). The number of errors made ranged from 1 to 50 for Group A and 0 to 77 for Group B. This suggested that provision of an individualised medication calendar to members of the experimental group, did not lead to the expected decrease in the total number of errors made by these participants. Similarly, when experimental

and control groups were compared according to mean number of errors of omission and commission respectively, no significant differences between them were found.

Subsidiary hypotheses

Overall Medication Compliance Rates

The present study was designed to establish average medication compliance rates in a sample of the community dwelling older population taking multiple medications. It was predicted that compliance would be higher than the average 50% to 66% commonly cited in the literature (see Chapter One). The average overall compliance ratio for the sample (that is, experimental and control groups combined) was 97% (M = 97.06, Mdn = 98.50, SD = 4.98) and ranged from a minimum of 82% to a maximum of 109%. On average, participants made 19 errors in the interval between pill counts (M = 18.96, Mdn = 13.00, SD = 18.42). The total number of errors made ranged from a minimum of zero to a maximum of 77. The majority (79%) of the errors made were errors of omission (M = 14.56, Mdn = 7.50, SD = 16.94) while 21% were errors of commission (M = 4.40, Mdn = 1.00, SD = 7.47). The number of errors of omission and commission ranged from zero to 75 and 31 respectively. Only one participant made no errors, while three made no errors of omission and 19 made no errors of commission.

Relationship Between Amount of Daily Medication and Compliance

The present study hypothesised that the greater the amount of medication ingested daily, the lower the compliance rate and the greater the medication error rate would be. There was no significant relationship between the number of daily tablets ingested and compliance deviation score. However, a significant relationship was established between the amount of daily medication and total medication errors, with

this association being moderate in magnitude (r = .45, p = <.001). Thus, the amount of medication ingested daily accounted for about 20% of the variance in total errors made. Interestingly, when total medication errors were broken down into errors of omission versus errors of commission and correlated respectively with the amount of daily medication, only errors of commission reached significance (r = .53, p = <.001). Thus while the amount of medication ingested daily accounted for about 28% of the variance in errors of commission, it was not significantly related to errors of omission.

Demographic and Socio-economic Factors

Another focus of the present study was the relationship between compliance levels and demographic and socio-economic factors, particularly, age, living arrangements, gender, ethnicity, education, income and employment. Given the inconsistency in prior research (discussed in Chapter Two), the present study conducted exploratory bivariate analyses for demographic and socio-economic factors. There was no significant relationship between age and any of the compliance measures, nor between living arrangements and any of the compliance measures. However, a Mann Whitney U test indicated a gender difference in compliance deviation score; U (48) = 150.50, p <.001, with women in this sample more likely to demonstrate non-compliance. At this stage, there were no gender differences in numbers or types of errors made. As only one participant identified ethnicity other than European (New Zealand or "other"), relationships between ethnicity and compliance measures or other independent variables were not examined.

As far as the interrelationship between education and compliance measures was concerned, only errors of commission were weakly and inversely related to education, (r_s = -.33, p = .018). On average, education accounted for about 11% of the variance in errors of commission in this sample, with less well educated participants tending to make more errors of commission than better educated

participants. Similarly, only errors of commission were moderately and inversely related to income (r_s = .-42, p =.003), with income accounting for about 18% of the variance in errors of commission, with participants receiving lower annual incomes tending to make more errors of commission than participants receiving higher annual incomes. As far as employment status was concerned, again, errors of commission was the only compliance measure to be significantly related to it (r_s = .33, p = .021). The data showed that more errors of commission were made by participants in this sample who were retired or receiving a sickness benefit, than by those in full or part time employment. Further analyses were conducted to establish relationships between demographic and socio-economic variables (see Table 4).

Table 4

Intercorrelations between Independent Variables

	1	2	3	4	5	6	7
1. Age	--						
2. Gender	.06	--					
3. No. of daily tablets	-.32*[a]	-.21	--				
4. Income	-.41**[b]	.11	.18	--			
5. Employment	.39**[b]	.24	.05	-.54**[b]	--		
6. Education	-.08	.49	-.15	.40**[b]	-.31*[b]	--	
7. Living situation	-.10	-.33*[c]	.01	.20	.25	.31	--

*p < .05. **p < .01.

Note. [a] Pearson's r. [b]Spearman's r_s. [c]Cramer's V.

The significant bivariate correlations in Table 4 indicate that, on average, older participants in the sample received lower incomes and were more likely to be retired. Those on lower incomes were more likely to be retired or on a sickness benefit rather than employed. The higher the level of education, the more likely it was that a

participant was employed and the higher their income was likely to be. It is noteworthy that the correlation between age and number of tablets was an inverse correlation, suggesting that the older the participant, the fewer the number of daily tablets taken tended to be.

Due to these associations between independent variables, multiple linear regression (standard or "all in") was employed in order to assess whether any of the significantly related demographic and socio-economic variables were independent predictors of compliance.

Compliance Deviation Score

Where compliance deviation score was entered as the dependent variable, the adjusted R^2 was significantly different from zero (adjusted $R^2 = .173$, $F(5,44) = 3.05$, $p = .02$). Thus, the model accounted for about 17% of the variance in compliance deviation score, with this relationship unlikely to be due to chance. Regression co-efficients for the independent variables are set out in Table 5.

Table 5

Regression Co-efficients for Multivariate Model Using Compliance Deviation Score as the Dependent Variable

Variable	*B*	*SEB*	*ß*
Age	.12	.08	.24
Gender	4.00	1.21	.46**
No. of daily tablets	8.15	.15	.08
Income	.28	.58	.08
Education	.60	.31	.30

*$p < .05$. **$p < .01$.

As is evident from table 5, gender was the only independent variable contained in this model to contribute significantly to the prediction of compliance deviation score, consistent with the previously established bivariate gender difference. The gender difference in compliance deviation score of about four indicated that, on average and in this sample, women tended to be more non-compliant than men.

Total Error Rate

Where error rate was entered as the dependent variable, the adjusted R^2 was significantly different from zero (adjusted R^2 = .243, $F(5,44) = 4.15$, $p = .004$). This model accounted for about 24% of the variance in total error rate, with this relationship highly unlikely to be due to chance. Regression co-efficients for the independent variables are set out in Table 6.

Table 6

Regression Co-efficients for Multivariate Model Using Total Error Rate as the Dependent Variable

Variable	*B*	*SEB*	ß
Age	.40	.34	.18
Gender	12.53	5.10	.33*
No. of daily tablets	2.73	.63	.59**
Income	.30	2.43	.02
Education	1.38	1.30	.16

*$p < .05$. **$p < .01$.

As is evident from table 6, only two out of the five independent variables contained in this model contributed significantly to the prediction of total error rate. These were gender and number of daily tablets, with the latter responsible for the greatest amount of variance, on average, in total medication errors made. The results indicated that for every one standard deviation increase in number of daily tablets, there was a .59 standard deviation increase in error rate, on average, which was highly unlikely to be due to chance. This finding is consistent with the previously established significant bivariate correlation between number of daily tablets and total errors made (r = .45).

The gender difference in total error rate of about 12.5 indicated that, on average and in this sample, women tended to make more medication errors than men. This finding is inconsistent with preliminary analyses, where a Mann Whitney *U* test indicated no gender differences in numbers of errors made.

Errors of Omission and Commission

Errors of omission. The adjusted R^2 was significantly different from zero (adjusted R^2 = .133, $F(5,44) = 2.51$, p = .044). Thus the model accounted for about 13% of the variance in errors of omission, with this relationship unlikely to be due to chance. Regression co-efficients for the independent variables for this model are set out in Table 7. As before, only two out of the four independent variables contributed significantly to the prediction of errors of omission, namely gender and number of daily tablets. This result is inconsistent with preliminary analyses, where a Mann Whitney *U* test indicated no gender differences in numbers of errors made and there was no significant bivariate correlation between number of daily tablets and errors of omission.

Table 7

Regression Co-efficients for Multivariate Model using Errors of Omission as Dependent Variable

Variable	*B*	*SEB*	ß
Age	.54	.33	.26
Gender	10.52	5.02	.30*
No. of daily tablets	1.76	.62	.42**
Income	2.33	2.40	.16
Education	1.84	1.28	.23

*$p < .05$. **$p < .01$.

Errors of commission. The adjusted R^2 was significantly different from zero (adjusted $R^2 = .376$, $F(5,44) = 6.90$, $p = < .001$). Thus, the model accounted for about 38% of the variance in errors of commission, with this relationship highly unlikely to be due to chance. Regression co-efficients for the independent variables for this model are set out in Table 8. Again, only two out of the four independent variables contributed significantly to the prediction of errors of commission, with number of daily tablets reaching significance, as in all of the previous models and consistent with the significant bivariate correlation ($r = .53$). However, gender failed to produce a significant effect, whereas there was a significant effect for income. This is consistent with the previously significant bivariate correlation between income and errors of commission ($r_s = -.42$).

Table 8

Regression Co-efficients for Multivariate Model Using Errors of Commission as Dependent Variable

Variable	*B*	*SEB*	ß
Age	-.15	.12	-.16
Gender	2.01	1.88	.13
No. of daily tablets	.97	.23	.52**
Income	-2.03	.90	-.32*
Education	-.46	.48	-.13

*$p < .05$. **$p < .01$.

Strategies for Remembering to Take Medication

This study also proposed to investigate the methods or strategies commonly used by community dwelling older adults, who had been prescribed multiple medications, to remember to take their daily drugs. Participants were asked to describe the ways they reminded themselves to take their daily medication. Table 9 lists the different methods or strategies reported by participants. Three postgraduate psychology students were requested to rank these strategies on an ordinal scale, according to perceived levels of sophistication. "Sophistication" was defined as raters' perception of how efficient strategies were likely to be as a reminder to take medication and/or as an aid to taking medication correctly. For instance, all raters agreed that the least sophisticated strategy was the use of memory or "habit" alone, and that the use of a blister pack provided by a pharmacist was the most sophisticated.

Raters were requested to use the scale to assign a rating to each participant according to the sophistication of their medication reminder strategy. Inter-rater reliability was 93%. No significant correlation was found between the sophistication ranking of medication reminder strategies and any of the compliance measures.

Table 9

Methods Used by Study Participants to Remember to Take their Daily Medication (N = 50)

Type of strategy employed	*n*	%	"Sophistication" ranking
Habit or memory	8	16	1
Medication removed from original containers and placed in others (e.g., Tupperware containers, egg cups)	12	24	2
Participant reminded to take medication by spouse	2	4	3
Medication taken once daily, with a meal; thus meal serves as reminder	6	12	4
Medication left in a prominent place (e.g., kitchen, bathroom) to serve as a visual reminder	13	26	5
Weekly medication organiser/pill tray used (loaded by participant)	8	16	6
Blister pack provided by pharmacist	1	2	7

Reported Usefulness and Ease of Use of Medication Calendars

An individualised medication calendar was constructed for 20 participants; the experimental group. These participants responded to two questionnaire items about the calendar, which were rated on a Likert-type scale. The first questionnaire item assessed calendar usefulness. Possible ratings ranged from 1 (*not at all useful*) to 7 (*extremely useful*). Responses are set out in Table 10.

Table 10

Participant Responses to the Question "On a Scale of 1 – 7, please rate how useful you found the medication calendar to be".

Rating	*n*	%
1 *(not at all useful)*	5	25
2	2	10
3	2	10
4	4	20
5	2	10
6	1	5
7 (*extremely useful)*	4	20

No significant correlations were found between any of the medication compliance measures and the extent of usefulness of the calendar for participants in the experimental group. There was also no significant relationship between the number of daily tablets and the perceived usefulness of the calendar.

The second questionnaire item assessed how easy to use the participants found the medication calendar to be. Possible ratings ranged from 1 (*not at all easy*) to 7 (*extremely easy to use*). Responses are set out in Table 11. No significant correlations were found between any of the medication compliance measures and the ease of use of the calendar.

Table 11

Participant Responses to the Question "On a Scale of 1 – 7, please rate how easy you found the medication calendar to use".

Rating	*n*	%
1 *(not at all easy)*	1	5
2	0	0
3	0	0
4	0	0
5	1	5
6	5	25
7 *(extremely easy to use)*	13	65

These results suggest that while medication calendars proved easy to use for the great majority of the participants who used them in the interval between pill counts, only about half of them rated the calendar as being useful.

CHAPTER SEVEN: DISCUSSION

Overview

The following chapter discusses the findings of the present study in relation to its previously declared aims. It also reviews relevant methodological issues and study limitations. These include concerns about a lack of sample representativeness, its size and the participant recruitment method employed. Difficulties encountered with the pill counting procedure are discussed. The chapter concludes with some suggestions relating to future research into medication compliance.

Main Hypothesis

The present study anticipated that those individuals in the sample who were provided with an individualised medication reminder calendar (the experimental group) would, on average, achieve higher rates of compliance with medication regimens and make fewer medication errors than those who were not (the control group). Statistical analyses of the data indicate that this hypothesis was not supported, and groups did not differ according to either average compliance ratios or error rates. This result differs from previous findings, such as those by Wandless and Davie (1977), who used a tear-off calendar to significantly reduce error rate in a group of older adults. However, unlike the community dwelling participants of the present study, Wandless and Davie's sample members resided in rehabilitation wards of general hospitals. Results of the present study also contradict research by Park et al. (1992), who examined the effect on medication compliance of external cognitive aids such as organizational charts (detailing medication regimens) or medication organisers. Park and colleagues found that the use of such aids significantly reduced errors of omission in their "old-old", community dwelling participants (operationally defined as aged 71 years or older; $M = 78$). Nonetheless, their "young-old" participants (aged 70 years or

younger; M = 66) showed a 94% rate of adherence which was not improved by the addition of the interventions, a rate consistent with that obtained in the present study. Possible reasons for the failure of the present study to find improved compliance rates for participants in the group provided with a medication calendar are considered later in the present chapter, and include sample non-representativeness and the possibility of a Hawthorne effect.

As stated in Chapter Four, in addition to its main aim of investigating the effectiveness of medication calendars for older adults ingesting three or more prescription drugs per day, the present study had several subsidiary aims. These were to establish average overall medication compliance rates and to investigate the relationship between compliance measures, the amount of daily medication and selected demographic and socio-economic factors. Strategies for remembering to take medication were also investigated.

Subsidiary Topics

Average Overall Compliance Rates

As stated in Chapter One, the consensus in the medication compliance literature is that, on average, about 50 to 66% of patients are compliant (Wright, 1993). However, the present study anticipated that the average compliance rate of participants would be greater than that commonly cited in the literature, due to the availability of blister packaging and sophisticated medication organisers, plus an increased awareness of the problems resulting from non-compliance. In fact, the mean compliance rate of the participants of the present study (97%) was substantially higher than that found in many past studies. As mentioned in Chapter One, comparison with other studies is made difficult by the wide range of operational definitions of compliance. Nevertheless, when compared to similar studies that also defined compliance according to the average percentage of prescribed doses of medication

taken by their participants (e.g., Ware et al., 1991), the present study's finding of a 97% average compliance rate seems high. Nevertheless, a few studies have found rates of compliance which exceed 80%. For instance, the mean rate of compliance for all of the 61 older adults in Park and colleagues' (1992) study was 89%, while that found by Rich and colleagues (1996) in their sample of 156 older participants was 85%. Likewise, Conn and colleagues (1991) found an adherence rate of 92% in their sample of 178 older adults recently discharged from hospital. Conversely, Gravely and Oseasohn (1991) found compliance (defined as taking between 80 to 110% of drugs) to be as low as 27% in their sample of 249 veterans aged over 64 years, while Wandless and Davie (1977) found that only 20% of their sample made no medication errors over a two week period. According to the definition of compliance adopted by the present study, namely taking 90-110% of prescribed medication (Lorenc & Branthwaite, 1993), only three participants may be defined as non-compliant (taking 82%, 83% and 88% of their medication respectively). As far as error rate is concerned, and in keeping with the findings of previous studies (Col et al., 1990; Gravely & Oseasohn, 1991; Kruse et al., 1992; Law & Chalmers, 1976; Leirer et al., 1988; Park et al., 1992; Salzman, 1995; Spagnoli et al., 1989) the present study found most medication errors (79%) to be errors of omission.

The most probable explanation for both the high average rate of medication compliance, and the lack of a difference between experimental and control groups, is the non-representativeness of the sample. The participants of the present study were all volunteers, who were fully informed about the nature of the study prior to consenting to participate. Epstein and Cluss (1982) suggest that volunteers may be different in motivational or other characteristics, making them more likely to comply with their medication than others who are not willing to participate. They suggest that as a result, in many studies medication compliance is likely to have been overstated. In fact, analysis of the demographic characteristics of the present study's participants

indicates that, in some respects, these characteristics do differ from those of the general population of older adults in New Zealand, most notably in terms of education. For instance, about 35% of the New Zealand population aged 15 years and over have a tertiary qualification (Statistics New Zealand, 1996), compared to 48% of participants in the present study. This difference becomes even more notable when study participants are compared to their peers, as according to the 1996 census only about 31% of older men and 18% of older women have some type of tertiary qualification (Statistics New Zealand, 1998). Several studies have implicated education as a factor promoting medication compliance (i.e., Daniels et al., 1994; Leistyna & Macaulay, 1966). Additionally, research has indicated that older adults with higher levels of education are more likely to volunteer to participate in research projects (Main, Rodriguez, & Brown, 1988). The non-representativeness of the sample in the present study in terms of educational achievements is likely to have contributed to the high rate of medication compliance rates.

Moreover, participants in the present study were not as disabled as the general population of older adults in New Zealand, about a quarter of whom suffer from vision or hearing deficits, and over a third of whom suffer from a physical disability of some sort (Statistics New Zealand, 1998). Only one participant was visually impaired to the extent that she had to have the demographic and medication calendar questionnaires read to her by the researcher. Interestingly, despite her disability and the consequent presumption that she would not be able to read the labels on her medication containers (she lived alone), this participant's compliance ratio was 91% and she made no more errors than the average of 19 over the study period. This suggests that a visual disability may not necessarily always result in medication non-compliance.

The fact that study participants differ markedly from their peers in the general older adult population becomes even more apparent when the relationship between age and medication is considered. The findings of the present study are contrary to

what is commonly found in the literature, namely that advancing age is associated with poorer health status and with the accompanying use of more medications (Chrischilles et al., 1992; Gien & Anderson, 1989; Helling et al., 1987). In summary, the explanation for the high average compliance rate found in this study may simply be that, due to sampling deficiencies, the large majority of participants in the present study were drawn solely from the population of patients that previous research has found tend to be compliant with their medication. A representative sample, including both compliant and non-compliant participants, was not obtained.

Relationship between Amount of Daily Medication and Compliance

As mentioned in Chapter One, previous studies of medication use among community dwelling older adults suggest they consume a daily average of about three or four prescribed drugs (Cohen et al., 1998; Chrischilles et al., 1992; Conn et al., 1991; Helling et al., 1987; Kendrick & Bayne,1982; Law & Chalmers, 1976; Spagnoli et al., 1989). As stated in Chapter Five, participants in the present study were prescribed an average of five different medications per day, resulting in an average daily ingestion of seven tablets or capsules per day. The slightly higher than average number of drugs prescribed to participants in the present study, compared to those in the literature, may be the result of many patients being prescribed drugs which are available over the counter such as multivitamins or aspirin and which have been included in the drug and tablet count. On the basis of the findings of previous research (e.g., Gravely and Oseasohn, 1991; Kendrick & Bayne, 1982), it was hypothesised that there would be a positive association between the number of tablets consumed daily and medication error rates. The present study obtained results consistent with the research literature, in that the greater the number of daily tablets taken, the greater the error rate was. It was also hypothesised that there would be a negative association between the number of tablets consumed daily and compliance rates. However, the

present study failed to establish a significant relationship between amount of daily medication and compliance rate. This result is likely to be due to the limited range of compliance rates found in this sample and the high average medication compliance rate.

Demographic and Socio-economic Factors

Due to the inconsistencies in previous research, the present study aimed to investigate the relationship between compliance rates and demographic and socio-economic factors, particularly gender, age, ethnicity, education, income and living arrangements. As stated, despite the largely unchangeable nature of these characteristics, they are nevertheless of interest in attempting to understand the phenomenon of medication non-compliance.

Gender was the only one of the demographic variables to be significantly related to both medication compliance and error rates in the present study. On average, female participants were less compliant and made more errors than male participants. This result has been obtained in other studies (e.g., Col et al., 1990; Daniels et al., 1994). Conversely, when total medication error rate was broken down into errors of omission and commission, the gender effect failed to reach significance in the latter instance. Thus, while women appeared to make more errors of omission than men in this sample, there were no gender differences where errors of commission were concerned. As the present study failed to establish a significant relationship between gender and the amount of daily medication taken, the finding that women are likely to be less compliant with their medication regimen than men, is difficult to explain. However, this finding is in keeping with the research literature, where inconsistent findings relating to differences in medication compliance according to gender are prevalent.

As far as the relationship between income and non-compliance is concerned, previous research has established a link between low socio-economic status and non-compliance (e.g., Bame et al., 1993). It is noteworthy that the present study established an inverse relationship between income and errors of commission, but not between income and errors of omission or total errors made. This finding suggests that persons of lower socio-economic status were more likely to over-comply with medication. As indicated in Table 4, income was related to both education level and employment status in the present sample. A recent study (Gray, Mahoney & Blough, 2001) established an association between low education and medication over-adherence in a sample of 147 older participants, although this univariate effect failed to reach significance in a multivariate model. The finding of the present study may be the result of lower socio-economic participants, when uncertain about whether or not they had taken their medication, preferring to err on the side of caution. It is also possible that these participants may not understand that over-medication is potentially as hazardous for their health as is under-medication.

Strategies for Remembering to Take Medication

The present study also aimed to survey the methods or strategies commonly used by community dwelling older adults to remember to take their daily medication. As discussed in Chapter Six, a variety of reminder strategies were employed by study participants, although there was no significant relationship between the sophistication level of a strategy and any of the compliance measures. This result was consistent with the findings by Gravely and Oseasohn (1991), who found there was no significant relationship between compliance and those who used memory aids. The most popular strategy employed by participants in the present study, was to place medication in a prominent position where it could be seen and thus serve as a memory prompt. Examples of such strategies were keeping medicine in the kitchen, or in the bathroom

with shaving equipment. Others removed medication from its original container and placed it in household containers labelled "breakfast", "lunch" or "dinner". Interestingly, only a small proportion of participants indicated that they remembered to take their medication by memory or "habit" alone, with a smaller proportion acknowledging that their spouse played a part in reminding them about their pills (e.g., "Cuppa brought each morning by a loving husband is reminder enough"). Some had only to take pills once daily with a meal, usually breakfast, which served as their reminder. It was noteworthy that only one participant used a blister pack, although not all her prescribed medication (e.g., half an aspirin) was able to be included in it. Another participant stated that she had previously tried a blister pack when on holiday, but complained that it had been too easily damaged in her handbag. Several of these strategies are mentioned by Gravely and Oseasohn (1991) including putting all the pills to be taken for the day in different containers according to times they were required to be ingested. Some of the participants in the Gravely and Oseasohn study also set alarms to remind themselves to take their tablets, a strategy not encountered in the present study.

Usefulness of Medication Calendars

Finally, the present study wished to establish the extent of the usefulness of individualised medication calendars for those persons in the experimental group, anticipating that such calendars would prove useful and easy to use for the majority of them. Although just over half of the participants indicated that they found the medication calendar to be useful, as stated, its use did not significantly improve their compliance rates, compared to those participants who were not given a calendar. It is also noteworthy that no link was found between the number of daily tablets and the perceived usefulness of the calendar, as might be expected.

As the majority of sample participants reported that the calendar was easy to use, these results are unlikely to be the result of a design fault in the medication calendar itself. Rather, the high average compliance rate of participants in the present study suggests that members of this sample had no need for additional reminder strategies in order to comply with their medication. That is, they were coping perfectly well without a medication calendar. Comments such as the following indicate that this was indeed the case, for instance, "I have my own reliable system" or "I have a better ... method" or "Too set in my ways". The majority of participants had been on the same drug regimen for some time and medication taking habits were well established. In addition, many participants expressed to the researcher their awareness of the vital role their medication played in the maintenance of their health, thereby illustrating their motivation to comply with their medication regimens. Therefore, the medication calendars used in the present study may be most useful to those persons who are unable to formulate a reminder strategy for themselves, or who have only recently started to take prescription medication, or undergone changes to an existing complex regimen. Indeed, one participant who had several long term medications discontinued and replaced during the course of the study, confided to the researcher that the changes had caused her to "..... get very muddled".

There was a slight possibility that social desirability bias may have affected the responses obtained to questions relating to the usefulness and ease of use of the medication calendar, as the researcher was always present while questionnaires were being completed. However, in order to mitigate potential social desirability bias, prior to requesting completion of the questionnaire, participants were always asked to be honest and not to be concerned about offending the feelings of the researcher.

A questionnaire item soliciting ideas on how to improve the design of the medication calendar (see Appendix B) was filled out by only one participant. This participant suggested the use of lighter coloured paper, rather than the purple which

was used, as she found the colour made the calendar difficult to read. She also commented that it was difficult to find somewhere to put the calendar, as she did not want to mount it where others would be able to see the private details of her medication regimen. Another participant expressed light-hearted concern about the "stickability" of the Blu-tak which had been provided to participants to stick their calendars to cupboard doors or fridges. He volunteered that one night he had heard a "helluva crash" and had leapt rapidly out of bed presuming that he was being burgled, when in fact it was his medication calendar falling off the fridge. This lack of feedback from sample members regarding ways to improve the medication calendar, is likely to be the result of participants' disinterest in using it, due to their commonly expressed satisfaction with their current medication reminder strategy.

Methodological Issues and Limitations of the Present study

Sample Issues

The sample used in the present study was one of convenience. This study consequently has limited external validity, constraining the generalisation of results to older adults in the general population. Establishing equivalence between willing and unwilling participants is difficult in studies such as the present one, where volunteers are solicited via a third party, in this case, general practitioners. General practitioners were not requested to keep records of patients who were given information sheets, but did not consent to participate in the present study. Additionally, some of the demographic characteristics of study participants do indeed differ from those of the general population of older adults in New Zealand. Differences in educational qualifications have already been mentioned. While the gender ratio of 64:36 (female to male) is not unexpected, given the greater longevity of older women compared to older men, the sample is 98% European compared to about 75% in the general population of New Zealand. The sample has only one Maori participant (2%) whereas

the proportion of Maori in the general population is 15% (although this drops considerably for older Maori, to about 4%). There were no Asian or Pacific Island participants (about 5% of the population each) (Statistics New Zealand, 1996; Statistics New Zealand, 1998). Nonetheless, this paucity of Maori, Pacific Island or Asian participants is similar to that in another New Zealand study into medication compliance in older adults, conducted at Auckland Hospital (Ware et al., 1991). The 18 general practitioners who volunteered to recruit patients for the present study, represented practices all over the Auckland region, and the lack of a more ethnically diverse sample is unfortunate.

As far as the size of the sample is concerned (N = 50), sample members were recruited by word of mouth or through general medical practitioners who had agreed to participate in the study. As mentioned previously, only 18 out of a potential pool of around 700 agreed to hand out information sheets to patients meeting the study's criteria. Although the literature is replete with studies using similarly sized samples (e.g., Botelho & Dudrak, 1992; Kendrick & Bayne, 1982; Lorenc & Branthwaite, 1993; Wandless & Davie, 1977), the final sample size of the present study is not ideal.

Participant Recruitment Method

The results of the present study suggest that it is difficult for students in New Zealand to undertake research projects which involve general practitioners, most probably due to their time constraints. A sizeable majority (79%) of the general practitioners to whom personally addressed and individually signed requests for assistance were posted did not respond, despite the availability of an addressed freepost envelope and a brief "registration of interest" form. The financial costs and time involved in preparing and posting out letters and information sheets to the over 500 practitioners who did not reply, suggest that using general practitioners as an

avenue to recruit participants is an option that should perhaps only be pursued by students when all other avenues of obtaining volunteers have been exhausted.

The present study required that general practitioners who agreed to assist, were to provide the researcher with the prescription medication details of participants. However, it became apparent during the course of the study that the labels on participants' medication containers were sufficient to provide the researcher with all required information. The request for general practitioners to provide medication information thus proved to be unnecessary. It is possible that without this requirement and the time factor it involved, more general practitioners may have consented to hand out information sheets to potential participants. Consequently, if general practitioners are indeed reluctant to participate in research due to their heavy work load, it would be wise for future researchers to limit their requests for practitioner involvement to that which is strictly necessary to achieve the aims of their study.

Difficulty With the Pill Counting Procedure

In the context of the present study, pill counting proved to be a potentially inaccurate medication compliance measure. Chapter Three has elucidated some of the difficulties associated with this method of investigating compliance, primarily the need to assume that absent medication has been taken by the patient, rather than that it has been dropped or otherwise disposed of.

While it is unlikely in the present study that the actual pill counting process was subject to error, as the researcher was always accompanied by a research assistant who checked the count, there were several other ways mistakes could have occurred. For instance, at both pill counts, it was stressed to participants that the researcher needed *all* the medication in their possession, in order to make a complete and correct inventory. Nevertheless, it was not uncommon for participants to remember at the

second pill count that they had a "spare" container of medication somewhere (in their handbag, for example) or for spares to be produced at the second count that were dated prior to the first pill count. Additionally, the amount of daily medication taken by the patient occasionally bore little resemblance to the amount indicated by the general practitioner, or fluctuated during the course of the study. In such instances, or where confusion reigned for other reasons, it was necessary to drop the suspect drug from the inventory. In this way, compliance figures are likely to have been inflated somewhat.

As anticipated, in the calculation of compliance ratio, errors of omission often cancelled out errors of commission, perhaps where similar looking pills had been confused. Thus, the high overall compliance ratio (97%) for participants in the present study may nevertheless disguise numerous drug taking mistakes. Some support for this supposition is evident in the total error rate rate, where, on average, each participant made 19 errors and the maximum number of errors made by a participant during the interval between pill counts reached as high as 77.

Use of Compliance Ratio

The use of compliance ratio (number of doses taken, divided by the number of doses that should have been taken, multiplied by 100) to compare the performance of the experimental versus the control group, may be questioned. Compliance ratio is only an accurate indication of the average level of compliance in a group where all errors are errors of omission. Where some sample members commit errors of commission and hence have a compliance ratio which exceeds 100%, combining these higher ratios with those below 100% artificially inflates the true average level of compliance. In the present study, 11 participants had compliance ratios which exceeded 100%. When these participants are excluded from the calculation of average compliance rate, this drops from 97% to 95.5%. Consequently, the average

97% compliance ratio of the overall sample in the present study is an overstatement of the true performance of the group. Nevertheless, when experimental and control groups were compared in terms of average compliance deviation score (how a score differs from 100) rather than compliance ratio, no significant differences were discovered. Thus, while the use of compliance ratio in the present study did not alter the finding that the medication calendar did not improve compliance rates in the experimental versus the control group, its use can be misleading.

The Hawthorne Effect

The Hawthorne effect refers to the inducement of change as a result only of the subjects' awareness that they are being observed (Schweigert, 1994). When applied to the present study, a Hawthorne effect would mean that an over-estimation of compliance levels may occur, as subjects may not behave as they would under normal everyday circumstances. Park and colleagues (1992) took this into account in the design of their medication compliance study, which monitored subjects for two weeks, but only analysed data from week two. They suggested that a longer period of monitoring may be useful to limit the Hawthorne effect. The interval between pills counts in the present study was, on average, about 7½ weeks. Nevertheless, the possibility that a Hawthorne effect occurred cannot be completely ruled out, even though it is impossible to measure. The long interval between pill counts makes this less likely however than in studies of shorter duration.

Suggestions for Future Research

Suggestions for future research into medication compliance are presented in the following section. These include the necessity to encourage physically infirm and cognitively impaired older adults to participate in research projects like the present

study. The need for further research into the timing of medication intake and the reasons for non-compliance are considered. Finally, the necessity for research into non-prescription medication use is discussed.

Physically Infirm and Cognitively Impaired Older Adults

The medication calendar used in the present study was conceived as a potential cognitive aid for those older adults who, due to a combination of physiological changes due to ageing, chronic ill health and polypharmacy, perhaps require additional support in order to correctly take their medication. As discussed in Chapter One, the greater possibility of cognitive impairment with increasing age, combined with the frequent use of multiple medications, may increase the vulnerability of some older adults to non-compliance with medication regimens (Fitten et al., 1995).

The present study wished to recruit participants via general practitioners, rather than by alternative methods such advertising in the media for participants or using the electoral rolls, in the hope that practitioners would encourage their more "at-risk" patients to take part in the study. Clearly, this did not eventuate, and the question of how to access such patients remains. Many participants in the present study, without prompting, told of relatives or people they knew for whom they felt the calendar would have been useful as a reminder, or as a means of avoiding confusion when a medication regimen was complex. Additionally, several mentioned people they knew who had been hospitalised due to medication mistakes. While memory deficits may not necessarily be the cause of such medication errors, anecdotes of this nature suggest that there *are* older adults in the population who may benefit from a medication calendar, which could easily be drawn up by a relative or friend with access to a computer.

Furthermore, the ageing population, in combination with government policy of allowing "ageing in place", suggests that there are likely to be growing numbers of physically infirm or possibly cognitively impaired older adults who remain living in their own homes. It is perhaps upon such individuals that future research into medication compliance should focus. Again, the persons most likely to be in a position to encourage such older adults to take part in research projects like the present study, are general practitioners, particularly those who perform home visits. The question of how to encourage busy practitioners to assist in the recruitment of study participants is, without doubt, a substantial obstacle future researchers will need to circumvent.

Research Into Timing of Medication Intake

The manual pill count method used by the present study was of no use in establishing whether medication had been taken correctly, at the prescribed intervals. Several studies have found timing errors to be more common than dosage errors (e.g., Choo et al., 1999; Gravely & Oseasohn, 1991). Indeed, when the physiological changes that accompany ageing are considered, it is clear that medication timing errors can detrimentally affect the health of older adults due to their narrow "therapeutic window" and thus greater potential for adverse drug reactions (Richardson, 1986). As mentioned in Chapter Three, sophisticated, but expensive, electronic pill dispensers are available which indicate the number of tablets taken and the date and timing of such doses. This information can be downloaded onto a computer, allowing researchers to analyse it and show patients a graphical display of when and how often doses were skipped (Stephenson, 1999). Assuming future researchers are able to afford these dispensers, their use may reveal whether high average compliance ratios nevertheless mask deficits in medication timing. A Weekend Herald article by Johnson (2000) reports that Auckland Healthcare used such dispensers to supervise compliance with tuberculosis drugs. However, using

devices of this type still does not allow researchers to escape the necessity of making the assumption that medication removed from the container was actually ingested. Nevertheless, more information about the "dynamics of compliance" (Kruse et al., 1992, p.1154), especially where multiple medications are prescribed and the drug regimen is complex, would be illuminating.

Reasons for Non-Compliance with Medication

As mentioned in Chapter Two, there are numerous reasons for medication non-compliance in addition to forgetting, which was the focus of the present study. It is possible, for example, that many errors of commission in the present study represented tablets that had been dropped rather than swallowed, with no threat to health whatsoever. Non compliance may also be intentional, rather than non-intentional. An interesting aspect of intentional non-compliance, referred to by one researcher as "intelligent non-compliance" (Weintraub, 1978, cited in Fincham & Wertheimer, 1988) deserves mention. For instance, one participant volunteered that on the days she was employed, she purposely did not take her morning diuretic (Frusid) as the resultant increased frequency in the need to urinate was not compatible with her working environment. Results indicated that this participant had indeed omitted 43 tablets over the study period (representing 7% of the 616 tablets she should have taken over the period), all of which were Frusid. No other mistakes were made; consequently without taking this drug into account her compliance rate would have been 100%. Such non-compliance may better be viewed as the outcome of a reasoned decision making process rather than non-compliance in the traditional sense (Miller, 1997). Further investigation into the nature and degree of the phenomenon of "intelligent non-compliance" may be warranted.

Non-Prescription Medication

The nature and extent of non-prescription medication use among older adults in New Zealand is largely unknown. Indeed, one participant produced a plastic bag which appeared to contain about a dozen bottles of over-the-counter medications, supplements and herbal remedies. The potential for interaction with prescription medications is alarming. The use of over-the-counter remedies in combination with prescribed drugs is a topic currently receiving attention in the media and its investigation may prove to be both interesting and fruitful for future researchers.

Conclusion

The present study found compliance rates to be substantially higher than those quoted in the research literature. Despite the cited concerns about the non-representativeness of the convenience sample used, these findings of high rates of compliance are reassuring, considering New Zealand's ageing population and the limited resources available in the health sector. The present sample, although non-representative, is nevertheless comprised of fifty older adults, suffering from a variety of chronic conditions requiring them to ingest around five prescription drugs daily. The high medication compliance rates of participants suggest that they are neither wasting health resources nor putting their own health at risk by non-compliance. These findings are encouraging and satisfying for health professionals dealing with older adults in general, and for the general practitioners of sample members in particular.

REFERENCES

Adler, N.E., Boyce, T., Chesney, M.A., Cohen, S., Folkman, S., Kahn, R.L., & Syme, S.L. (1994). Socioeconomic status and health : the challenge of the gradient. *American Psychologist, 49,* 15-24.

Ascione, F., & Raven, R. (1975). Physicians' attitudes regarding patients' knowledge of prescribed medication. *Journal of American Pharmacy Association, 15,* 386-391.

Atkin, P.A., Finnegan, T.P., Ogle, S.J., & Shenfield, G.M. (1994). Functional ability of patients to manage medication packaging : a survey of geriatric inpatients. *Age & Ageing, 23*, 113-116.

Atwood, J.R., Giordano, L., Vargas, P., Blackwell, G.G., Earnest, D.L., Meyskens, F., & Alberts, D. (1996). Adherence enhancers in pill-related clinical trials : a health behavior in cancer prevention model-based approach. *Patient Education and Counseling, 28,* 15-23.

Avorn, J., Dreyer, P., Connelly, K., & Soumerai, S.B. (1989). Use of psychoactive medication and the quality of care in rest homes. Findings and policy implications of a statewide study. *New England Journal of Medicine, 320*, 227-32

Balkrishnan, R. (1998). Predictors of medication adherence in the elderly. *Clinical Therapeutics, 20*, 764-771.

Bame, S.I., Petersen, N., & Wray, N.P. (1993). Variations in hemodialysis patient compliance according to demographic characteristics. *Social Science and Medicine, 37*, 1035-1043.

Barat, J., Andreasen, F., & Damsgaard, E.M. (2001). Drug therapy in the elderly : what doctors believe and patients actually do. *British Journal of Clinical Pharmacology, 51*, 615-22.

Beers, M., Avorn, J., Soumerai, S., Everitt, D.E., Sherman, D.S., & Salem, S. (1988). Psychoactive medication use in intermediate-care facility residents. *Journal of the American Medical Association, 260*, 3016-3024.

Ben-Sira, Z. (1980). Affective and instrumental components in the physician-patient relationship : an additional dimension of interaction theory. *Journal of Health and Social Behaviour, 21,* 170-180.

Berg, J.S., Dischler, J., Wagner, D.J., Raia, J.J., & Palmer-Shevlin, N. (1993). Medication compliance : a healthcare problem. *The Annals of Pharmacotherapy, 27*, S2-S19.

Berg, J., Dunbar-Jacob, J., & Rohay, J.M. (1998). Compliance with inhaled medications : the relationship between diary and electronic monitor. *Annals of Behavioral Medicine, 20*, 36-38.

Birren, J.E., & Schroots, J.J.F. (1996). History, concepts, and theory in the psychology of aging. In J. E. Birren & K. W. Schaie (Eds.), *Handbook of the psychology of aging* (4th ed., pp. 3-23). San Diego : Academic Press.

Black, D.M., Brand, R.J., Greenlick, M., Hughes, G., & Smith, J. (1987). Compliance to treatment for hypertension in elderly patients : the SHEP pilot study. *Journal of Gerontology, 42*, 552-557.

Black, S., & Scogin, F. (1998). Cognitive interventions for older diabetics. *Educational Gerontology, 24,* 553-566.

Blackwell, B. (1972). The drug defaulter. *Clinical Pharmacology & Therapeutics, 13*, 841-848.

Blazer, D.G. (1982). *Depression in late life.* St. Louis : Mosby Co.

Bliss, M.R. (1981). Prescribing for the elderly. *British Medical Journal, 283,* 203-206.

Botelho, R.J., & Dudrak, R. (1992). Home assessment of adherence to long-term medication in the elderly. *The Journal of Family Practice, 35*, 61-65.

Brody, D.S. (1980). The patient's role in clinical decision-making. *Annals of Internal Medicine, 93*, 718-722.

Buckalew, L.W., & Buckalew, N.M. (1995). Survey of the nature and prevalence of patients' non-compliance and implications for intervention. *Psychological Reports, 76*, 315-321.

Butler, R.N., Lewis, M., & Sunderland, T. (1991). *Aging and Mental Health* (4th ed). New York : Macmillan Publishing Company.

Burt, W.L., & Cooper, M.H. (1984). Barriers to medication. Dunedin, New Zealand: University of Otago.

Carney, R.M., Freedland, K.E., Eisen, S.A., Rich, M.W., & Jaffe, A.S. (1995). Major depression and medication adherence in elderly patients with coronary artery disease. *Health Psychology, 14*, 88-90.

Choo, P.W., Rand, C.S., Inui, T.S., Lee, M.L., Cain, E., Cordeiro-Breault, M., Canning, C., & Platt, R. (1999). Validation of patient reports, automated pharmacy records and pill counts with electronic monitoring of adherence to antihypertensive therapy. *Medical Care, 37*, 846-857.

Chrischilles, E.A., Segar, E.T., & Wallace, R.B. (1992). Self reported adverse drug reactions and related resource use : a study of community-dwelling persons 65 years of age and older. *Annals of Internal Medicine, 117,* 634-640.

Christensen, A.J., Moran, P.J., & Wiebe, J.S. (1999). Assessment of irrational health beliefs : relation to health practices and medical regimen adherence. *Health Psychology, 18*, 169-176.

Coe, N.P.W. (1997). A time to listen. *American Journal of Surgery, 173*, 534-537

Cohen, G. (1991). Anxiety and general medical disorders. In C. Salzman & B.D. Lebowitz (Eds.), *Anxiety in the elderly : Treatment and research.* Springer Publishing Company : New York.

Cohen, G., & Faulkner, D. (1989). Age differences in source forgetting: effects on reality monitoring and on eyewitness testimony. *Psychology and Aging, 4*, 10-17.

Cohen, I., Rogers, O., Burke V., & Beilin, L.J. (1998). Predictors of medication use, compliance and symptoms of hypotension in a community based sample of elderly men and women. *Journal of Clinical Pharmacy & Therapeutics, 23*, 423-32.

Col. N., Fanale, J.E., & Kronholm, P. (1990). The role of medication noncompliance and adverse drug reactions in hospitalisations of the elderly. *Archives of Internal Medicine, 150,* 841-845.

Conn, V.S., Taylor, S.G., & Kelley, S. (1991). Medication regimen complexity and adherence among older adults. *Image : Journal of Nursing Scholarship, 23*, 231-235.

Conner, M., & Norman, P. (1998). Health behavior. In A.S. Bellack & M. Hersen (Eds.), *Comprehensive Clinical Psychology*. United Kingdom : Pergamon.

Conrad, P. (1985). The meaning of medications : another look at compliance. *Social Science & Medicine, 20*, 29-37.

Cooper, J.W. (1990). Drug related problems in the elderly at all levels of care. *Journal of Geriatric Drug Therapy, 4*, 79-83.

Corlett, A.J. (1996). Caring for older people : aids to compliance with medication. *British Medical Journal, 313,* 926-929.

Coronary Drug Project Research Group. (1980). Influence of adherence to treatment and response of cholesterol on mortality in the Coronary Drug Project. *New England Journal of Medicine, 303,* 1038-1041.

Cowie, M.R., Mosterd, A., Wood, D.A., Deckers, J.W., Poole-Wilson, P.A., Sutton, G.C., & Grobbee, D.E. (1997). The epidemiology of heart failure. *European Heart Journal, 18*, 208-225.

Crooks, J., Shepherd, A.M., & Stevenson, I.H. (1975). Drugs and the elderly. The nature of the problem. *Health Bulletin, 33*, 222-227.

Curtin, R.B., Svarstad, B.L., & Keller, T.H. (1999). Hemodialysis patients' non-compliance with oral medications. *Anna Journal, 26*, 307-316.

Daniels, D.E., Rene, A.A., & Daniels, V.R. (1994). Race : an explanation of patient compliance – fact or fiction?. *Journal of the National Medical Association, 86*, 20–25.

Davison, G.C., & Neale, J.N. (1994). *Abnormal Psychology* (6th ed.). New York: John Wiley & Sons. Inc.

Deeg, D.J.H., Kardaun, J. W.P.F., & Fozard, J.L. (1996). Health, behavior and aging. In J.E. Birren & K.W. Schaie (Eds.), *Handbook of the psychology of aging* (4th ed., pp. 129-149). San Diego : Academic Press.

Donovan, J.L. (1995). Patient decision making. The missing ingredient in compliance research. *International Journal of Technology Assessment in Health Care, 11*, 443-455.

Dunbar, J.M., & Agras, W.S. (1980). Compliance with medical instructions. In J.M. Ferguson & C.B. Taylor (Eds.), *Comprehensive handbook of behavioral medicine* (Vol 3). New York : Spectrum.

Dunnell, K. (1973). Medication takers and hoarders. *Journal of the Royal College of General Practitioners, 23*, 2-9.

Einstein, G.O., Holland, L.J., MCDaniel, M.A., & Guynn, M.J. (1992). Age-related deficits in prospective memory : the influence of task complexity. *Psychology and Aging, 7*, 471-478.

Eisdorfer, C., Cohen, D., & Veith, R. (1981). *The psychopathology of aging.* Washington : Upjohn.

Eisen, S.A., Miller, D.K., Woodward, R.S., Spitznagel, E., & Przybeck, T.R. (1990). The effect of prescribed daily dose frequency on patient medication compliance. *Archives of Internal Medicine, 150*, 1881-1884.

Epstein, L.H., & Cluss, P.A. (1982). A behavioral medicine perspective on adherence to long term medical regimens. *Journal of Consulting and Clinical Psychology, 50*, 950-971.

European Pharmaceutical Marketing Research Association (2000). *Anatomical Classification Guidelines.* Retrieved September 4, 2001, from http://www.ephmra.org/atc/6_002.html

Filipp, S.H. (1996). Motivation and emotion. In J. E Birren & K. W. Schaie (Eds.), *Handbook of the psychology of aging.* (4th ed., pp. 218-235). San Diego : Academic Press.

Fincham, J.E., & Wertheimer, A.I. (1988). Elderly patient initial non-compliance: the drugs and the reasons. *Journal of Geriatric Drug Therapy, 2*, 53-62.

Fitten, L.J., Coleman, L., Siembieda, D.W. , Yu, M., & Ganzell, S. (1995). Assessment of capacity to comply with medication regimens in older patients. *Journal of the American Geriatrics Society, 43,* 361-367.

Fulmer, T.T., Feldman, P.H., Kim, T.S., Carty, B., Beers, M., Molina, M., & Putnam, M. (1999). An intervention study to enhance medication compliance in community-dwelling elderly individuals. *Journal of Gerontological Nursing, 25*, 6-14.

Galbraith, A., Bullock, S., & Manias, E. (1994). Fundamentals of pharmacology: a text for nurses and allied health professionals. Sydney : Addison-Wesley Publishing Company.

Gehres, R.W. (1986). A medication monitoring service for elderly patients offered by the pharmacist on a fee-for-service basis. *Journal of Geriatric Drug Therapy, 1*, 81-89.

Gien, L., & Anderson, J.A.D. (1989). Medication and the elderly : a review. *Journal of Geriatric Drug Therapy, 4*, 59-89.

Gordis, L. (1979). Conceptual and methodologic problems in measuring patient compliance. In R.B. Haynes, D.W. Taylor, & D.L. Sackett (Eds.), *Compliance in health care.* Baltimore : Johns Hopkins Press.

Gordis, L., Markowitz, M., & Lilienfeld, A.M. (1969). The inaccuracy in using interviews to estimate patient reliability in taking medications at home. *Medical Care, 7*, 49-54.

Gravely E.A., & Oseasohn, C. (1991). Multiple drug regimens : medication compliance among veterans 65 years and older. *Nursing & Health, 14,* 51-58.

Gray, S.L., Mahoney, J.E., & Blough, D.K. (2001). Medication adherence in elderly patients receiving home health services following hospital discharge. *Annals of Pharmacotherapy, 35*, 539-545.

Gray, S.L., Williams, D.M., Pulliam, C.C., Sirgo, M.A., Bishop, A.L., & Donohue, J.F. (1996). Characteristics predicting incorrect metered-dose inhaler technique in older subjects. *Archives of Internal Medicine, 156,* 984-988.

Grayson, P., Lubin, B., & Van Whitlock, R. (1995). Comparison of depression in the community-dwelling and assisted-living elderly. *Journal of Clinical Psychology, 51*, 18-21.

Green, L.W., Mullen, P.D., & Stainbrook, G.L. (1986). Programs to reduce drug errors in the elderly : direct and indirect evidence from patient education. *Journal of Geriatric Drug Therapy, 1*, 3–18.

Greenblatt, D.J., Sellers, E.M., & Shader, R.I. (1982). Drug disposition in old age. *The New England Journal of Medicine, 306*, 1081-1088.

Hall, J.A., Roter, D.L., & Rand, C.S. (1981). Communication of affect between patient and physician. *Journal of Health and Social Behaviour, 22*, 18-30.

Harris, L.E., Luft, F.C., Rudy, D.W., & Tierney, W.M. (1995). Correlates of health care satisfaction in inner city patients with hypertension and chronic renal insufficiency. *Social Science and Medicine, 41*, 1639-1645.

Hashtroudi, S., Johnson, M.K., & Chrosniak, L.D. (1990). Aging and qualitative characteristics of memories for perceived and imagined complex events. *Psychology and Aging, 5*, 119-126.

Hatfield, A.B. (1994) *Medication compliance.* Arlington, Va, USA : National Alliance for the Mentally Ill (NAMI).

Haynes, R.B. (1979). Introduction. In R.B. Haynes, D.W. Taylor & D.L. Sackett (Eds.), *Compliance in health care.* Baltimore : Johns Hopkins University Press.

Haynes, R.B. , Sackett, D.L., Gibson, E.S., Taylor, D.W., Hackett, B.C., Roberts, R.S., & Johnson, A.K. (1976). Improvement of medication compliance in uncontrolled hypertension. *The Lancet, 1,* 1265-1268.

Health Research Council of New Zealand. (1999). *Guidelines for researchers on health research involving Maori.* Retrieved April 8th, 1999, from http://www.hrc.govt.nz/maoguide.htm

Helling, D.K., Lemke, J.H., Semla, T.P., Wallace, R.B., Lipson, D.P., & Cornoni-Huntley, J. (1987). Medication use characteristics in the elderly : the Iowa 65+ rural health study. *Journal of the American Geriatrics Society, 35*, 4-12.

Husaini, B.A. (1997). Predictors of depression among the elderly : racial differences over time. *American Journal of Orthopsychiatry, 67*, 48-58.

Isaac, L.M., & Tamblyn, R.M. (1993). Compliance and cognitive function : a methodological approach to measuring unintentional errors in medication compliance in the elderly. McGill-Calgary Drug Research Team. *Gerontologist, 33*, 772-781.

Isaacs, P., & Spoonley, P. (1994). *Ageing in the Wairarapa : empowering the older person.* Wairarapa Organisation for Older Persons Social Research and Consultancy Agency, Palmerston North : Massey University.

Janz, N., & Becker, M. (1984). The health belief model : a decade later. *Health Education Quarterly, 11,* 1-47 .

Johnston, M. (2000, January 22-23). Keeping tabs on a killer. *Weekend Herald,* pp. A17.

Kazis, L.E., & Friedman, R.H. (1988). Improving medication compliance in the elderly : strategies for the health care provider. *Journal of the American Geriatric Society, 36,* 1161-1162.

Kendrick, R., & Bayne, J.R.D. (1982). Compliance with prescribed medication by elderly patients. *Canadian Medical Association Journal, 15,* 127-128.

Kim, K., & Grier M. (1981). Pacing effects of medication instructions for the elderly. *Journal of Gerontological Nursing, 7,* 464-468.

Kruse, W., Koch-Gwinner, P., Nikolaus, T., Oster, P., Schlierf, G., & Weber, E. (1992). Measurement of drug compliance by continuous electronic monitoring : a pilot study in elderly patients discharged from hospital. *Journal of the American Geriatrics Society, 40,* 1151-1155.

Lamy, P.P. (1980). Misuse and abuse of drugs by the elderly. *American Pharmacy, 20*, 14-17.

Law, R., & Chalmers, C. (1976). Medicines and elderly people : a general practice survey. *British Medical Journal, 1,* 565-568.

Leirer, V.O., Morrow, D.G., Tanke, E.D., & Pariante, G.M. (1991). Elders' non-adherence : its assessment and medication reminding by voice mail. *The Gerontologist, 31*, 514-520.

Leirer, V.O., Morrow, D.G., Pariante, G.M., & Sheikh, J.I. (1988). Elders' non-adherence, its assessment, and computer assisted instruction for medication recall training. *Journal of the American Geriatrics Society, 36,* 877-884.

Leistyna, J.A., & Macaulay, J.C. (1966). Therapy of streptococcal infections. Do pediatric patients receive prescribed oral medication? *American Journal of Diseases of Children, 111*, 22-26.

Ley, P. (1979). Memory for medical information. *British Journal of Social and Clinical Psychology, 18,* 245-255.

Lipton, H.L. (1988). Elderly patients and their pills : the role of compliance in safe and effective drug use. *Pride Institute Journal of Long Term Home Health Care, 8,* 26-31.

Lorenc, L., & Branthwaite, A. (1993). Are older adults less compliant with prescribed medication than younger adults? *British Journal of Clinical Psychology, 32,* 485-492.

Lyndon, R.W., & Russell, J.D. (1990). Can overuse of psychotropic drugs by the elderly be prevented? *Australian & New Zealand Journal of Psychiatry, 24,* 77-81.

Maddox, J.C., Levi, M., & Thompson, C. (1994). The compliance with antidepressants in general practice. *Journal of Psychopharmacology, 8,* 48-53.

Maine, L.L., Rodriguez, R., & Brown, J. (1988). Geriatric drug testing – who will volunteer? A descriptive survey. *Journal of Geriatric Drug Therapy, 2,* 63-65.

Marcantonio, E.R., McKean, S., Goldfinger, M., Kleefield, S., Yurkofsky, M., & Brennan, T.A. (1999). Factors associated with unplanned hospital readmission among patients 65 years of age and older in a Medicare managed care plan. *The American Journal of Medicine, 107,* 13-17.

Marston, M. V. (1970). Compliance with medical regimens: a review of the literature. *Nursing Research, 19,* 312-323.

Martin, C. (1996). Aspirin : new life for an old drug. *Chemistry in Britain, 32,* 8-10.

Matsui, D., Hermann, C., Klein, J., Berkovitch, M., Olivieri, N., & Koren, G. (1994). Critical comparison of novel and existing methods of compliance assessment during a clinical trial of an oral iron chelator. *Journal of Clinical Pharmacology, 34,* 944-949.

McDonald-Smith, P.B. (1997). *The quality of life, risk of abuse and self-esteem of older adults in the Manawatu : a thesis presented in partial fulfilment of the requirements for the degree of Master of Philosophy in Psychology at Massey University.* Unpublished master's thesis, Massey University, Palmerston North, New Zealand.

McDonald (n.d.). *Senior Citizens Briefing.* Retrieved September 25th, 2000, from http://www/executive.govt.nz/96-9...ster/mcdonald/briefing/paper8.htm

McIntire, M.S., Angle, C.R., Sathees, K., & Lee, P.S. (1977). Safety packaging -- what does the public think? *American Journal of Public Health, 67*, 169-71.

McKenney, J.M. (1979). The clinical pharmacy and compliance. In R.B. Haynes, D.W. Taylor, & D.L. Sackett (Eds.), *Compliance in health care.* Baltimore: Johns Hopkins University Press.

McKenney, J.M., & Harrison, W.L. (1976). Drug-related hospital admissions. *American Journal of Hospital Pharmacy, 33*, 792-795.

Meichenbaum D., & Turk, D.C. (1987). Facilitating treatment adherence. New York City: Plenum Press.

Millar, M.A., Flett, R.A., Kazantzis, N., Long, N.R., & McDonald C. (1999). Physician service use by older adults in New Zealand. *Australian Journal of Rehabilitation Counselling, 5*, 126-135.

Miller, N.H. (1997). Compliance with treatment regimens in chronic asymptomatic diseases. *American Journal of Medicine, 102,* 43-49.

Mindel, C.H., & Kail, B.L. (1989). Issues in research on the older woman of color. *The Journal of Drug Issues, 19*, 191-206.

Monane, M., Bohn, R.L., Gurwitz, J.H., Glynn, R.J., & Avorn, J. (1994). Noncompliance with congestive heart failure therapy in the elderly. *Archives of Internal Medicine, 154,* 433-437.

Morrell, R.W., Park, D.C., & Poon, L.W. (1990). Effects of labeling techniques on memory and comprehension of prescription information in young and old adults. *Journal of Gerontology, 45*, 166-172 .

Morrow, D., Leirer, V., & Sheikh, J. (1988). Adherence and medication instructions : review and recommendations. *Journal of the American Geriatrics Society, 36,* 1147-1160.

Moser, M. (1995). Non-compliance in the management of hypertension : a different perspective. *Primary Cardiology, 21,* 3-4.

New Ethicals Catalogue, Vol. 36, No. 1 (May, 1999). New Zealand : Adis International.

New Zealand Health Information Service (1995). *Patients in profile : the use of health care services in New Zealand.* Retrieved September 25th, 2000, from http://www/nzhis.govt.nz/publications/Patients.html

New Zealand Health Information Service (1999). *Selected morbidity data for publicly funded hospitals : 1997/98.* Wellington : Ministry of Health.

New Zealand Health Information Service (2000). *Selected health statistics : public hospital patients.* Retrieved September 25th, 2000 from http://www/nzhis.govt.nz/stats/hospstats-p.html

Nichol, M.B., Venturini, F., & Sung, J.C.Y. (1999). A critical evaluation of the methodology of the literature on medication compliance. *The Annals of Pharmacotherapy, 33,* 531-540.

Norell, S.E. (1979). Improving medication compliance : A randomised clinical trial. *British Medical Journal, 2,* 1031-1033.

North, N. (1983). *Compliance from the perspective of tuberculosis patients : a thesis presented in partial fulfilment of the requirements for the degree of Master of Arts in Nursing Studies at Massey University.* Unpublished master's thesis, Massey University, Palmerston North, New Zealand.

Oakley-Browne, M.A., Joyce, P.R., Wells, J.E., Bushnell, J.A., & Hornblow, A.R. (1989). Christchurch psychiatric epidemiology study, part II : six month and other period prevalences of specific psychiatric disorders. *Australian and New Zealand Journal of Psychiatry, 23,* 327-340.

O'Connell, M.B., & Johnson, J.F. (1992). Evaluation of education knowledge in elderly patients. *The Annals of Pharmacotherapy, 26,* 919-921.

Ostrum, J.R., Hammarlund, E.R., Christensen, D.B., & Plein, J.B. (1985). Medication usage in an elderly population. *Medical Care, 23*, 157-164.

Palmer, H.M., & Dobson, K.S. (1994). Self-medication and memory in an elderly Canadian sample. *The Gerontologist, 34*, 658-664.

Park, D.C., Morrell, R.W., Frieske, D., & Kincaid, D. (1992). Medication adherence behaviors in older adults : effects of external cognitive supports. *Psychology and Aging, 7*, 252-256.

Parkin. D. M., Henney, C.R., Quirk, J., & Crooks, J. (1976). Deviation from prescribed drug treatment after discharge from hospital. *British Medical Journal, 2,* 686-688.

Pearce, N., Pomare, E., Marshall, S., & Borman, B. (1993). Mortality and social class in Maori and non-Maori New Zealand men: changes between 1975-7 and 1985-7. *New Zealand Medical Journal, 106*, 193-196.

Perri, M., Martin, B.C., & Pritchard, F.L. (1995). Improving medication compliance: a practical intervention. *Journal of Pharmacy Technology, 11,* 167-172.

Pesznecker, B.L., Patsdaugher, C., Moody, K.A., & Albert, M. (1990). Medication regimens and the home care client : a challenge for health care providers. *Home Health Care Services Quarterly, 11*, 9-68.

Pharmaeutical Management Agency Limited. (Pharmac). (1999*). From the archive : more doctors choosing to prescribe generics.* Retrieved September 25th, 2000, from http://www/pharmac.govt.nz/press/archiveitem.asp?id=917480308.

Phillips, E.L. (1988). *Patient compliance : new light on health delivery systems in medicine and psychotherapy.* Toronto : Hans Huber Publishers.

Potempa, K., & Folta, A. (1992). Drug use and effects in older adults in the United States. *International Journal of Nursing Studies, 29,* 17-26.

Prime Ministerial Task Force on Positive Ageing. (1997). *Facing the future : a strategic plan.* Department of the Prime Minister and Cabinet: Wellington, New Zealand.

Prime Ministerial Task Force on Positive Ageing. (1997). *Facing the future : a possible way forward : a second document for public consultation (April/May 1997).* Department of the Prime Minister and Cabinet: Wellington, New Zealand.

Raiz, L.R., Kilty, K.M., Henry, M.L., & Ferguson, R.M. (1999). Medication compliance following renal transplantation. *Transplantation, 68,* 51-5.

Raynor, D.K., Booth, T.G., & Blenkinsopp, A. (1993). Effects of computer generated reminder charts on patients' compliance with drug regimens. *British Medical Journal, 306,* 1158-1161.

Rich, M.W., Baldus Gray, D., Beckham, V., Wittenberg, C., & Luther, P. (1996) Effect of a multidisciplinary intervention on medication compliance in elderly patients with congestive heart failure. *American Journal of Medicine, 101,* 270-276.

Richards, H.L., Fortune, D.G., O'Sullivan, T.M., Main, C.J., & Griffiths, C.E. (1999). Patients with psoriasis and their compliance with medication. *Journal of the American Academy of Dermatology, 41,* 581-583.

Richardson, J.L. (1986). Perspectives on compliance with drug regimens among the elderly. *Journal of Compliance in Health Care, 1,* 33-46.

Rocca, W.A., Hofman, A., Brayne, C., Breteler, M.M.B., Clarke, M., Copeland, J.R.M., Dartigues, J.F., Engedal, K., Hagnell, O., Heeren, T.J., Jonker, C., Lindesay, J., Lobo, A., Mann, A.H., Molsa, P.K., Morgan, K., O'Connor, D.W., da Silva Droux, A., Sulkava, R., Kay, D.W.K., & Amaducci, L. (1991). Frequency and distribution of Alzheimer's disease in Europe : a collaborative study of 1980-1990 prevalence findings. *American Neurological Association, 30,* 381-390.

Rotter, J.B. (1966). Generalized expectancies for internal versus external control of reinforcement. *Psychological Monographs, 35*, 651-665.

Ryan, A.A. (1999). Medication compliance and older people : a review of the literature. *International Journal of Nursing Studies, 36,* 153-162.

Sackett, D.L. (1979). A compliance practicum for the busy practitioner. In R.B. Haynes, D.W. Taylor, & D.L. Sackett (Eds.), *Compliance in health care.* Baltimore : Johns Hopkins Press.

Sackett, D.L., & Snow, J.C. (1979). The magnitude of compliance and noncompliance. In R.B. Haynes, D.W. Taylor & D.L. Sackett (Eds.), *Compliance in health care.* Baltimore : Johns Hopkins Press.

Salthouse, T.A., & Mitchell, D. R.D. (1989). Structural and operational capacities in integrative spatial ability. *Psychology and Aging, 4*,18-25.

Salzman, C. (1995). Medication compliance in the elderly. *Journal of Clinical Psychiatry, 56*, 18-22.

Schweigert, W.A. (1994). *Research methods and statistics for psychology.* Pacific Grove : California.

Senior Citizens Unit. (1990). *Senior citizens speak : issues and concerns. The findings of the 1990 consultation.* Wellington, New Zealand.

Shah, P.M., Maly, R.C., Frank, J.C., Hirsch, S.H., & Reuben, D.B. (1997). Managing geriatric syndromes : what geriatric assessment teams recommend, what primary care physicians implement, what patients adhere to. *Journal of the American Geriatrics Society, 45,* 413-419.

Shipley, J. (August, 1996). *Message from the Minister of Health : income and asset testing.* Retrieved September 25th, 2000, from http://www.executive.govt.nz/93-96/minister/shipley/matters/facts.htm

Simoneau, G.G., & Leibowitz, H.W. (1996). Posture, gait, and falls. In J. E Birren & K. W. Schaie (Eds.), *Handbook of the psychology of aging* (4th ed., pp.204-217). San Diego : Academic Press.

Skegg, D.C., Doll, R., & Perry, J. (1977). Use of medicines in general practice. *British Medical Journal, 1*, 1561-1563.

Smith, A.D. (1996). Memory. In J. E Birren & K. W. Schaie (Eds.), *Handbook of the psychology of aging* (4th ed., pp.236-250). San Diego : Academic Press

Snowdon, D. (2001). *Aging with Grace : what the Nun study teaches us about leading longer, healthier and more meaningful lives.* USA : Bantam Books.

Southam, M.A., & Dunbar, J.M. (1986). Facilitating patient compliance with medical interventions. In K. Holroyd & T. Creer (Eds.), *Self management of chronic disease.* New York : Academic Press.

Spagnoli, A., Ostino, G., Borga, A.D., D'Ambrosio, R., Maggiorotti, P., Todisco, E., Prattichizzo, W., Pia, L., & Comelli, M. (1989). Drug compliance and unreported drugs in the elderly. *Journal of the American Geriatrics Society, 37,* 619-624.

Statistics New Zealand (1996). *Highlights.* Retrieved April 2nd, 2001, from http://www.stats.govt.nz/__4c2563...edfb4c25652b00703ca4?OpenDocument

Statistics New Zealand (1996). *North Shore City.* Wellington : New Zealand.

Statistics New Zealand (1997). *People and places.* Wellington, New Zealand.

Statistics New Zealand (1998). *65 Plus.* Wellington, New Zealand.

Stephenson, J. (1999). Non-compliance may cause half of antihypertensive drug "failures". *Journal of the American Medical Association, 282*, 313-314.

Stromberg, A., Brostrom, A., Fridlund, B., Dahlstrom, U., & Fridlund, B. (1999). Factors influencing patient compliance with therapeutic regimens in chronic heart failure : a critical incident technique analysis. *Heart & Lung, 28*, 334-341.

Suchman, A.L., Markakis, K., Beckman, H.B., & Frankel, R. (1997). A model of empathic communication in the medical interview. *Journal of the American Medical Association, 277*, 678-682.

Tabachnick, B.G., & Fidell, L.S. (1989). *Using multivariate statistics* (2nd ed.). New York : Harper & Row.

Telecom New Zealand. (1999). *The Telephone Book : Auckland 1999.* New Zealand : Telecom Directories Ltd.

Thwaites, J.H. (1999). Practical aspects of drug treatment in elderly patients with mobility problems. *Drugs & Aging, 14*,105-114.

Vincent, P. (1971). Factors influencing patient non-compliance: A theoretical approach. *Nursing Research, 20*, 509-516.

Wallston, K.A., & Wallston, B.S. (1982). Who is responsible for your health? The construct of health locus of control. In G.S. Sanders & J. Suls (Eds.), *Social Psychology of health and illness.* New Jersey : Lawrence Erlbaum Associates.

Wandless, I., & Davie, J.W. (1977). Can drug compliance in the elderly be improved? *British Medical Journal, 1,* 359-361.

Warheit, G.J., Arey, S.A., & Swanson, E. (1976). Patterns of drug use : An epidemiologic overview. *Journal of Drug Issues, 6,* 223-237.

Ware, G.J., Holford, N.H.G., Davison, J.G., & Harris, R.G. (1991). Unit dose calendar packaging and elderly patient compliance. *New Zealand Medical Journal, 104,* 495-497.

Wechsler, D. (1981). *Wechsler Adult Intelligence Scale – Revised.* The Psychological Corporation/Harcourt Brace Jovanovich, Inc. : United States of America.

Willcox, S.M., Himmelstein, D.U., & Woolhandler, S. (1994). Inappropriate drug prescribing for the community-dwelling elderly. *The Journal of the American Medical Association, 272*, 292-296.

Willis, S.L. (1996). Everyday problem solving. In J. E Birren & K. W. Schaie (Eds.), *Handbook of the psychology of aging* (4th ed., pp.287-307). San Diego : Academic Press.

Wolfe, S., & Schirm, V. (1992). Medication counselling for the elderly : effects on knowledge and compliance after hospital discharge. *Geriatric Nursing, 13,* 134-139.

Woodruff-Pak, D.S. (1997). The neuropsychology of aging. Oxford : Blackwell Publishers Ltd.

Woodward, N.J., & Wallston, B.S. (1987). Age and health care beliefs : Self-efficacy as a mediator of low desire for control. *Psychology and Aging, 2,* 3-8.

Wright, E. C. (1993). Non- compliance – or how many aunts has Matilda? *The Lancet, 342*, 909-913.

APPENDIX A

i. Invitation letter to general practitioners

ii. Registration of interest form for general practitioners

iii. Information sheet for participants

iv. Consent forms for participants

Massey University
COLLEGE OF HUMANITIES & SOCIAL SCIENCES

School of Psychology
Private Bag 11 222,
Palmerston North,
New Zealand
Telephone: 64 6 356 9099
Facsimile: 64 6 350 5673

RE: MEDICATION COMPLIANCE STUDY

My name is June Greyvenstein and I am currently a post graduate student in a Masters programme in the School of Psychology at Massey University, Palmerston North. I would like to ask you to participate in a study which will take up very little of your time.

I am hoping to conduct research into medication compliance for my Masters thesis. The study proposes to target out-patients aged over 55 years, who are on three or more prescription medications, as this is the age group for whom the consequences of medication non-compliance are the most severe.

Specifically, it has as its objective the assessment of whether or not the provision to out-patients of an individualised "medication calendar" (intended to serve as a memory cue) encourages better compliance with prescription medication regimens. Compliance will be assessed via medication inventories conducted using strict hygiene measures. (The Massey University Human Ethics Committee requires that the researcher be accompanied by a research assistant during the medication inventories, to be absolutely certain that procedures are strictly adhered to and that the count is accurate).

To allow you to assess whether you would be interested in participating, I enclose for your information a copy of documentation relating to this study, as follows:

i. Information sheet for potential participants
ii. Consent Form No. 1 (for participation in the study)
iii. Consent Form No. 2 (allowing physicians to release details regarding prescription medication)

If you would be interested in seeing an example of the proposed medication calendar, I would be delighted to send you an example. (It will be printed on brightly coloured cardboard with a page for each week, and a holder with pencil will be provided to each participant).

What will be required of GPs who agree to participate

In the first instance, GPs who agree to participate will be asked to return the attached "Registration of Interest" form to the researcher in the freepost envelope provided. You will note that this form requests that you indicate approximately how many patients you think you would be able or willing to forward or hand information to. This will allow us to provide you with the appropriate number of sets of documentation and freepost envelopes.

Once you have received the documentation, which will be placed inside freepost envelopes, we would be grateful if you would address and post them, or alternatively if you prefer, hand them out to appropriate participants subsequent to a consultation. (You will note that the "Information Sheet" explains to the potential participant that the documentation has been sent to them by their general practitioner).

Consent forms from participants will be returned directly to the researcher. Once authorisation is received, you (or your practice nurse, if this is acceptable to you) will be asked to provide us with a list of the medications you have prescribed for your patient. Six weeks later, prior to the second medication inventory, you will be asked to provide information about any medication prescribed for your patient in the interim. This will conclude your participation in the study.

All participating physicians will be provided with a brief summary report of the results at the conclusion of the study. Should the medication calendar have proved useful, the format will be made available on disc (at the cost of the disc).

This study has been approved by the Massey University Human Ethics Committee.

I would be most grateful if you would consider participating. Any questions you may have regarding this project should be addressed to either of the following:

June Greyvenstein (researcher):

[redacted]

Dr. Nancy Pachana (supervisor)

- 06 350-5799 ext 2065 (tel)
- 06 350-5673(fax)
- N.A.Pachana@massey.ac.nz (Email)

Yours sincerely

JUNE GREYVENSTEIN

MASSEY UNIVERSITY

MEDICATION CALENDAR STUDY

REGISTRATION OF INTEREST BY GENERAL PRACTITIONER

NAME OF PHYSICIAN: _____

DATE : _____

ADDRESS : _____

_____

_____

TELEPHONE NUMBER : _____

I am interested in participating in this study

YES ☐ NO ☐

I am willing to forward documentation to ..... (please state approximate number) appropriate patients.

Massey University
COLLEGE OF HUMANITIES & SOCIAL SCIENCES

School of Psychology
Private Bag 11 222,
Palmerston North,
New Zealand
Telephone: 64 6 356 9099
Facsimile: 64 6 350 5673

MEDICATION CALENDAR STUDY

INFORMATION SHEET FOR PARTICIPANTS

June Greyvenstein, a student at Massey University, would like to invite you to participate in the research project she is conducting as part of her MA (Master of Arts) degree. This project is under the supervision of Dr. Nancy Pachana, Graduate Co-ordinator in the School of Psychology at the Palmerston North Campus of Massey University. (Contact telephone numbers are given on page 5).

This information has very kindly been forwarded to you, on our behalf, by your doctor.

<u>The purpose of the research project is:</u>

1. To find out whether patients find it helpful to have a personal "medication calendar" to use as a reminder to take their pills. It will list all their medicines and when and how each one should be taken. The chart will include boxes to be ticked off after each dose has been taken.

2. It is very common for patients to sometimes forget to take a dose of medicine. We would like to find out if patients who use a "medication calendar" will be less likely to forget to take their medicine than other patients who do not use it.

What this research will involve for participants

Please feel free to discuss this study with your family and friends. Should you agree to participate, and once you have returned the two consent forms (which are attached) to the researcher (freepost envelope provided) you will be placed in one of two groups.

Group One, the "experimental" group, will receive the calendar at the beginning of the study, while Group Two, the "control" group will receive it at the end of the study (if participants are interested in doing so).

Which group you are placed in depends completely on chance - the first person to agree to take part in the study will be in Group One, the second person to agree will be in Group Two, the third in Group One, the fourth in Group Two and so on.

Group One:

This is the "experimental" group which will receive the "medication calendar" to try out immediately.

There are two parts to this research:

Part 1:

Within a few days after receiving your consent forms, the researcher (June Greyvenstein) will telephone you to arrange an appointment time convenient to you, to come to your home. The researcher will carry identification in the form of a Massey University Student card and will be accompanied by a research assistant.

She will give you your personal "medication chart" and show you how to use it. (It is very simple to use). You will be asked to keep this in a prominent place with or near to your medicines and to tick the appropriate spaces every time you take your pills. She will also give you a small cardboard container in which you will be asked to store all empty pill containers once you have used up the contents.

The researcher will also ask if a "pill count" can be done. This will probably take not more than half an hour. You will need to provide her with your pill bottles so that she can count the number of pills you have in your possession at this time. This pill count will be done very carefully and hygienically and it is the job of the research assistant to help the researcher make certain that it is done accurately and according to strict procedures.

Part 2:
About six weeks later, the same researcher will again telephone you to ask if another pill count can be done so that we can compare this to the first count.

You will also be asked to fill out a very short questionnaire (it should only take 5 minutes) telling us whether or not you found the medication chart useful.

This is all that will be required to complete the study.

Group Two:

This is the "control" group which will NOT immediately receive the "medicine chart" to try out. However, should you be interested in doing so, you will receive one to try at the time of the second visit to your home by the researcher.

The procedure for this group will be exactly the same as for Group One, but of course you will not have to use the chart. However you will also be contacted soon after we have received your consent forms, to arrange to do the pill counts at a time convenient to you.

VERY IMPORTANT INFORMATION ABOUT THIS STUDY

CONFIDENTIALITY

Only the researcher and her supervisor will have access to any personal information. Any information bearing your name will be destroyed at the end of the study. At no time will your name be made public or used in any report.

The researcher will only be able to obtain information from your doctor that relates to the drugs you have been prescribed. She will have NO ACCESS to any information about your medical condition or medical records.

HOW THE INFORMATION GATHERED WILL BE USED

The information collected will be used to form part of a thesis which the researcher will submit to Massey University to be examined for her degree. There will be no personal information contained in this thesis.

A short report will also be drawn up about the usefulness (or otherwise) of "medication calendars" for patients. Your doctor will receive a copy of this report (but there will be no personal information about you in this report). You are most welcome to request a copy of this report and there is a space provided on Consent Form No. 1 for you to do so.

CONSENT FORMS

Should you agree to participate, please be kind enough to sign the two attached consent forms (one is to agree to participate in the study and the other is to allow the researcher to obtain information from your doctor about your prescribed medication) and return them in the freepost envelope provided..

However, please do not feel under any obligation whatsoever to participate. If you do decide to participate:

i. **you are able to withdraw from the study at any time you choose**
ii. **you may refuse to answer any questions at any time you choose.**

iii. you may ask any questions about the study at any time during participation

QUESTIONS

IF YOU HAVE ANY QUESTIONS ABOUT THIS STUDY PLEASE FEEL FREE TO CALL EITHER OF THE FOLLOWING:

i. June Greyvenstein (researcher):
[redacted]

ii. Dr. Nancy Pachana (supervisor)
- 06 350-5799 ext. 2065(tel)
- 06 350-5673(fax)
- N.A.Pachana@massey.ac.nz (Email)

Massey University
COLLEGE OF HUMANITIES & SOCIAL SCIENCES

School of Psychology
Private Bag 11 222,
Palmerston North,
New Zealand
Telephone: 64 6 356 9099
Facsimile: 64 6 350 5673

MEDICATION CALENDAR STUDY

CONSENT FORM NO. 1
(Consent to participate in study)

1. I have read the Information Sheet and understand what is involved in this study. I understand that I may ask questions at any time.

2. I understand that I have the right to withdraw from the study at any time without endangering my rights or access to health services, and that I may refuse to answer any particular question at any time.

3. I agree to provide information to the researcher on the understanding that my name will be kept confidential and will not be used in any reports.

4. I agree to take part in this study under the conditions set out in the Information Sheet.

FULL NAME : _____

SIGNED : _____

DATE : _____

TELEPHONE NUMBER : _____

Please indicate if you would like to receive feedback on the results of this study YES ☐ NO ☐

Massey University
COLLEGE OF HUMANITIES & SOCIAL SCIENCES

School of Psychology
Private Bag 11 222,
Palmerston North,
New Zealand
Telephone: 64 6 356 9099
Facsimile: 64 6 350 5673

MEDICATION CALENDAR STUDY

CONSENT FORM NO. 2
(Consent to allow medical practitioner to release details of prescription medication)

1. I have read the Information Sheet and understand what is involved in this study.

2. I agree to allow my general practitioner Dr..... (please insert name of your doctor) to release details of my prescription medication to June Greyvenstein, the researcher in this study, upon provision of Massey University identification and during the course of this study only.

FULL NAME : _____

SIGNED : _____

DATE : _____

TELEPHONE NUMBER : _____

APPENDIX B

i. Drug Inventory form

ii. Sociodemographic questionnaire

iii. General questionnaire

MASSEY UNIVERSITY : MEDICATION CALENDAR STUDY
PRESCRIPTION MEDICATION INVENTORY

NAME OF PARTICIPANT :
PARTICIPANT'S ADDRESS :

Tel.
DOCTOR'S NAME : **Dr.**
GROUP: **A - Experimental**

Pill Count No. 2 **Name of Research Assistant :**

Date	Medication name	No. of pills	Signature of Researcher	Signature of Research Assistant
24/5	**Thyroxine 100mg - 4 tablets each WEEK** When taken? Tues, Thurs, Fri & Sunday at breakfast No. of pills dispensed: 26/4/00 Date dispensed: 22 Repeats: Nae	16		
24/5	**Bezalip Retard - take 1 daily** When taken? With breakfast No. of pills dispensed: 30 Date dispensed: 26/4/00 Repeats: 1 by 27/6	9		
24/5	**Isosorbide Mononitrate Tab 60mg - take 1 daily** (Imdrate) When taken? With breakfast 30 Date dispensed: 26/4/00 Repeats 1 by 27/6	12		
24/5	**Dilzem Sr 90mg - take 1 tablet 2x daily** When taken? 1 at breakfast 1 before bed No. of pills dispensed: 60 Date dispensed: 26/4/00 Repeats 1 by 27/6	23		

MASSEY UNIVERSITY
MEDICATION CALENDAR STUDY
DEMOGRAPHIC QUESTIONNAIRE

NAME OF PARTICIPANT: _____

AGE IN YEARS: _____

PLEASE INDICATE HOW MUCH SCHOOLING YOU HAVE HAD?
(Please tick one)

- No school qualification _____
- School certificate in 1 or more subjects _____
- Sixth form certificate _____
- University bursary or scholarship _____
- Trade of professional certificate/diploma _____
- University undergraduate degree or diploma _____
- Postgraduate qualification _____

PLEASE INDICATE YOUR ETHNIC BACKGROUND :
(Please tick one)

- NZ European _____
- NZ Maori _____
- Pacific Islander _____
- Asian _____
- Other (please specify) _____

PLEASE INDICATE YOUR MAIN EMPLOYMENT STATUS
(Please tick one)

- Full time paid work _____
- Part time paid work _____
- Full time unpaid work _____
- Part time unpaid work _____
- Retired or permanently unable to work _____
- Other (please specify) _____

PLEASE INDICATE IN WHICH INCOME BRACKET YOU BELONG
(Please tick one)

- Up to or below $15,000 per annum _____
- $15,001 to $25,000 per annum _____
- $25,001 to $35,000 per annum _____
- Over $35,000 per annum _____

MASSEY UNIVERSITY

MEDICATION CALENDAR STUDY QUESTIONNAIRE

Name : .....

IF YOU TRIED OUT THE MEDICATION CALENDAR:

On a scale of 1 - 7, please rate how useful you found the medication calender to be. Choosing (1) would mean you found it to be not at all useful, while choosing (7) would mean you found it extremely useful:

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐
not at all useful ..... extremely useful

On a scale of 1 to 7, please rate how easy you found the medication calender to use. Choosing (1) would mean you found it to be not at all easy to use, while choosing (7) would mean you found it extremely easy to use:

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐
not at all easy ..... extremely easy to use

If you DID NOT find the medication calendar useful, please tell us why you did not like it:

We would be most grateful if you would please list any suggestions you have regarding how we may improve this calendar

WILL ALL PARTICIPANTS PLEASE FILL OUT THIS SECTION :

Please explain below the method you use to remind yourself to take your medicine:

APPENDIX C

i. **Thank you letter and Summary of Findings for General Practitioners**

ii. **Thank you letter and Summary of Findings for Participants**

Massey University
COLLEGE OF HUMANITIES & SOCIAL SCIENCES

School of Psychology
Private Bag 102 904,
North Shore MSC,
Auckland,
New Zealand
Telephone: 64 9 443 9799
extn 9180
Facsimile: 64 9 441 8157

MEDICATION CALENDAR STUDY

During the course of last year you were kind enough to agree to assist in the recruitment of participants for a Massey University research project, investigating medication compliance in older adults.

This study has now been completed, and I attach a brief summary of its findings.

I would like to take this opportunity to thank you again for volunteering your time to help me in this study. Your willingness to help was greatly appreciated.

Yours sincerely

JUNE GREYVENSTEIN

MEDICATION COMPLIANCE STUDY

BRIEF SUMMARY OF FINDINGS FOR GENERAL PRACTITIONERS

The present study aimed to investigate whether the provision of an individualised medication reminder calendar would improve medication compliance, by acting as a cognitive aid for older adults, who may be suffering the mild memory deficits which tend to be the usual concomitants of normal ageing. Additionally, medication compliance and error rates and their relationship with the amount of daily medication taken by participants, as well as with selected demographic and socio-economic factors, were examined. A convenience sample of 50 community dwelling participants, aged between 55 and 84 years (M = 71) and prescribed an average of five daily medications, was randomly assigned to either the calendar or a control group. Medication compliance was assessed via two pill counts conducted, on average, seven and a half weeks apart.

The results showed that participants using the calendar and those in the control group did not differ in terms of compliance measures. The average rate of compliance with medication for the sample was 97%. The mean number of errors made by participants during the interval between pill counts was 19 (79% errors of omission and 21% errors of commission). Multivariate analysis indicated that the number of daily tablets taken was positively associated with the number and types of errors made. Women were less compliant than men, while participants of lower socio-economic status made more errors of commission. There was no significant relationship between the age of a participant and compliance. Compliance rates found in this sample are substantially higher than those found in the research literature. The most likely explanation for this finding is the non-representativeness of the sample, who differed most notably from their peers in the general population in terms of education.

Massey University
COLLEGE OF HUMANITIES & SOCIAL SCIENCES

School of Psychology
Private Bag 102 904,
North Shore MSC,
Auckland,
New Zealand
Telephone: 64 9 443 9799
extn 9180
Facsimile: 64 9 441 8157

MEDICATION CALENDAR STUDY

During last year, or earlier this year, you were kind enough to participate in a Massey University research project, investigating whether patients found it helpful to have a personal "medication calendar" to use as a reminder to take their daily tablets.

This study has now been completed, and I attach a brief summary of its findings.

I would like to take this opportunity to thank you again for volunteering your time to assist me in this study. Your willingness to help was greatly appreciated.

Yours sincerely

JUNE GREYVENSTEIN

MEDICATION COMPLIANCE STUDY

BRIEF SUMMARY OF FINDINGS FOR PARTICIPANTS

The present study, conducted in Auckland, New Zealand, wished to find out whether patients given an individualised medication reminder calendar, would be more likely to remember to take their daily medication than patients who did not use such a calendar. The study also aimed to find out whether patients prescribed a large number of daily drugs were more likely to make mistakes than patients taking just a few. Of interest also, was whether there were any connections between medication mistakes and variables like age, gender, education or income.

A sample of 50 participants, aged between 55 and 84 years (average age 71 years), who were prescribed an average of five daily medications, were divided into either a calendar or a control group (no calendar). Medication taking was assessed by two pill counts, conducted about seven and a half weeks apart.

The results showed that participants using the calendar and those in the control group did not differ in terms of their medication taking behaviour. On average, participants took about 97% of their medication. However, the average number of mistakes made (pills forgotten, or extra pills taken) during the interval between the first and second pill counts was 19. Most mistakes (79%) involved patients forgetting to take tablets, and this is similar to what has been found by other studies. As expected, patients taking larger numbers of tablets made more errors. Women tended to be more likely than men to forget to take their medication, although the reason for this finding is unclear. There was no relationship between the age of a participant and medication taking behaviour.