Running Head: Exploring Medication Oversight in the Home Care

Exploring Medication Oversight Utilizing Mixed Linear Analyses

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Abstract

As Canada's population ages, the proportion of the population that is taking multiple medications will increase. A way to limit the number of adverse drug reactions for those on multiple medications is to have their medication regime reviewed by a health professional regularly. The current study utilizes both traditional and mixed linear analyses to examine the relationship between the lack of medication review and a number of health outcome measures on a dataset containing 76 810 subjects. The results indicate that differences exist for those who have not had their medications reviewed, clustering effects are significant, and the health outcome measures examined are influenced by whether or not one has received a medication review in the last 6 months.

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Introduction

The population of Canada is aging. Along with the increase in the average age of the population will come an increase in the prevalence of chronic disease, with a subsequent increase in medication use. As a result, Canada will have more seniors then ever who have multiple disease diagnoses and are taking a number of different prescription medications to deal with their health issues. Taking multiple medications, combined with age-related increased drug sensitivity and an increased probability of predisposing conditions, increases the likelihood of adverse drug reactions. Because of this increased probability of medication troubles, medication reviews performed by qualified health workers are necessary for this population and should performed regularly.

One segment of the older population in which medication reviews are essential is that of the people receiving home care. These individuals require care but do not receive their care within an institutional setting. As such, their medications are often prescribed, administered, and monitored by a number of different health professionals that are frequently uncoordinated which leaves these clients at risk of having adverse drug reactions.

For individuals receiving services from Community Care Access Centres (CCACs) Ontario, individual routine clinical data is taken using the Minimum Data Set-Home Care (MDS_HC) tool that has been developed by the interRAI team of researchers (InterRAI, 2008). Within the MDS-HC, there is one item that pertains to medication reviews. It is titled medication oversight and refers to a lack of medication review for the client. This item measures whether or not a physician reviewed the client's mediations as a whole in the last 180 days (or since last assessment). Due to the importance of medication reviews, the medication oversight item was used as a Home Care Quality Indicator (HCQI). HCQIs were constructed in order to be used by

Community Care Access Centres to support evidence based decision making related to the quality of home care services (Hirdes et al., 2004).

From the HCQI system in place in Ontario, it was reported that home care patients within the district of Thunder Bay had a higher than expected rate of medical oversights. To explore these issues further, data on Ontario home care patients will be used collected using the MDS-HC assessment tool. This current exploration into the MDS-HC data will reveal results such as provincial prevalence of medication oversight, and its effect on a number of outcome measures.

The introduction to this thesis has been organized in the following fashion. To begin, a general overview of the population demographics and their implications to medications will be presented; followed by a section on medications and medication reviews; and it will conclude with a review of routine organizational data and their use in research.

Population Demographics

Within Canada, the senior population has been growing faster than all others age groups. The 2006 population census estimated that there were 4.33 million Canadians over the age of 65, an 80% increase from the 1981 estimate of 2.4 million (Statistics Canada, 2008). In fact, the senior population has grown almost twice as fast as the general population since the 1981 census. As a result of this growth, the proportion of Canadians over the age of 65 has now reached 13.5% (Statistics Canada, 2008) and it has been forecasted to reach 17.7% by the year 2026 (Health Canada, 2003).

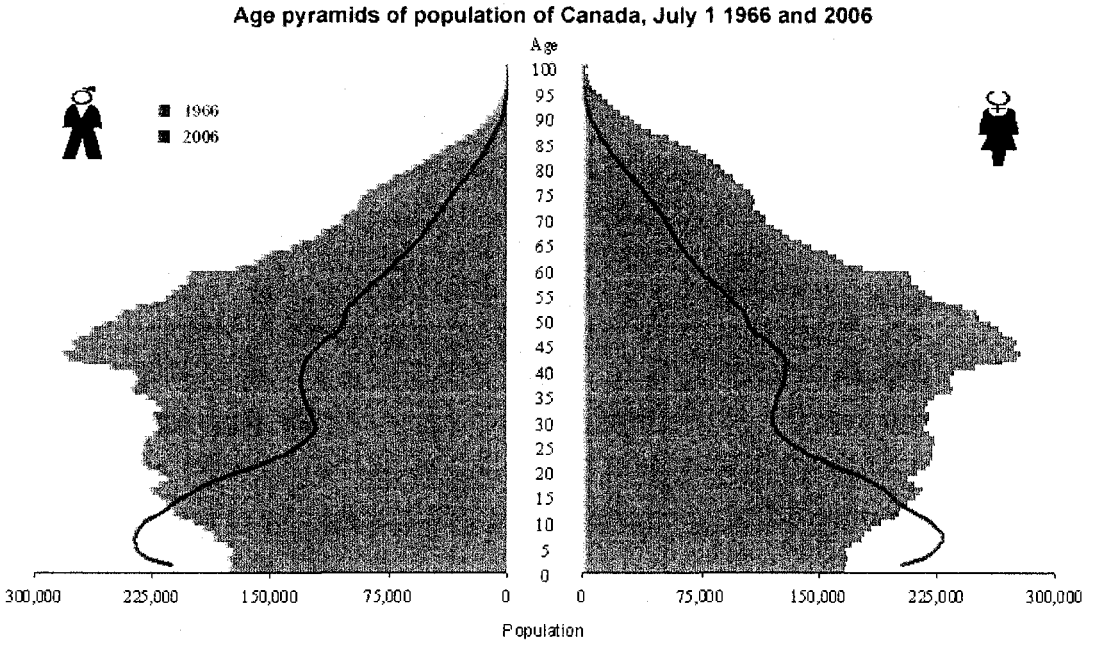
This growth trend also can be seen in the average age of the population. The 2006 Census confirmed the median age of the population to have reached an all time high of 39.5 years of age (Statistics Canada, 2008). This is has increased from 35.3 in 1996 and 37.6 in 2001 (Statistics Canada, 2008). The median age is the point where exactly one half of the population is older, and the other half is younger. Because the median age is increasing, one could expect change to occur in many areas of life including Canada's health care system, social services, labour force, and economy. This trend of an increasing age of our nation is expected continue and to accelerate over the upcoming decades as the "baby boomer" generation enters into senior-hood. By the year 2056, the projected percentage of the population of Canada over the age of 65 is to have reached over 25% (Statistics Canada, 2008).

The baby boom generation can be defined as individuals born during the years following World War II, 1946-1965 (Turcotte & Schellenberg, 2006). During these years, birth rates skyrocketed in a number of countries around the world, including Canada and the United States. This increase in births after the war was followed by a steady decline in birthrate after the mid 1960s has left a massive bulge in the age demographics of the population (Statistics Canada,

2008; Turcotte & Schellenberg, 2006). Over sixty years ago, this demographic bulge affected the age make up of the population by drastically decreasing the median age. And over time, as this "baby boomer" generation has aged, society has had to deal with a multitude of different effects on labour, the economy, and the health care system. Consequently, we are now about reach a new era for this generation, as the oldest of the "baby boomers" will soon become seniors.

Figure 1. *Age Pyramid of Canada for 1966, and 2006.*

Source: Statistics Canada (2008)



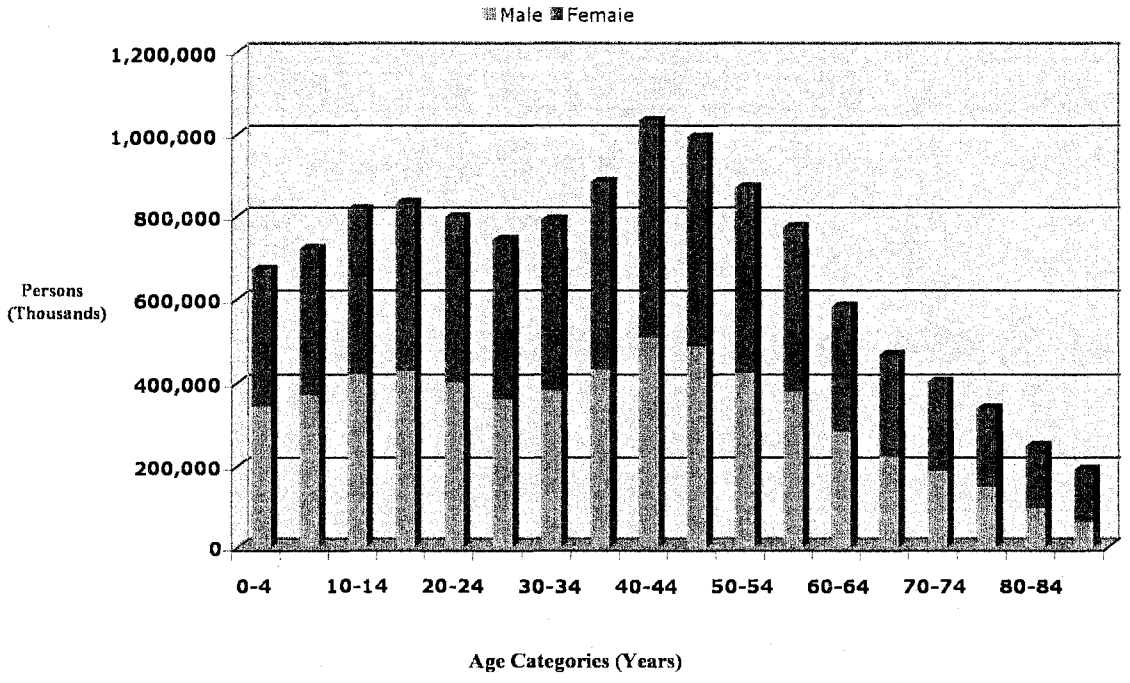
It is because of this "baby boomer" generation, combined with longer life expectancies and low fertility rates, that we see this drift in the age of our nation (Turcotte & Schellenberg, 2006). This trend can also be looked at from a provincial standpoint with differences occurring between the provinces and territories. The province of Alberta, due to the migratory influx of young workers and a high fertility rate, is Canada's youngest province with a median age of 35.5

years (Statistics Canada, 2008). Contrarily, the province of Newfoundland and Labrador is the oldest province with a median age 41.3 years (Statistics Canada, 2008). In Ontario, the province of interest for this thesis, the median age in 2006 was 39.0 years, one half a year less than the nation's average (Statistics Canada, 2008).

The trend of an increasing proportion of seniors can also be found within Ontario's demographic makeup (Fig. 2). In the year 2000, the percentage of the Ontario population who were seniors was 12.6% (Government of Ontario, 2008b). Some recent governmental reports have estimated that the senior population of Ontario will double in the next 16 years (Government of Ontario, 2008b).

Figure 2. *Population of Ontario by Age Category 2006*

Source: Statistics Canada (2008)



However, this increase in the average age is not uniformly affecting all areas in the province of Ontario. Some areas, such as the Niagara area and the North are aging faster than the highly populated areas of Southern Ontario. From the 2001 census, Ontario had four of the top 10 youngest Census Metropolitan Areas (CMAs) in Canada (Government of ON, 2008a). These areas were Toronto, Oshawa, Windsor, and Kitchener with Kitchener being the youngest CMA in Ontario with a median age of 35.3 (Government of ON, 2008a). On the other hand, Ontario also had 4 of the top ten oldest metropolitan areas in Canada. These areas were Kingston, Greater Sudbury, Thunder Bay, and St. Catherines-Niagara (Government of ON, 2008a). The oldest city in Ontario was Elliot Lake, with a median age of 49.4 years in 2001 (Government of ON, 2008a). From this, one could draw together that the implications of an aging society will have a varying affect from region to region.

Due to this demographic bulge in the population of Ontario and the nation of Canada, issues and challenges will arise that will need to be taken on by researchers of all disciplines. Research into such challenges should and must be done in order to minimize the negative effects on the expanding older population. It is important to reduce such harmful effects that will impact all Canadians and on all levels of government.

Implications for Health

The aging trend occurring currently in Canada is expected to raise a number of challenges in many facets of Canadian society including the economy, the workforce, and social programming (Turcotte & Schellenberg, 2006). One major area of concern that will arise as the large cohort of people becomes older is the health of, and health services for, the older population. While seniors are generally living longer than they did in the past, the older

population is still more likely than youth to endure health problems and experience chronic diseases (National Advisory Council on Aging, 2006). Health problems at an older age can lead to a loss of self-sufficiency, independence and control over their every day activities. Therefore, it is not surprising that those over the age of 65 use the health care system more than any other age group (Rotermann, 2003).

When examining the current status of the health of Canadian seniors, some aspects of their health have been improving over the recent years. These include life expectancy at the age of 65, the prevalence of heart disease, and malnutrition (National Advisory Council on Aging, 2006). For example, between 1999 and 2003, life expectancy increased by 1 year for men and by 0.6 years for women (National Advisory Council on Aging, 2006). There are other aspects in the health of seniors that are declining in recent years. The rate of having one or more chronic diseases is rising, as are the obesity rates (National Advisory Council on Aging, 2006). Related to the increased obesity rates is the ever-increasing rate of diabetes in the senior population. From 2001 to 2005, the diabetes prevalence rate among seniors raised two percent from 13% to 15% (National Advisory Council on Aging, 2006). Areas that have remained stable include physical activity, suicide among elderly males and falls (National Advisory Council on Aging, 2006).

In order to support older people as they age, the government of Ontario has developed a continuum of care that assist people in different ways depending on their individual needs. This continuum ranges from supportive and home care services, to supportive housing, and eventually long-term care homes (Ontario Home Care Association, 2008).

For this thesis, the element of the care continuum that is focused on is home care. Home care consists of a variety of health and care services offered by different providers to individuals

in their place of residence. These include but are not exclusive to chronic disease treatment, illness prevention, health promotion, assistance with activities of daily living, rehabilitation, and disease diagnosis (Ontario Association of Community Care Access Centres, 2008). By providing these services, home care functions as a bridge between the different care settings including acute care, emergency rooms, long term care hospitals and hospices.

In the province of Ontario, home care is publicly funded and has emerged as an integral component of the health care system. In 1996, the Ministry of Health and Long-term Care established a system of 43 Community Care Access Centres (CCACs) in order to assist the public in accessing government-funded services offered in the continuum of care. Since the development of Local Health Integrated Networks (LHINs), the 43 CCACs have been narrowed down and aligned to match the 14 geographical areas within the LHIN system (Government of Ontario, 2008c).

CCACs are responsible for determination of eligibility and access with regards to the continuum of care. Every year in Ontario, the Community Care Access Centres provide coordinated access to health and support services to approximately 500,000 clients, and provides services daily to approximately 185,000 Ontarians in their communities (OACCAC, 2007).

Medications

Each year, Canadians are prescribed over 400 million medications and spend approximately $770 each on their medications (Sketris, Ingram, & Lummis, 2003). In terms of the population, Canadians spend $24.8 billion dollars a year on medications. A study performed by Canadian Insitutue for Health Information (CIHI, 2007) found that drugs have been one of the fastest growing components of total health expenditures in Canada. Between the years of 1985

and 2005, the average annual growth rate of total health expenditures was 6.5%. During the same time period, the average growth rate in drug expenditures was 9.5%. In per capita terms, drug expenses increased from $147 per person in 1985, to $723 per person in 2005. Although these figures and numbers are for the general Canadian public, a large proportion relates to the senior population, as those over the age of 65 are the major consumers of medications within Canada (CIHI, 2007). One can only assume that these medication trends will continue and even increase the next decade as the demographic bulge ages.

With the increase in number of chronic conditions and health problems that occur in aged individuals, it is not uncommon for those over the age of 65 to be on a number of different prescription medicines. This use of multiple prescriptions is referred to as polypharmacy. Statistics Canada data shows that in 1994/1995, 10% of Canadians aged 65-74 and 13% of those aged 75 and over were multiple medication users (Millar, 1998). Statistics Canada reported that 27% of elderly women and 16% of elderly men took at least 5 different types of medications (Rotermann, 2003).

Medication Metabolism and Physiological Changes Associated with Age

As individuals grow older, a number of physiological changes occur. These bodily changes affect not only how the body performs on a daily basis but also have a great effect on how drugs act once they have entered the bodily system (known as pharmacokinetics) and their eventual outcomes. According to Taliaferro (2001), the five changes that have a large effect on pharmacokinetics in geriatric patients are:

1. An increase in body fat: The increase in body fat will affect a drug that is lipid soluble causing them to have a broader and prolonged distribution.
2. A decrease in body fluid: Any decrease in bodily fluid could result in a higher concentration of a drug within the body.
3. A decrease in action of the gastrointestinal tract: Because the contents of the gastrointestinal tract move slower in old age, the action of medications may be delayed or decreased.
4. A decrease in liver function: A less functioning liver could potentially result in an accumulation of medications within the liver and may lead to toxicity.
5. A decrease in kidney function: A decrease in kidney function leads to slower excretion of medications.

These age-related changes affect the absorption, distribution, protein binding, metabolism, excretion, and dosage sensitivity of the medications consumed in the older adult (Hutchison & O'Brian, 2007). When compared to a younger adult, the same medication being consumed by an older person can behave differently within the body and lead to different outcomes. An awareness of these physiological effects helps in the understanding of why medications become

a health issue in the older population, why some medications cause adverse reactions, and why some prescription medications can be considered inappropriate for the older population.

Adverse Drug reactions

With multiple medications comes an increased chance of adverse drug reactions (ADRs). ADRs can be defined as any noxious, unintended, and undesired effect of a drug, which occurs at doses used in humans for prophylaxis, diagnosis, or therapy (WHO, 1998). ADRs are more common in older persons due to the previously mentioned increases in the number and combination medications being taken, as well as age-related sensitivity to drug effects and the prevalence of predisposing conditions. These factors have been shown to increase the frequency and severity of adverse drug reactions (Ray, Griffin, & Shore, 1990). Of the adverse drug reactions in Canada, older adults experience a vast share of them, which lead to a list of undesirable outcomes such as falls, hip fractures, delirium, and urticaria (Gurwitz et al., 2000). Approximately one in three older persons taking at least five medications will experience an adverse drug event each year with about two-thirds those patients requiring medical attention (Hanlon et al., 1997). It has also been found that over 90% of these ADRs are predictable, and about 28% are preventable (Gurwitz et al., 2003). Research has clearly demonstrated that not only are adverse drug events common but they are predictable and therefore, preventable.

A 2003 study performed by Juurlink et al. (2003) examined drug-to-drug interactions in Ontarians over the age of 65. This study investigated three different drug combinations and found that 2-8% of the hospitalizations studied could have been prevented if the patients had not been receiving medications that are known to lead to adverse drug reactions.

The Canadian Adverse Events Study (Baker et al., 2003) found that after reviewing 3745

hospital charts, 40.8% had at least one screening criterion for an adverse drug event (ADE) and that among patients with ADEs, 36.9% were retrospectively judged to be preventable. Baker et al. concluded that the incidence rate of 7.5% for ADE associated hospitalizations in their study suggests that 185 000 of the 2.5 million annual hospital admissions are associated with an ADE and close to 70 000 of these hospitalizations are potentially preventable. In a 2002 review article, Patel and Zed stated that 28% of all emergency room visits were drug related. Of those visits, 24% resulted in hospital admission (Patel & Zed, 2002).

As the literature has demonstrated, adverse drug reactions are incredibly common amongst older individuals and can be prevented when the proper measures are put into place.

Inappropriate Medications

Inappropriate medications can be defined as medications whose risk of adverse effects poses a greater threat to an individual than the possible positive health benefits that they may provide (Fick et al., 2003). Inappropriate prescribing and inappropriate medication use occurs frequently within the elderly population. A study by Howard et al. (2004) found that the prevalence of potentially inappropriate medications was 16.3% in a sample of 889 elderly patients in southern Ontario. The prevalence rates of inappropriate medication use has been shown to as high or higher in other countries: 12-40% in a number of different older populations within the U.S. (Zhan et al., 2001), approximately 20% in home care populations in a number of different European countries (Fialova et al., 2005), and 21% in Japan (Niwata, Yukari, & Ikegami, 2006).

The use of an inappropriate medication can lead to a number of negative outcomes including adverse drug reactions, falls, fractures, orthostatic hypertension, prolonged sedation,

hospitalization, and possibly death (Fu, Liu, & Christensen, 2004). A 2005 study looking at 3372 nursing home residents found that those receiving inappropriate medications had greater odds of being hospitalized (Lau et al., 2005). This study also found that residents with intermittent inappropriate medication exposure were at greater odds of death that those with no exposure (Lau et al., 2005).

One can conclude from the prevalence figures that inappropriate medication prescribing and their use is a major problem for the elderly population all over the globe. These medications on their own can have a deleterious effect on a individual's health. Many studies have been conducted that look and the prevalence of this problem and at the effect of specific drugs with their particular related adverse effects on the elderly individuals.

One study performed by Liu, Fu, and Christensen (2004) explored the relationship between inappropriate medication and health outcomes at a national level. This group used the Beers criteria to identify potentially inappropriate medication (PIM). For their research they used secondary data gathered by the 1996 Medical Expenditure Panel Survey data set. This survey data provided nationally representative estimates of healthcare utilization, expenditures, sources of payment, and insurance coverage for the non-institutionalized elderly population. A 5-point scale question looking at perceived health status was used as the dependent variable in their analyses. They found that after controlling for a set of possible confounding variables, individuals who were using inappropriate medications at time 1 had a significantly lower score at time 2 on their self-perceived health status than those not using inappropriate medications. Other risk factors that were found to also predict a lower score on the dependent variable were a higher number of prescriptions, being black, having low education, and having one or more chronic diseases. Fiu, Liu and Christensen (2004) concluded that their study provided strong evidence

that inappropriate medication use is associated with a subsequent decrease in self-perceived health status in the elderly.

Falls and Injuries

Another way that medications can affect the health of the elderly is their relationship with falls and hip fractures. Because of their many side effects, drugs can increase the risk of falling through sedative properties, balance impairment, delayed reaction times, unintentional lowering of blood pressure, drug-induced Parkinsonian symptoms, and a variety of other mechanisms. The cost to an older person's health after a fall is colossal. Falls can cause death, continuing disability, chronic pain, depression, institutionalization, and a fear of falling (Grisso et al., 1990, Nevitt et al., 1991, Tinetti, Mednes de Leon et al., 1994). A fear of falling can lead to withdrawal from activities, which will most likely have a negative effect on health status (Tinetti, Mednes de Leon et al., 1994).

A study was performed in 1998 that looked at drug use, cognitive status, and falls in a population of Swedish women over the age of 75 (Guo, Wills, Viitanen, Fastbom & Winblad, 1998). This study found that those women who were cognitively impaired and taking opioid analgesics were twice as likely to fall. The foremost opioid analgesic prescribed to this population was propoxyphene. Propoxyphene, which is on the Beers Criteria List 1, has been declared inappropriate for the elderly because of its strong narcotic side effects with little more pain suppression than that of acetaminophen. This is just one example of a drug that is known to have negative side effects to be continually prescribed by doctors to elderly patients.

Inappropriate drugs can directly affect one's health status as well as indirectly through causing them to have a fall. In the next section, the effect of unsuitable drugs on the elderly

population is reviewed.

Cognitive Status and Medications

One particularly large group of commonly used drugs that often cause problems in the elderly is anticholinergics. Anticholinergics are drugs that block the action of the neurotransmitter acetylcholine and are prescribed for clinical disorders such as Parkinson's disease and bladder incontinence (Lechevallier-Michel, Molimard, Dartigues, Fabrigoule, & Fourrier-Reglat, 2004). When used with seniors, anticholinergic drugs may cause a wide variety of side effects that may be able to be misinterpreted as part of the normal aging process such as dry mouth, nausea, blurred vision, and rapid heart rate, among many others. On top of those unwanted side effects, recent research points that anticholinergic drugs have a negative effect on the cognitive status of older people. In a 2006 study performed by Ancelin et al. (2006), it was found that 10% of the community dwelling elderly in their study used anticholinergic drugs regularly and of those individuals, 80% performed poorly on a cognitive test (Mini-Mental State Examination) compared to 35% of non-users.

A second study examining drugs and cognition was conducted to examine the association between the use of drugs with anticholinergic properties and cognitive performance in an elderly population (Lechevallier-Michel et al., 2004). The sample contained 1780 community dwelling subjects over the age of 70 and also made use the Mini-Mental State Examination as the cognitive test. After controlling for confounding factors, it was found that anticholinergic drug use was significantly associated with low cognitive performance.

A third and more recent study from 2007 demonstrated that seniors who took anticholinergic drugs had more memory impairment than non-users, and they also performed

significantly more poorly on tests of balance and physical function (Hilmer et al., 2007). Their findings suggest that not only do anticholinergic drugs impair the ability of seniors to function mentally, but they may also impair them physically.

Functioning Ability

As individuals age, age-related biological changes can affect not only the way medications react within the body, but can also cause a decrease in the ability to function and perform their everyday tasks. It is has been found that inappropriate medications can have serious negative effect on the elderly population and their every day functioning.

Landi et al. (2007) examined a population of frail elderly Italians living in the community to explore the relationship between inappropriate medications and measures of physical performance, muscle strength, and functional status. The average age of the population was 85.8 years and based on the 2003 Beers criteria, 26% of the 364 Italians were using at least one inappropriate medication. Their findings indicated that irrespective of possible confounds, the use of inappropriate drugs is associated with impaired physical performance and that the association became stronger with the increasing number of inappropriate medications used.

A study conducted in the United States looked at both prescribed and over the counter medications and their subsequent effect on the activities of daily living (ADL) in a population of community dwelling older women (Magaziner, Cadigan, Fedder, & Hebel, 1989). These researchers examined 609 women in two interviews that were held one year apart in Baltimore, Maryland. After controlling for variables such as age, education, physical health, number of chronic conditions and baseline functional status, they found that prescription medication use to be associated with functional declines in ability to perform both their physical (eating, dressing,

bathing, etc.) and instrumental (using the phone, walking, shopping, etc.) ADLs. The same study demonstrated that over the counter medicine only had a negative effect on physical ADL.

As we have seen, medications can cause a decrease in physical functioning and in cognition, and can cause side effects that lead to falls and fractures. Therefore, it should not be surprising that decreases in the ability to operate a motor vehicle have also been found in older drivers who are on medications. An increase risk of motor vehicle accidents in the elderly population has been found to be associated with antidepressant use (Ray, Fought, & Decker, 1992) and benzodiazepine use (Hemmelgarn, Suissa, Huang, Boivin, & Pinard, 1997; Ray, Fought, & Decker, 1992). One population-based case-control study from Alabama (McGwin, Sims, Pulley & Roseman, 2000) found that the use of benzodiazepines was associated with an increased risk of at-fault involvement in crashes.

After reviewing the literature, it is clear that medications can cause a number of negative effects within the population over the age of 65. It is important for the health care system and the country as whole to minimize such harmful effects. Many methods are currently be attempted by researchers and governments in order to discover new methods and develop systems that reduce adverse effects. One proven way to reduce adverse drug effects is to have all medications periodically reviewed by a qualified health professional.

Medication Reviews

Due to the increased probability of adverse reactions caused by medications in the older population, medication reviews performed by qualified health professionals are necessary and should performed regularly on older individuals receiving multiple medications.

Research has shown that one of the foremost positive effects of medication reviews is that they typically lead to a decrease in the total number of medications being taken by the elderly (Bolton, Tipper & Tasker, 2004; Lenaghan, Holland, & Brooks, 2007; Williams et al. 2004). By having their medications reviewed, patients are relieved of any unnecessary or inappropriate medications that may be affecting their well-being. A review article by Chumney and Robinson (2006) examined a large number of studies that looked at drug regimen reviews performed by pharmacists. Their work found that medication reviews can lead to a number of positive effects including reduced number of medications, increased adherence, decreased adverse drug reactions, and increased quality of life.

One American study (Hanlon et al., 1996) looked at medication reviews performed by pharmacists on 208 patients over the age of 65. All subjects were on 5 or more medications and were randomly split into a control group and experimental group. Those in the experimental group met with a pharmacist to review their drug regimen while those in the control group where treated as per usual. The individuals who received the complete medication review were found to experience less adverse drug reactions as well as having fewer inappropriate medications.

Another study specifically looked at the effect of medication reviews performed by general practitioners on their patients over 65 (Bolton, Tipper, &Tasker, 2004). Sixty-four GPs participated in the study, each enrolling at least 12 of their patients. Data on the total number of medications, number and dosage of selected cardiovascular, and psychotropic medications were

taken into account. After the patients' medications were reviewed, it was found that the number of medications was significantly decreased, the dose and number of benzodiazepines significantly decreased, and the number of selective serotonin reuptake inhibitors significantly increased.

There are also a number of other reasons for a need of frequent medication reviews among older adults. For example, seniors are often serviced by a number of different health care professionals. By having a number of different medication prescribers, inappropriate prescriptions and unnecessary therapeutic duplication can easily occur. Additionally, as individuals grow older, many may have a number of different chronic conditions. Each separate condition can have a need for one or more prescriptions, which eventually leads to polypharmacy. As the number of medications and conditions grow, it is vital to check to make sure medications and conditions are not interacting with other medications or diagnoses causing adverse reactions. Senior's health care is also not always given to them in a coordinated manner in that no one person is responsible for care. Quite often older people see a wide range of different professionals from nurses to pharmacists to health care aides, which can easily lead to miscommunications and medication issues.

One segment of these older populations in which medication reviews may be even more essential is that of those receiving home care. Every year in Ontario, the Community Care Access Centres provide coordinated access to health and support services to approximately 500,000 clients, and provides services daily to approximately 185,000 Ontarians in their homes (OACCAC, 2007). Since individuals receiving care at home are not in an institutional setting with supervision of doctors, there is an increased chance that their medications will be not be reviewed and medication oversight will have occurred for them. Aparasu and Mort (2004)

found that 7.14% of all community dwelling elderly in the U.S. or 2.30 million people received a potentially inappropriate psychotropic medication. This study demonstrates the prevalence of a medication issue within the population of elderly living outside of institutions.

Because of the growing importance of home care and the medication issues that occur in the older population, Meredith et al. (2002) examined the effect of a medication improvement program on medication use in a population of approximately 70 000 home care patients. Patients were screened for possible medication issues and those selected to have possible medication issues were randomly divided into a usual care group and a usual care with medication improvement program group. Medication use improved for 50% of intervention patients and 38% of control patients, an improvement of 12 patients per 100. The greatest effect of the intervention was for therapeutic duplication, with improvement for 71% of intervention and 24% of control patients, an improvement of 47 patients per 100.

After reviewing the literature, one can deduce that medication reviews have a positive effect on individuals by reducing the number of medications, reducing the number of inappropriate medications, increasing adherence, decreasing adverse drug reactions, as well as increasing quality of life. When considering the growth in the numbers of elderly that is occurring within Canada's population and the potential adverse effects caused by medication problems, one should agree that it is vital to study and examine these issues and take a proactive approach in order to avoid future troubles. One way to accomplish this proactive approach would be to better understand medication reviews and their effect on health status and medication use among older adults. By doing such, we should be able to better understand their health issues related to medications as well as to better understand the issues of medication reviews and inappropriate medication use.

Routinely Collected Clinical Data

Routinely collected clinical data refers to data that is routinely collected by a facility or an organization. This data is specifically collected in order to aid clinical decision-making and to assist in the administration of the process or the organization. The main purpose of routinely collected clinical data is to support care planning and not for the purposes of research. However, when collected in a reliable manner, the data can have significant potential for use in research.

The Minimum Data Set (MDS)

One widely used type of routinely collected clinical data is the MDS, which is the assessment component of the Resident Assessment Instrument (RAI). The RAI and MDS were developed by interRAI, a collaborative network of researchers from over 20 countries. A number of different instruments or tools based on a common core set of items have been developed by this network in order to be used by different populations (i.e., long term care, home care, mental health) all the while working together to form an integrated health information system (interRAI, 2008).

The RAI instruments were developed with a number of applications in mind. The main objective was to develop a tool to provide all-inclusive assessment as the basis for care planning (interRAI, 2008). This objective was not to automate the care planning process but to assist in performing it. A second aim of the RAI instruments is using assessment information to contribute to the area of case mix funding (interRAI, 2008). Case mix is a system that classifies individuals into groups that are uniform in their use of resources (interRAI, 2008).. Governments can utilize case mix in order to assist them in allocating their resources to the people in need in an evidence based way. A third objective of the interRAI assessment systems is

outcome measurement (interRAI, 2008). These tools can be used to measure both the status and the outcomes of individuals or groups of people. Within each separate tool are scales and indices that can provide insight to an individual's current status. The fourth application is to provide quality indicators to: (a) the organizations providing care in order to improve their services; (b) the government to monitor care; and (c) the public for reporting purposes (interRAI, 2008).

For the current study, the RAI-HC tool will be utilized. This tool employs a Minimum Data Set form as its assessment component. It is a standardized set of 120 items organized into 23 categories. The different categories gather information on function, health, social support and service use of the individuals (Morris et al, 1999).

In terms of reliability, the RAI-HC tool has been proven to be a reliable and valid tool by a number of different researchers (Kwan, Chi, Lam, Lam & Chou, 2000; Landi et al., 2000; Morris et al., 1997). This assessment tool is currently being used in many countries outside of Canada including the U.S., Italy, Switzerland, Japan, and Australia.

In 2002, the province of Ontario mandated that the Resident Assessment Instrument – Home Care (RAI-HC) be used to serve this organizational purpose for all home care clients expected to be utilizing service for 60 days or more. Thus, since 2002, every individual who has received home care in the province has had a standardized set of information taken on him or her with the primary goal being assessment. From the assessment, the following components are derived:

- Client Assessment Protocols
- Outcome Measures
- Method for Assigning Priority Levels
- Quality Indicators

Client Assessment Protocols (CAPs)

CAPs are designed to assist the assessor in interpreting all of the client's information recorded on the MDS-HC (Morris et al, 1999). These Assessment Protocols are not meant to automate the care planning; rather they are intended to point out key issues or potential trouble areas. When a CAP is activated or has a positive result, the clinician can focus on the area and explore possible ways to intervene. Each Assessment Protocol has been designed by a number of researchers and validated through clinical focus groups and studies (Morris et al, 1999).

Outcome Measures

The current status and outcomes of individuals are also measured by using the items found on the MDS-HC. By systematically combining different items, various scales and indices are formed indicating the current status of the client. These measures can be compared from initial assessment and follow up (usually 6 months later) to determine changes in the different domains. The outcome measures explored in the current study include the Cognitive Performance Scale, the Depression Rating Scale, the Activities of Daily Living Hierarchy, and the Instrumental Activities of Daily Living Sum.

Method for Assigning Priority Levels (MAPLe)

The MAPLe is a scale designed to use MDS-HC items to determine home care clients' priority levels for institutionalization and caregiver burn-out (Hirdes, Poss, & Curtin-Telegdi, 2008). Clients who score high on this scale typically trigger the nursing home CAP and have ADL impairment, cognitive impairment, and behavioural problems (Hirdes, Poss, & Curtin-Telegdi, 2008). Clients with low priority levels have no such issues and can be considered

functional and self-reliant (Hirdes, Poss, & Curtin-Telegdi, 2008).

Quality Indicators

In order to improve the overall quality of care provided within homecare, inter-RAI developed home care quality indicators (HCQIs) for the MDS-HC. This effort lead to a set of 22 HCQIs based on the MDS-HC data (Dalby, Hires, & Fries, 2005). This set is a mixture of prevalence measures and incidence measures. When HCQIs have a high rate within a community it is indicative of poorer service provision for that measure. These HCQIs can be used to support a variety of quality functions including internal quality management initiatives, external quality comparisons to other home care providers/communities and public report cards (Hirdes et al., 2004).

Implications for Research

The MDS can be a valuable tool for gathering evidence, profiling clients that have chronic illnesses, and to find how those illnesses affect different aspects of their lives. Once the profile of individuals with certain health issues is known, health promotion interventions can be used to target those individuals.

Harrison et al. (2006) conducted a study that looked at use of MDS data to determine the extent to which nursing interventions provided during hospitalization are associated with patients' therapeutic self-care and functional health outcomes. The results indicated that particular interventions aimed at promoting exercise, positioning and self-care assistance predicted functional status outcome. They concluded that nurses could use the MDS data on patient outcomes to assess the effectiveness of their interventions.

Gruneir, Smith, Hirdes, and Cameron (2005) performed a study of health of the elderly utilizing MDS data. Their goal was to use the MDS to examine the prevalence of depression; its recognition and its treatment in continuing care patients with advanced illness. The study found that patients with advanced illness were more than twice as likely to be depressed than other patients and were also less likely to be receiving antidepressants. The MDS data also revealed that the cancer patients in the study received better end of life care than others.

Current Study

Existing literature has clearly demonstrated the large number of possible and preventable deleterious effects caused by medication use. Research has also clearly demonstrated that having a medication regime reviewed by a qualified health professional can reduce number of medications and the number of inappropriate medications, increase adherence, decrease adverse drug reactions, and increased quality of life. To explore these issues further, data from Ontario home care patients will be explored using information collected with the RAI-HC assessment tool. This current exploration into the RAI-HC data aims to investigate provincial prevalence of medication oversight, differences between those with and without medication reviews using traditional statistical analyses and the effect of medication oversight on a number of outcome measures utilizing mixed linear analyses.

Methodology

This thesis used data collected by the 14 Community Care Access Centres across Ontario using the MDS-HC assessment tool as mandated by the provincial government. All data comes from clients of the CCACs who are either receiving home care, those recently released from acute care and those who have been waitlisted for long term care. The dataset used for this study was drawn from the February 2008 provincial data cut and was electronically stored in Waterloo, Ontario, and accessed remotely from Thunder Bay.

Sample

Secondary data analyses were conducted using 212,756 first time CCAC client assessments that were performed with the RAI-HC. Of those clients, 92 811 had a second assessment. The original data set was reduced by the following means:

1. All clients who had only the initial assessment were removed leaving only those who had a second assessment to be analyzed. This was done to ensure that persons were utilizing home care for more than 6 months and had a chance to have their medications reviewed during that time.

2. All clients who were on no medications or 1 medication were removed from the dataset. This was done to ensure that only the people who were in need of medication reviews were used in the study. This data reduction is also performed by interRAI when calculating the Home Care Quality Indicator that monitors medication oversight.

3. All clients under the age of 65 were removed from the dataset. This was performed in order to only analyze the population of interest, older adults of the age of 65 or older.

After performing the above reductions, the data set contained 76 810 clients. In this sample of assessments, the average age of the subjects was 81.44 years and range was from 65 to

106 years. Females made up 66.85% of this sample (51 223). Table 1 presents the frequency of clients by CCAC.

Table 1

Number of Clients in Each CCAC

CCAC Name	Frequency
Central	8256
Central East	7551
Central West	2096
Champlain	6482
Erie St. Clair	4239
Hamilton Niagara	12 537
Mississauga Halton	4507
North East	4296
North Simcoe Muskoka	3895
North West	2193
South East	2578
South West	7563
Toronto Central	4794
Waterloo Wellington	5167

Measures

Medication oversight was the key variable of interest. Those clients who had all of their medications reviewed by a health professional in the past 180 days were scored with a 0, and no medication oversight occurred for them. Those persons who had not had a health professional review their medication regime in the past 180 days were scored with a 1, with medication

oversight occurring in such persons. This item is found on both the initial assessment at time 1 and on the follow-up assessment at time 2.

An average medication oversight score was created for each CCAC at both time 1 and time 2 by taking the number of patients with medication oversight within each CCAC and dividing it by the total number of patients within each CCAC. The CCAC means were used to create a centered score for medication oversight at both time 1 and time 2. A centered score was created for each client for both time assessments.

A third variable called "drug category" was created for the number of medications they consumed in the last week. The variable had 3 categories: those who consumed two to five medications, those who consumed five to eight medications, and those who consumed nine or more medications.

All outcome measures and Client Assessment Protocols are based on MDS-HC items that have been shown to have an average inter-rater reliability of .85 (Morris et al., 1999). Six outcome measures were used as dependent variables:

1. Cognitive Performance Scale
2. Depression Rating Scale
3. MAPLe
4. CHESS
5. Activities of Daily Living Hierarchy
6. Instrumental Activities of Daily Living Sum

The Cognitive Performance Scale (CPS) has been shown to accurately discriminate level of cognition among institutionalize populations (Harmaier et al., 1995). It makes use of an algorithm that combines information on memory impairment, level of consciousness, and executive functioning. The CPS has shown to be highly correlated ($r = -.863$, $p < .001$; Hartmaier et al., 1995) with the Mini Mental State Exam in nursing home residents. This scale

ranges from 0-6 with 0 meaning the client is cognitively intact and 6 signifying severe impairment (interRAI, 2008).

The Depression Rating Scale (DRS) is a summation of 7 items on the MDS-HC. This scale is highly correlated with the Hamilton Depression Scale (r = .70) and the Cornell Scale (r = .69) and was developed using samples of older adults living in nursing homes (Burrows, Moris, Simon, Hirdes, & Phillips, 2000). This scale ranges from 0, no symptoms present, to 2, daily occurrence of depressive symptoms (interRAI, 2008).

The Activities of Daily Living Hierarchy Scale uses 4 items to assess the clients' level of functioning in activities of daily living including eating ability, personal hygiene, ability to toilet oneself, and walking/locomotion. Internal consistency of .90 has been reported in past research (Morris et al., 1999). Th ADL Hier Scale ranges from 0, meaning the client is independent, to 6, signifying a total dependence for their activities of daily living (interRAI, 2008).

The Method for Assigning Priority Levels (MAPLe) is a psychometrically sound decision-support tool that is used to inform choices related to the allocation of home care resources and prioritization of clients needing community or facility–based services. This algorithm has been shown to be a strong predictor of nursing home placement, caregiver distress and for being rated as requiring alternative placement to improve outlook (Hirdes, Poss, & Curtin-Telegdi, 2008), and has been validated with data from four provinces and five other countries. The MAPLe ranges from low which is represented by a score of 1, to high which is scored with a 5 (Hirdes, Poss, & Curtin-Telegdi, 2008).

The Changes in Health, End-stage disease and Symptoms and Signs (CHESS) scale is a composite measure made up from MDS-HC items. It examines changes in health, end-stage disease and symptoms and signs of medical problems. It has been proven to be a strong

predictor of mortality ($p < .0001$; Hirdes, Frijters, & Teare, 2003) among older adults in chronic care facilities. Further research is needed to validate this tool in home care settings. This scale is a 6-point scale (Hirdes, Frijters, & Teare, 2003) with scores ranging between 0 (meaning no instability) to 5 (for the highest level of instability).

The Client Assessment Protocols (CAPs) have been designed specifically to aid in further assessment and individualized care planning for clients who have problematic trigger conditions. All CAPs have been developed by teams of clinicians and researchers and have been validated through focus groups and research studies (Morris et al., 1999). The CAPs are scored in a binary format (not trigger = 0, triggered = 1). Complete descriptions of all 30 of the CAPs as well as their triggering rules can be found within the RAI-HC Handbook (Morris et al., 1999).

Analyses

Once connected to the computers at Waterloo, SAS 9.1 was used to perform the secondary analyses of the anonymized data set.

The t-tests and Chi-squared tests were used to compare the frequencies on the outcome measures and CAPs between those with a recent medication review at the second assessment (time 2) and those without.

Mixed Linear Analysis (MLA) was chosen to analyze the outcome measures. MLA is used for research designs where the data for participants is organized at more than one level. For this study, participants are clients with the CCAC system within the province of Ontario. Clearly, demographic makeup, staffing ratios, availability of family physicians, environmental hazards, etc., vary from one CCAC to the next. Therefore, for the MDS-HC data, MLA analyses

must be used in order to account for this clustering of participants. Only two levels were used in the models, individuals and CCACs.

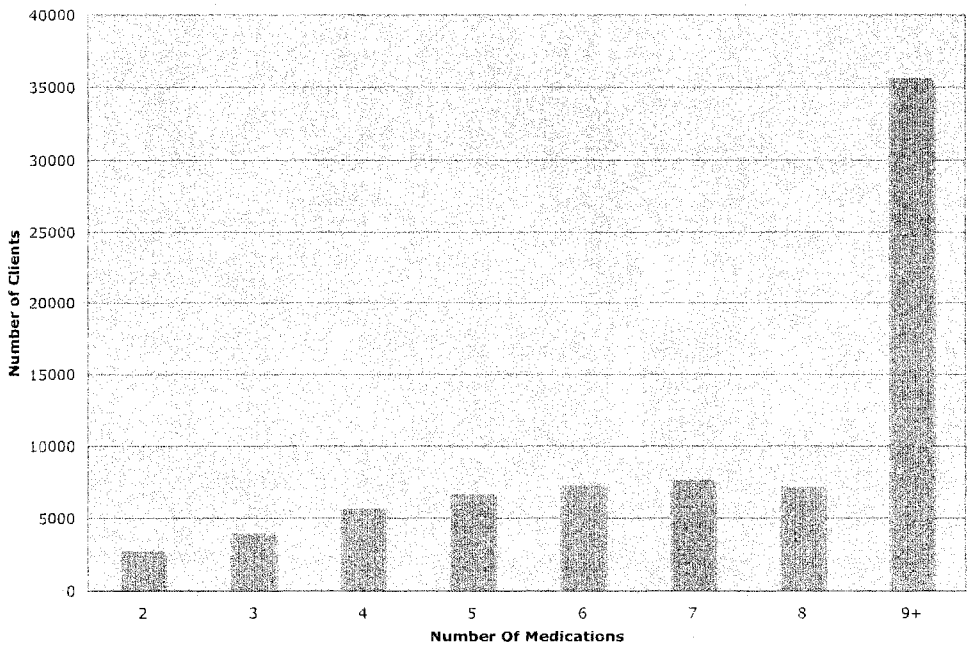
Separate MLA analyses were computed for each outcome measure. Each analysis was sequential and included a null model and three further models that increased in complexity. The null model included CCACs as a random intercept with no fixed effects. A significant intercept provides evidence that CCACs differ significantly on the dependent variable. In model 1, centered medication oversight at time 2 was added as a fixed effect to determine its fixed relationship with the outcome measure with CCAC controlled. Centering in this and subsequent models was with respect to the CCAC mean. Model 2 included centered medication oversight at time 2 as both fixed and random variables. This model tests the viability of centered medication oversight as a random individual difference measure. Failures of convergence or identification suggest that centered medication oversight is not viable as a random individual difference measure with the data set analyzed. Consequently, it was omitted from the list of random variables in model 3. Model 3 added additional variables as fixed effects. These include the categorical variable of number of drugs taken, age, gender, living status (alone or not alone), CCAC mean oversight at time 2, and centered medication oversight at time 1. Also included as fixed effects in model 3 were interactions between the centered medication oversight at time 2 with (a) drug categories and (b) CCAC mean medication oversight at time 2.

Results

The prevalence rate at the first assessment was 2.67% (n = 2047) and at second assessment the medication oversight prevalence rate was 2.03% (n = 1556).

Due to the way that the number of medications is measured on the MDS-HC, the true mean for number of medications cannot be calculated. The range on the MDS-HC for the number of medications currently taken by a client is from zero to nine plus. Therefore, all clients who are taking 9 or more medications are grouped into a single category. The frequency for each of the drug categories at time 2 is shown in figure 3. Of the clients, 46.41% (35 650) received nine or more medications while 25.82% (19 066) received five or less.

Figure 3. *Frequency of People by Number of Medications*



The results for Chi-square tests for the CAPs comparing the frequencies of those with medication oversight at time 2 to those with no medication oversight at time 2 can be found in table 2. Of the 29 CAPs analyzed, 17 were found to differ significantly between the two groups at the .05 level. The CAPS that differed significantly at the $p < .05$ level in order of decreasing Chi square values were Adherence, Environmental Assessment, Brittle Supports, Depression and Anxiety, Immunization and Screening, Behaviour, Cognition, Alcohol Dependence, Falls, Dehydration, Skin and Foot Conditions, Communication, Oral Health, Pressure Ulcers, and Reduction of Formal Services. Also included in table 2 is the percentage of each population that triggered each individual cap. Of all the prevalence rates for the CAPs, only the Reduction of Formal Services CAP had a higher triggered prevalence rate for those who had received a medication review in the past 180 days. All other CAPs that had a significant difference between the two groups resulted in a higher triggered prevalence rate for those who had medication oversight.

Table 2

Chi-square tests for Client Assessment Protocols (CAPS)

Client Assessment Protocol	Chi Sq	P	Triggered CAP Percentage of Persons with Medication Review	Triggered CAP Percentage of Persons with Medication Oversight
Activities of Daily Living / Rehabilitation Potential	0.1505	0.6981	39.05	38.56
Instrumental Activities of Daily Living	0.0186	0.8916	80.07	80.21
Health Promotion	0.1778	0.6733	55.76	56.30
Institutional Risk	0.6913	0.4057	17.95	18.77
Communication Disorders	8.8685	0.0029	56.63	60.41
Visual Function	2.2652	0.1323	30.30	32.07
Alcohol Dependence	13.5892	0.0002	1.12	2.12
Cognition	14.7632	0.0001	49.00	53.92
Behaviour	28.9973	<.0001	9.61	13.69
Depression and Anxiety	35.7031	<.0001	23.22	29.69
Elder Abuse	0.0276	0.8680	0.73	0.77
Social Function	22.8655	<.0001	20.79	25.77
Cardio-Respiratory	0.9994	0.3174	33.30	34.51
Dehydration	12.6465	0.0004	3.42	5.08
Falls	13.5050	0.0002	47.87	52.57
Nutrition	0.2047	0.6510	20.39	19.92
Oral Health	6.0401	0.0140	14.73	16.97
Pain	0.2055	0.6503	63.22	62.66
Pressure Ulcers	5.5191	0.0188	18.73	21.08
Skin and Foot Conditions	13.3458	0.0003	31.26	35.60
Adherence	115.5495	<.0001	6.16	12.85
Brittle Supports	35.7706	<.0001	18.92	24.94
Palliative Care	1.9772	0.1597	1.31	0.90
Immunization and Screening	32.1324	<.0001	88.59	93.19
Psychotropic Drugs	0.0499	0.8232	33.17	32.90
Reduction of Formal Services	5.1494	0.0233	14.65	12.60
Environmental Assessment	88.5006	<.0001	5.33	10.80
Bowel Management	4.6302	0.0314	16.28	18.32
Urine Incontinence	2.0704	0.1502	41.95	43.77

Table 3 displays the result for the *t*-tests between the six outcome measures comparing the means of those with medication oversight to those with no medication oversight. All but IADL Sum were found to be significantly different at the .05 level.

Table 3

T-tests for Outcome Measures

Variable	t-value	P	Average Score of Persons with Medication Review	Average Score of Persons with Medication Oversight
ADL Hierarchy	-1.47	0.1411	0.746 (SD = 1.254)	0.794 (SD = 1.310)
CHESS	-3.48	0.0005	1.152 (SD = 1.049)	1.246 (SD = 1.115)
Cognition Performance Scale	-3.12	0.0018	1.195 (SD = 1.342)	1.302 (SD = 1.358)
Depression Rating Scale	-6.44	<.0001	0.967 (SD = 1.770)	1.261 (SD = 2.043)
MAPLe	-5.36	<.0001	2.966 (SD = 1.280)	3.142 (SD = 1.285)
IADL Sum	1.64	0.1018	12.13 (SD = 5.769)	11.89 (SD = 5.694)

Note. SD = Standard Deviation.

Table 4 shows the percentage of clients without a medication review for each CCAC at both the initial assessment (Time 1) and the follow up assessment (Time 2). The CCAC with the highest prevalence of medication oversight at both times was South West (Time 1 = 4.82%, Time 2 = 3.69%). The Central CCAC scored the lowest with at both assessment times. All CCACs had lower prevalence rates at the time of the clients' second assessment. The prevalence rate across all CCACs was 2.61% for time 1 and 2.01% for time 2 ($t[13]= 7.96, p<.001$).

Table 4

CCAC Medication Oversights

CCAC Name	Time 1 Percentage of Population with Medication Oversight	Time 2 Percentage of Population with Medication Oversight
Central	1.52%	1.09%
Central East	3.32%	2.53%
Central West	1.67%	1.48%
Champlain	2.28%	1.60%
Erie St. Clair	2.42%	2.31%
Hamilton Niagara	2.83%	2.42%
Mississauga Halton	1.67%	1.11%
North East	3.26%	2.54%
North Simcoe Muskoka	2.37%	1.42%
North West	3.06%	2.14%
South East	2.88%	2.13%
South West	4.82%	3.69%
Toronto Central	2.35%	1.67%
Waterloo Wellington	1.97%	1.18%

A correlation matrix between the medication oversight items (both Time 1 and Time 2), the drug category variable and the 6 health outcome variables can be found in Table 5. Medication oversight at time 1 (MO-T1) correlates with the Time 2 medication oversight (MO-T2) with $r = .540$. The highest correlation was found between the MAPLe and CPS scores with $r = .681$. The Values are low enough that multicollinearity is not expected to be a significant threat to the validity of the regression analyses that follow.

Table 5

Correlation Matrix for Medication Oversights (Time 1 and 2), Drug Category and Outcome Variables

	MO-T1	MO-T2	Drug Category	MAPLe	CPS	DRS	ADL Hier	CHESS	IADL sum
MO-T1	1.00	.540	.028	.018	.013	.022	.006	.008	-.004
MO-T2		1.00	.026	.019	.010	.024	.008	.013	-.005
Drug Category			1.00	.047	.106	-.041	.015	-.104	-.005
MAPLe				1.00	.681	.188	.380	.231	.649
CPS					1.00	.139	.401	.152	.571
DRS						1.00	.098	.196	.098
ADL Hier							1.00	.199	.534
CHESS								1.00	.199
IADL Sum									1.00

Results of the mixed linear analysis are shown in tables 6 through to 17, with two tables for each outcome measure. Each model lists the -2 Res Log Liklihood for the model, the random effects and the fixed effects results. For each null model, the effect of the CCAC grouping was found to be significant. The highest intraclass correlation for the null model was found in the Instrumental Activities of Daily Living Sum outcome measure (0.0248) and the lowest intraclass correlation was found in the Depression Rating Scale (0.00183).

In table 6, the MLA results for the Null Model and Model 1 for the MAPLe are displayed. For the Null model, the Intercept and Residual estimates were found to be significant with 1.25% of variance due to the CCAC groupings. In model 1, the centered medication oversight at time 2 (Cen MO T2) was found to have a significant linear relationship with the MAPLe outcome scores. Model 2 did not converge for the MAPLe.

Table 6

Mixed Linear Analyses Results for MAPLe: Null Model and Model 1

Null Model					
		Estimate	SE	Z Value	Pr Z
Random Effects	Intercept	0.02048	0.008138	2.52	0.0059
	Residual	1.6225	0.008321	195.00	<.0001
	Intraclass Correlation =		0.0125		
	-2 Res Log Likelihood =		252735.7		
Model 1	***Added Fixed Variable to Null Model: Centered Medication Oversight At Time 2***				
		Estimate	SE	Z value	Pr Z
Random Effects	Intercept	0.02048	0.008138	2.52	0.0059
	Residual	1.6218	0.008317	195.00	<.0001
		Estimate	SE	T value	Pr T
Fixed effects	Intercept	2.9626	0.03860	76.74	<.0001
	Cen MO T2	0.1929	.03271	5.90	<.0001
	-2 Res Log Likelihood =		252706.0		

Note. Cen MO T2 = Centered medication oversight at time 2.

In Table 7, the results for Model 3 for the MAPLe outcome are given. Significant predictors of the MAPLe score from this model included the number of drugs categorical

variable (Drug Category), social living circumstance (Alone), gender, age, and the centered medication oversight at time 1 variable.

Table 7

Mixed Linear Analyses Results for MAPLe: Model 3

Model 3	**Added Fixed Variables**				
		Estimate	SE	Z value	Pr Z
Random Effects	Intercept	0.01298	0.005432	2.39	0.0084
	Residual	1.4998	0.007704	194.68	<.0001
		Estimate	SE	T value	Pr T
Fixed effects	Intercept	1.4946	0.1064	14.05	<.0001
	Centered MO Time 2	-0.03637	0.1251	-0.29	0.7713
	Drug Category	0.09932	0.006135	16.19	<.0001
	Centered MO T2 * Drug Category	0.08746	0.04077	2.15	0.0319
	Alone	0.6680	0.009659	69.17	<.0001
	Gender	-0.1376	0.009690	-14.20	<.0001
	Age	0.01412	0.000636	22.20	<.0001
	Centered MO Time 1	0.1232	0.03256	3.79	0.0002
	CCAC Average	-2.8167	4.3916	-0.64	0.5333
	Cen MO T2 * CCAC Average	0.1250	3.9966	0.03	0.9749
	-2 Res Log Likelihood =		245986.5		

Note. Cen MO T2 = Centered medication oversight at time 2, Drug Cateregory = categorical variable representing the number of drugs client is taking, Alone = social living circumstance for client, CCAC Average = average medication oversight at time 2 for the CCAC to which the client belongs.

In table 8, the MLA results of the Null Model and Model 1 for the CPS are displayed. For the Null model, the Intercept and Residual estimates were found to be significant with 1.08% of variance due to the CCAC groupings. In model 1, the centered medication oversight at time 2 (Cen MO T2) was found to have a significant linear relationship with the CPS scores. Model 2 did not converge for the CPS.

Table 8

Mixed Linear Analyses Results for Cognitive Performance Scale: Null Model and Model 1

Null Model		Estimate	SE	Z Value	Pr Z
Random Effects	Intercept	0.01940	0.007779	2.49	0.0063
	Residual	1.7833	0.009146	194.98	<.0001
	Intraclass Correlation =		0.0108		
	-2 Res Log Likelihood =		259873.0		

Model 1	***Added Fixed Variable to Null Model: Centered Medication Oversight At Time 2***				
		Estimate	SE	Z value	Pr Z
Random Effects	Intercept	0.01940	0.007770	2.49	0.0063
	Residual	1.7831	0.009145	194.98	<.0001
		Estimate	SE	T value	Pr T
Fixed effects	Intercept	1.1901	.03763	31.63	<.0001
	Cen MO T2	0.1191	0.03430	3.47	0.0005
	-2 Res Log Likelihood =		259865.9		

Note. Cen MO T2 = Centered medication oversight at time 2.

In Table 9, the results for Model 3 for the CPS outcome are given. Significant predictors of the Cognitive Performance Scale scores from this model included the number of drugs categorical variable (Drug Category), social living circumstance (Alone), gender, age, and the centered medication oversight at time 1 variable.

Table 9

Mixed Linear Analyses Results for Cognitive Performance Scale: Model 3

Model 3					
		Estimate	SE	Z value	Pr Z
Random Effects	Intercept	0.01478	0.006160	2.40	0.0082
	Residual	1.6592	0.008524	194.66	<.0001
		Estimate	SE	T value	Pr T
Fixed effects	Intercept	-0.5642	0.1131	-4.99	0.0003
	Centered MO Time 2	-0.3172	0.1316	-0.24	0.8085
	Drug Category	0.2093	0.006454	32.43	<.0001
	Centered MO T2 * Drug Category	0.07054	0.04288	1.65	0.0999
	Alone	0.6096	0.01016	60.00	<.0001
	Gender	-0.1280	0.01019	-12.56	<.0001
	Age	0.01503	0.000669	22.47	<.0001
	Centered MO Time 1	0.1101	0.03425	3.22	0.0013
	CCAC Average	-0.4281	4.6842	-0.09	0.9287
	Cen MO T2 * CCAC Average	-2.3802	4.1770	-0.57	0.5688
	-2 Res Log Likelihood =		253601.5		

Note. Cen MO T2 = Centered medication oversight at time 2, Drug Cateregory = categorical variable representing the number of drugs client is taking, Alone = social living circumstance for client, CCAC Average = average medication oversight at time 2 for the CCAC to which the client belongs.

Table 10 displays the MLA results of the Null Model, Model 1, and Model 2 for the DRS. For the Null model, the Intercept and Residual estimates were found to be significant with 0.18% of variance due to the CCAC groupings. This intraclass correlation for the DRS was the smallest of the six outcomes in these analyses. In model 1, the centered medication oversight at time 2 (Cen MO T2) was found to have a significant linear relationship with the DRS scores. This relationship ($t = 6.57$) was the strongest of all Model 1 results. For the DRS, Model 2 did converge after adding the centered medication oversight at time 2 as a random variable. However, it resulted in a non-significant random effect.

Table 10

Mixed Linear Analyses Results for Depression Rating Scale: Null Model, Model 1 and Model 2

Null Model		Estimate	SE	Z Value	Pr Z
Random Effects	Intercept	0.005772	0.002529	2.28	0.0112
	Residual	3.1512	0.01617	194.92	<.0001
	Intraclass Correlation =		0.00183		
	-2 Res Log Likelihood =		302946.2		

Model 1	***Added Fixed Variable to Null Model: Centered Medication Oversight At Time 2***				
		Estimate	SE	Z value	Pr Z
Random Effects	Intercept	0.005773	0.002529	2.28	0.0112
	Residual	3.1494	0.01616	194.92	<.0001
		Estimate	SE	T value	Pr T
Fixed effects	Intercept	0.9610	0.02154	44.62	<.0001
	Cen MO T2	0.2999	0.04561	6.57	<.0001
	-2 Res Log Likelihood =		302907.3		

Model 2	***Added Random Variable to Model 1: Centered Medication Oversight At Time 2***				
		Estimate	SE	Z value	Pr Z
Random Effects	Intercept	0.005773	0.002529	2.28	0.0112
	Cen MO T2	0.03441	0.02538	1.36	0.0876
	Residual	3.1488	0.01616	194.90	<.0001
		Estimate	SE	T value	Pr T
Fixed effects	Intercept	0.9610	0.02154	44.62	<.0001
	Cen MO T2	0.2563	0.07123	3.60	0.0032
	-2 Res Log Likelihood =		302900.5		

Note. Cen MO T2 = Centered medication oversight at time 2.

In Table 11, the results for Model 3 for the DRS outcome are given. Significant predictors of the Depression Rating Scale scores included the number of drugs categorical variable (Drug Category), social living circumstance (Alone), gender, age, and the centered medication oversight at time 1 variable.

Table 11

Mixed Linear Analyses Results for Depression Rating Scale: Model 3

Model 3					
		Estimate	SE	Z value	Pr Z
Random Effects	Intercept	0.006010	0.002731	2.20	0.0139
	Centered MO Time 2	0.02702	0.2574	1.05	0.1469
	Residual	3.1121	0.01599	194.58	<.0001
		Estimate	SE	T value	Pr T
Fixed effects	Intercept	2.4340	0.1020	23.87	<.0001
	Centered MO Time 2	0.03902	0.2286	0.17	0.8644
	Drug Category	-0.07456	0.008840	-8.43	<.0001
	Centered MO T2 * Drug Category	-0.04926	0.05888	-0.84	0.4028
	Alone	0.2026	0.01391	14.56	<.0001
	Gender	0.1586	0.01396	11.36	<.0001
	Age	-0.02152	0.000917	-23.48	<.0001
	Centered MO Time 1	0.1371	0.04701	2.92	0.0035
	CCAC Average	0.4983	3.0875	0.16	0.8745
	Cen MO T2 * CCAC Average	11.7855	8.7879	1.34	0.1799
	-2 Res Log Likelihood =		3301067.1		

Note. Cen MO T2 = Centered medication oversight at time 2, Drug Cateregory = categorical variable representing the number of drugs client is taking, Alone = social living circumstance for client, CCAC Average = average medication oversight at time 2 for the CCAC to which the client belongs.

Table 12 displays the MLA results of the Null Model and Model 1 for the ADL Hierarchy item. For the Null model, the Intercept and Residual estimates were found to be significant with 1.84% of variance due to the CCAC groupings. In model 1, the centered medication oversight at time 2 (Cen MO T2) was found to have a significant linear relationship with the ADL Hier scores. Model 2 converged but the random effect of the centered medication oversight at time 2 was found to be non significant.

Table 12

Mixed Linear Analyses Results for Activities of Daily Living Hierarchy Scale: Null Model and Model 1

Null Model		Estimate	SE	Z Value	Pr Z
Random Effects	Intercept	0.02904	0.01150	2.53	0.0058
	Residual	1.5477	0.007938	194.97	<.0001
	Intraclass Correlation =		0.0184		
	-2 Res Log Likelihood =		249073.1		
Model 1	***Added Fixed Variable to Null Model: Centered Medication Oversight At Time 2***				
		Estimate	SE	Z value	Pr Z
Random Effects	Intercept	0.02904	0.01150	2.53	0.0058
	Residual	1.5476	0.007938	194.97	<.0001
		Estimate	SE	T value	Pr T
Fixed effects	Intercept	0.7552	0.04583	16.48	<.0001
	Cen MO T2	0.0916	0.03195	2.87	0.0041
	-2 Res Log Likelihood =		249070.0		
Model 2	***Added Random Variable to Model 1: Centered Medication Oversight At Time 2***				
		Estimate	SE	Z value	Pr Z
Random Effects	Intercept	0.02904	0.01150	2.53	0.0058
	Cen MO T2	0.01363	0.01764	0.77	0.2198
	Residual	1.5474	0.007938	194.93	<.0001
		Estimate	SE	T value	Pr T
Fixed effects	Intercept	0.7552	0.04583	16.48	<.0001
	Cen MO T2	0.09031	0.04727	1.91	0.0783
	-2 Res Log Likelihood =		249069.1		

In Table 13, the results for Model 3 for the ADL Hier outcome are given. Significant predictors of the ADL Hier scores included social living circumstance (Alone), gender, age, the centered medication oversight at time 1 variable and the CCAC time 2 average medication oversight score.

Table 13

Mixed Linear Analyses Results for Activities of Daily Living Hierarchy Scale: Model 3

Model 3					
		Estimate	SE	Z value	Pr Z
Random Effects	Intercept	0.01159	0.004947	2.34	0.0095
	Centered MO Time 2	0.01981	0.01858	1.07	0.1431
	Residual	1.4567	0.007485	194.62	<.0001
		Estimate	SE	T value	Pr T
Fixed effects	Intercept	0.3483	0.1018	3.42	0.0051
	Centered MO Time 2	0.03927	0.1709	0.23	0.8183
	Drug Category	0.003957	0.006048	0.65	0.5130
	Centered MO T2 * Drug Category	0.04624	0.04026	1.15	0.2507
	Alone	0.5969	0.009521	62.69	<.0001
	Gender	-0.1384	0.009552	-14.49	<.0001
	Age	0.005973	0.000627	9.53	<.0001
	Centered MO Time 1	0.07631	0.03215	2.37	0.0176
	CCAC Average	-12.4748	4.1540	-3.00	0.0110
	Cen MO T2 * CCAC Average	-2.8640	6.8659	-0.42	0.6766
	-2 Res Log Likelihood =		243708.2		

Note. Cen MO T2 = Centered medication oversight at time 2, Drug Cateregory = categorical variable representing the number of drugs client is taking, Alone = social living circumstance for client, CCAC Average = average medication oversight at time 2 for the CCAC to which the client belongs.

Table 14 displays the MLA results of the Null Model, Model 1, and Model 2 for the CHESS outcome item. For the Null model, the Intercept and Residual estimates were found to be significant with 1.14% of variance due to the CCAC groupings. In model 1, the centered medication oversight at time 2 (Cen MO T2) was found to have a significant linear relationship with the CHESS scores. For the CHESS, Model 2 did converge after including the centered medication oversight at time 2 as a random variable and the random effects were found to be non significant.

Table 14

Mixed Linear Analyses Results for CHESS: Null Model, Model 1, and Model 2

Null Model		Estimate	SE	Z Value	Pr Z
Random Effects	Intercept	0.01257	0.005006	2.51	0.0060
	Residual	1.0937	0.005609	194.97	<.0001
	Intraclass Correlation =		0.0114		
	-2 Res Log Likelihood =		222671.2		

Model 1	***Added Fixed Variable to Null Model: Centered Medication Oversight At Time 2***				
		Estimate	SE	Z value	Pr Z
Random Effects	Intercept	0.01257	0.005006	2.51	0.0060
	Residual	1.0936	0.005609	194.97	<.0001
		Estimate	SE	T value	Pr T
Fixed effects	Intercept	1.1553	0.03027	38.17	<.0001
	Cen MO T2	0.08281	0.02687	3.08	0.0021
	-2 Res Log Likelihood =		222667.1		

Model 2	***Added Random Variable to Model 1: Centered Medication Oversight At Time 2***				
		Estimate	SE	Z value	Pr Z
Random Effects	Intercept	0.01257	0.005006	2.51	0.0060
	Cen MO T2	0.01709	0.01152	1.48	0.0690
	Residual	1.0933	0.005608	194.96	<.0001
		Estimate	SE	T value	Pr T
Fixed effects	Intercept	1.1553	0.03027	38.17	<.0001
	Cen MO T2	0.06626	0.046445	1.43	0.1773
	-2 Res Log Likelihood =		222657.2		

Note. Cen MO T2 = Centered medication oversight at time 2.

In Table 15, the results for Model 3 for the CHESS outcome item are displayed. The random effect of the centered medication oversight was found to be non significant. Significant predictors of the CHESS scores included the number of drugs categorical variable (Drug Category), social living circumstance (Alone), gender, and age.

Table 15

Mixed Linear Analyses Results for CHESS: Model 3

Model 3					
		Estimate	SE	Z value	Pr Z
Random Effects	Intercept	0.01188	0.004921	2.42	0.0079
	Centered MO Time 2	0.01783	0.01260	1.42	0.0785
	Residual	1.0818	0.005558	194.64	<.0001
		Estimate	SE	T value	Pr T
Fixed effects	Intercept	1.3707	0.09872	13.88	<.0001
	Cen MO Time 2	0.01460	0.1541	0.09	0.9245
	Drug Category	-0.1317	0.005211	-25.28	<.0001
	Centered MO T2 * Drug Category	0.002501	0.03473	0.07	0.9426
	Alone	0.05530	0.008205	6.74	<.0001
	Gender	-0.09183	0.008231	-11.16	<.0001
	Age	0.001070	0.000540	1.98	0.0477
	Centered MO Time 1	0.008788	0.02772	0.32	0.7513
	CCAC Average	2.0503	4.1934	0.49	0.6337
	Cen MO T2 * CCAC Average	3.2982	6.3029	0.52	0.6008
	-2 Res Log Likelihood =		221173.4		

Note. Cen MO T2 = Centered medication oversight at time 2, Drug Cateregory = categorical variable representing the number of drugs client is taking, Alone = social living circumstance for client, CCAC Average = average medication oversight at time 2 for the CCAC to which the client belongs.

In Table 16, the MLA results of the Null Model and Model 1 for the IADL Sum item are given. For the Null model, the Intercept and Residual estimates were found to be significant. The intraclass correlation indicates that 2.48% of variance is due to the CCAC groupings. In model 1, the centered medication oversight at time 2 (Cen MO T2) was found to have a significant linear relationship with the ADL Hier scores. Model 2 did converge for this outcome but the random effect of the Cen MO T2 was found to be of non significance.

Table 16

Mixed Linear Analyses Results for Instrumental Activities of Daily Living Sum: Null Model and Model 1

Null Model		Estimate	SE	Z Value	Pr Z
Random Effects	Intercept	0.8319	0.3271	2.54	0.0055
	Residual	32.7025	0.1678	194.92	<.0001
	Intraclass Correlation =	0.0248			
	-2 Res Log Likelihood =	480824.0			

Model 1	***Added Fixed Variable to Null Model: Centered Medication Oversight At Time 2***				
		Estimate	SE	Z value	Pr Z
Random Effects	Intercept	0.8319	0.3271	2.54	0.0055
	Residual	32.7029	0.1678	194.92	<.0001
		Estimate	SE	T value	Pr T
Fixed effects	Intercept	12.0961	0.2449	49.39	<.0001
	Cen MO T2	-0.04766	0.1470	-0.32	0.7457
	-2 Res Log Likelihood =		480825.9		

Model 2	***Added Random Variable to Model 1: Centered Medication Oversight At Time 2***				
		Estimate	SE	Z value	Pr Z
Random Effects	Intercept	0.8310	0.3271	2.54	0.0055
	Cen MO T2	0.02183	0.1180	0.19	0.4266
	Residual	32.7025	0.1678	194.91	<.0001
		Estimate	SE	T value	Pr T
Fixed effects	Intercept	12.0961	0.2449	49.39	<.0001
	Cen MO T2	-0.04629	0.1547	-0.30	0.7695
	-2 Res Log Likelihood =		480825.9		

Table 17 gives the results for Model 3 for the IADL Sum outcome. Significant predictors of the IADL Sum scores included the number of medications one was taking (Drug Category), social living circumstance (Alone), gender, age, the centered medication oversight at time 1 variable, and the CCAC time 2 average medication oversight score.

Table 17

Mixed Linear Analyses Results for Instrumental Activities of Daily Living Sum: Model 3

Model 3					
		Estimate	SE	Z value	Pr Z
Random Effects	Intercept	0.2643	0.1101	2.40	0.0082
	Residual	26.2825	0.1351	194.60	<.0001
		Estimate	SE	T value	Pr T
Fixed effects	Intercept	1.1763	0.4707	2.50	0.0280
	Centered MO Time 2	0.08086	0.5243	0.15	0.8774
	Drug Category	-0.05870	0.02569	-2.28	0.0223
	Centered MO T2 * Drug Category	0.2180	0.1708	1.28	0.2019
	Alone	4.9819	0.04045	123.16	<.0001
	Gender	-0.7750	0.04058	-19.10	<.0001
	Age	0.1221	0.002664	45.84	<.0001
	Centered MO Time 1	0.3212	0.1363	2.36	0.0185
	CCAC Average	-44.2639	19.7909	-2.24	0.0451
	Cen MO T2 * CCAC Average	-24.1393	16.6309	-1.45	0.1467
	-2 Res Log Likelihood =		462730.3		

Note. Cen MO T2 = Centered medication oversight at time 2, Drug Cateregory = categorical variable representing the number of drugs client is taking, Alone = social living circumstance for client, CCAC Average = average medication oversight at time 2 for the CCAC to which the client belongs.

Discussion

The purpose of this study was to explore medication oversight utilizing MDS-HC data through traditional statistical methods and mixed linear analyses. The prevalence rate of medication oversight for the dataset was found to be lower than 3 percent. Those who did not have their medications reviewed differed in many of the Client Assessment Protocols as well as in five of the six health outcome measures. By using mixed linear analyses it was found that clustering effects occurred within the MDS-HC data and that missed medication review was a significant predictor of some of the variance for each of the health outcome measures.

The prevalence rate at the first assessment was 2.67% (n = 2047) and at second assessment the medication oversight prevalence rate was 2.03% (n = 1556). Due to a lack of previous research into medication oversights, there are no previously published rates to compare this rate to. When looking at the 14 CCACs, prevalence rates varied across province from 1.09% in Central to 3.69% in the South West. All CCACs improved their rates at the time of the second assessments. This is a positive result, which demonstrates that once a client has entered into the CCAC system, the client is more likely to have received a review of their medication regime.

From the Chi square tests for the Client Assessment Protocols, numerous significant differences were found between those who have had their medication regimes reviewed versus those who had not. The CAPS that differed significantly at the $p < .05$ level in order of decreasing Chi square values were Adherence, Environmental Assessment, Brittle Supports, Depression and Anxiety, Immunization and Screening, Behaviour, Cognition, Alcohol Dependence, Falls, Dehydration, Skin and Foot Conditions, Communication, Oral Health, Pressure Ulcers, and Reduction of Formal Services. Complete descriptions of these CAPs as well as their triggering rules can be found within the RAI-HC Handbook (Morris et al., 1999).

The CAP where the greatest difference existed was Adherence. This CAP is defined as the extent to which a client's behaviour, in terms of taking medications, following diets, or executing lifestyle changes, coincides with medical or health advice. People who did not have their medications reviewed by a health professional in the last 180 days were more likely to have nonadherence to physician recommendations. This finding of a difference is not a surprising result as research into medication reviews has demonstrated that adherence can be significantly improved when reviews of medication regimes are given to patients receiving multiple prescriptions (Chumney & Robinson, 2006; Lefante et al., 2005).

A second CAP that showed significant difference for those with medication oversight is the Depression CAP. This CAP identifies the occurrence of symptoms of depression. The clients with medication oversight on average triggered this depression cap more often than those who have had their medications reviewed. This is interesting as more research should look into depression and medication reviews as one cannot be sure if the depression causes one to miss out on medication reviews or if inappropriate medications are the cause of the depression or both.

Overall, these Chi square results inform us that differences exist for those with medication oversight exist when their health status is assessed. By looking at these differences, a general profile of those who do not have their medications reviewed regularly is painted and more research should be performed in order to have a clear understanding of the factors involved for those patients who end up with a medication oversight. Further investigations may also determine the direction of causation (does the lack of having your medications reviewed increase the chance of depression; or, does depression increase the chance of not having your medications reviewed), and the extent of the effects. Of all the significant differences found in the CAPS, those with medication oversight were on the negative side of each of those differences (*ie.* Those

with medication oversight were more likely to trigger the risk of falling CAP). This finding demonstrates that the lack of medication review does lead to negative effects on a number of different health measures.

A second set of analyses, *t*-tests, was performed to investigate the differences between those with and without medication oversight for the six health outcome measures. The results of the *t*-tests for the outcome measures indicated differences between those who have had their medication regimes reviewed and for those who had not for the MAPLe, CHESS, DRS, and CPS. In each of those four outcomes, the average score was higher for those who had not had their medications reviewed. This suggests that those who do not have their medications reviewed by a doctor for a extended period of time are more likely to: (a) be placed into a long term care home as measured by the MAPLe; (b) show signs of depression as measured by the DRS; (c) have more cognitive impairment as measured by the CPS; and (d) have a higher risk of serious decline as measured by the CHESS. And again, these results demonstrate that the lack of a medication review leads to negative health outcomes. The relationship between medication oversight and the six outcome measures were further explored in this thesis by using mixed linear analyses.

From the results of the mixed linear analyses, the null models in each of the 6 outcomes revealed that the clustering effect of the 14 CCACs exists and can be accounted for. The intraclass correlations ranged from .0018 (DRS) to .0248 (IADL Sum). Each of the outcomes examined in this thesis had results of significant effects for the CCAC grouping variable. Thus, it is important for future studies to take such grouping effects into consideration when analyzing datasets containing multiple CCACs.

From the Model 1 analyses, all outcome variables were found to have a significant linear relationship with the centered medication oversight at time 2. The outcome variable that the centered medication oversight had its largest effect on was the Depression Rating Scale ($t = 6.57$, $p < .0001$) followed by the MAPLe ($t = 5.90$, $p < .0001$).

Social living circumstances (living alone), gender and age were significant predictors of all six of the health outcomes in model 3. The centered medication oversight at time 2 was found to be non significant for all of the six outcomes. However, for the MAPLe, DRS, CPS and ADL Hier, the centered medication oversight at time 1 was a significant predictor of higher scores on each outcome. Therefore, those who did not have their medications reviewed for the six months prior to first coming into contact with a CCAC were more likely to score higher each of those four measures. This implies that people whose medications are not reviewed by a doctor for 6 months prior to CCAC contact are more likely to: (a) be in need of long term care placement as measured by the MAPLe; (b) to have signs or symptoms of depression as measured by the DRS; (c) to have cognitive impairment as measured by the CPS; and (d) to depend on others for their activities of daily living as measured by the ADL Hier.

The categorical number of drugs variable (Drug Category) proved to be a significant predictor in 5 of the 6 outcome variables. However, its effect was not uniform in the way it predicted the scores. For the Depression Rating Scale, the CHESS, and the IADL Sum, the higher the number of drugs the clients were taking, the lower the predicted scores were on these two scales. Conversely, for the MAPLe and Cognitive Performance Scale, the higher the number of drugs the clients were taking, the higher the predicted scores were on these three scales. Therefore, on average, those who were on a higher number of drugs displayed less signs of depression, less risk of decline, and less need to depend on a care taker for assistance with

their instrumental activities of daily living. Those on a lower number of drugs were more likely to have a need to be placed within a long-term care home and to show signs of cognitive impairment.

Strengths and Limitations

One of the major strengths of this study was the size of the dataset. Even after reducing the original dataset to examine only older adults who were in need of medication review, approximately 90 000 clients were analyzed. Secondly, another strength of this study was the use of proven health outcome measures. These outcome measures have been shown to be valid and reliable (Hirdes, Frijters, & Teare, 2003; Hirdes, Poss, & Curtin-Telegdi, 2008; Morris et al., 1999; Burrows, Moris, Simon, Hirdes, & Phillips, 2000; Hartmaier et al., 1995; Morris et al., 1999); This proven validity and reliability adds to the strength of the findings of this study.

Despite the large size of the dataset, it may be difficult to generalize the findings to a general population due to the fact the sample population were all clients within the CCAC system and from the province of Ontario. This population consists of individuals who are using home care services, just released from acute care, and waiting for long-term care.

A second limitation was the use of routinely collected clinical data. Due to the fact that medication review is not the purpose of this tool, a number of important items related to medication reviews such as timing of last review and who performed the review are not included. Also, because of the way that the number of medications a client is on is collected on the MDS-HC, it is impossible to use that variable as a continuous one which limits not only the way it can be used in analyses, but also disallows any way to determine the true average of the number of medications used in this population.

Implications

From a research perspective, the implications of this study are the importance of using statistical methods that take into account the clustering effect of the 14 CCACs or geographical regions. The results of this thesis demonstrated this effect in that six out of six health outcome measures had significant clustering effects. Individual clients cannot be treated as completely separate entities as those living in the same region share a number of characteristics that are unlike those in other regions.

The results of the Chi square tests indicate those who do not have their medications reviewed share a number of characteristics and with further study, a profile of such persons could be to discovered to aid CCACs in providing interventions to lower the occurrence of medication oversight.

Further research is required to examine the relationship between medication oversight and the different health outcomes. Longitudinal research is predominantly required to determine the effect of not having one's medications reviewed on health status over a long period of time.

A second area that is lacking in the literature is the association between medication oversight and inappropriate medications. With inappropriate medication rates being as high as they are, the effect of medication oversight on such medication use should be examined in all populations including home care, long term care and the general public.

Conclusion

To conclude, medication oversight when taking multiple medications should not occur, as it could be detrimental to one's health to not have their medication regime reviewed by a qualified health professional regularly. As this study indicated, those who did not have their

medications reviewed in the last 6 months on average had a higher risk of decline (CHESS score), more cognitive impairment (CPS score), more frequent symptoms of depression (DRS score), more dependence (ADL Hierarchy score) and a higher risk of adverse outcomes (MAPLe score).

From the mixed linear analyses, differences between CCACs were found to exist. This finding implies that in the future, similar health research should take into account clustering effects when doing their analyses.

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