Pharmacist Led Diabetes Disease State Management in Residential Care Facilities

by

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ABSTRACT

Seniors requiring advanced care and supports are often residing in residential care facilities (RCF). Although, up to 33% of the residents are living with known diabetes, administrators and clinicians are faced with two important questions: 1) what is the prevalence of undetected diabetes; and, 2) what are the best management practices for residents of seniors' facilities with diabetes? Gaps in diabetes management have led to multiple international guidelines in the last 5 years, illustrating a growing recognition of the importance of these issues. Pharmacists are uniquely positioned in a growing multidisciplinary environment to assist or oversee diabetes disease state management in this population. The first study of this thesis, tests the effectiveness of two validated diabetes risk surveys to identify residents of RCFs living with undetected diabetes. The second study is a systematic review that examines current diabetes management strategies in RCFs.

The first study, a cross sectional survey compared the CANRISK and FINDRISC with A1c. 290 residents participated; mean age 84.3 (SD 7.3) years, 82 (28%) men, mean A1c 5.7% (SD 0.4). Mean CANRISK score was 29.4 (SD 8.0) and of the 254 (88%) considered moderate or high risk, 10 (4%) had an A1c≥6.5 and 49 (19%) had an A1c≥6.0%. Mean FINDRISC score was 10.8 (SD 4.2) and of the 58 (20%) considered high or very high risk, 4 (7%) had an A1c≥6.5% and 15 (26%) had an A1c≥6.0%. The area under the receiver operating characteristic curve was 0.57 (95% CI 0.42-0.72) for the CANRISK survey identifying participants with an A1c≥6.5% and 0.59 (95% CI 0.51-0.67) for identifying A1c≥6.0%. Similar characteristics were observed for the FINDRISC survey. Although we found a statistically significant correlation between these measures, the risk scores were unable to effectively discriminate between seniors with elevated and normal blood glucose.

In the systematic review, a total of 1639 articles were screened and 3 studies with a combined

sample of 685 residents met the inclusion criteria. Two were uncontrolled before and after studies and one was a non-randomized controlled trial. Glycemic control was the most common measure of program efficacy, along with rates of hypoglycemia. The systematic review identified an important evidence gap to help guide diabetes management in this population as well as areas for pharmacist involvement in the process of care including: development of policy and procedures for diabetes, education to the staff and sliding scale insulin reductions.

In conclusion, observations from these studies suggest pharmacists should not recommend implementation of diabetes risk tools in admission or resident screening and should instead use their expanded scope of practice to order an A1c as a screening test. Furthermore, by implementing the process of care identified, pharmacists can demonstrate a quick impact to diabetes management in RCF settings.

PREFACE

This thesis is an original work by Travis Featherstone. The research project, of which this thesis is a part, received research ethics approval from the University of Alberta Research Ethics Board, Pro00040010 “Is a screening tool useful for diabetes risk management for seniors living facility residents?”, October 25, 2013.

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Table of Contents

List of Tables

List of Figures

Chapter 1: INTRODUCTION

1.1 Introduction

Canada, like the rest of the world, is at an unprecedented time in history where the population greater than 65 years old will double in the next 15 years and continue increasing to exceed one quarter of the entire population by 2056.(1) With this increase, the total number of seniors will outnumber children less than 15 years of age for the first time in Canadian history. (2, 3)

As the number of seniors increases, the age distribution within this group is also expected to shift. The proportion that is 85 years and older will grow from 13% of seniors and 2% of the total population to 24% of seniors and 6% of the total population(3, 4). This shift will increase health care costs because the per capita cost for people over 80 years of age is $20,917, compared to $11,557 for 75-79 year olds and $6,298 for those aged 65-69.(3, 5, 6). Prior to 2013, aging was found to be a modest driver of health care cost increases and estimated to be 0.9% per year(5). However, as the proportion of seniors is anticipated to increase to 20% by 2031 and 25% by 2056, costs related to aging is expected to increase 33% to 1.2% per year. (1, 5, 7) This projected additional burden is concerning since healthcare costs already account for 35-42% of provincial budgets. (5)

As seniors continue to assume a larger proportion of the population, there is also evidence that their healthcare needs are becoming more complex. The complexity of care for seniors results in health expenditure and utilization are 10 times greater than the average person.(4) A major driver of the higher per capita health care expenditures is the improvements seen in chronic disease management.(8) For example, the life expectancy difference between people with diabetes and people without diabetes has been reduced by 40-60% over the past 20 years(s). (9,

10) These trends result in people with chronic complications living longer with increasing prevalence of chronic diseases and resulting complexity require a shift in the approach to care for seniors.

Canadian provincial governments have implemented facility care models to manage seniors and persons with advanced care needs, referred to as residential care facilities. As of 2010, there were 4,633 residential care facilities in Canada housing 265,220 residents(11). Seniors residents were structured care is provided are generally referred to as Residential Care Facilities internationally and provincially as Continuing Care Facilities. Continuing Care Facility subgroups have been organized into two general categories. Facilities that are considered Supportive/Assisted Living provide care from practical nursing staff and nurses aids and are referred to as Retirement Communities, Assisted Living, Supportive Living, Special Care Homes and Private Nursing Homes (Table 1).(12) Facilities that are considered Long Term Care are designated for residents that have a heavier care requirement where care is provided by registered nursing staff with practical nurse and aid support and provincial terminology include Residential Care, Long Term Care, Special care Home, Personal care Homes, Nursing Home, Homes for the Aged and Community Residences(Table 1).(12) Approximately 5% of seniors currently live in residential care facilities and another 5% living in seniors independent living facilities.(2, 3, 11, 13) The projected total cost to fund long term care in all provinces over the next 25 years is $1.2 trillion.(14) The projected funding shortfall over this time frame is $590 billion from current funding projections. This is equivalent to a permanent 6.4% tax increase to Canadian taxpayers.(14) Governmental strategy options for management of the funding shortfall could also include changes to what type of bed is funded in the future, reduced funding to the types of beds, changes to tax allocation, or improved care to reduce costs associated with acute care.(6, 14, 15)

People 75 years and older account for 6.9% percent of the Canadian population, yet this age group accounts for 35% of all hospitalizations in Canada.(16) Several provinces, like Ontario, are creating strategies to reduce potential avoidable hospitalizations for seniors, with the goal of helping to control overall health costs.(17, 18) Ontario's Avoidable Hospitalization Advisory Panel described proactive programs that reduce adverse drug effects in long term care will reduce falls leading to hospitalization.(17) Other potential areas for intervention have been identified through assessment of chronic medical conditions that are commonly associated with avoidable hospitalizations. Examples of conditions include: chronic heart failure, diabetes, and chronic obstructive diseases.(17, 19, 20) In addition to the medical conditions, many avoidable hospitalizations can be attributable to adverse drug reactions associated with the medications used to treat these conditions.(21-23)

1.2 Diabetes Research in Residential Care Facilities

Of the medical conditions commonly associated with potentially avoidable hospitalizations in seniors, diabetes was identified as an important disease state to focus on for a number of reasons. First, diabetes is highly prevalent in seniors, with over 25% of those over the age of 75 diagnosed with diabetes.(24) As seniors become more frail, or require more care and move into residential care facilities, diabetes prevalence climbs to 33%.(25-28) In addition to the high prevalence of diagnosed diabetes, there is great concern that many seniors may be living with undiagnosed or undetected diabetes. Indeed, some reports suggest 1 in 5 residents of care homes live with undiagnosed diabetes and as many as 1 in 2 people with diabetes are undiagnosed.(28-30)

The second reason for focussing on diabetes in seniors is the lack of clear and consistent management guidelines. In 2010, Canadian Agency for Drugs Technology in Health (CADTH)

prepared a report on management of diabetes in long term care, finding only one guideline available with limited evidence based recommendations.(31)

In Canada, the Canadian Diabetes Association guidelines include a chapter on diabetes in the elderly, which provide directions for diagnosis, reducing the risk of developing diabetes, management (glycemic control, nutrition and physical activity, oral anti-hyperglycemia agents, insulin), and the prevention of complications (hypertension, dyslipidemia, erectile dysfunction).(32) In this chapter there is a short comment on diabetes in nursing homes, commenting that diabetes is often undiagnosed in nursing home residents.(32) Undiagnosed diabetes is very concerning due to the high prevalence of diabetes in residential care facilities and the burden of macrovascular and microvascular complications associated with this disease, as well as other comorbidities.(26) The Canadian Diabetes Association guidelines recognize compliance is poor in institutions, insulin sliding scales are frequently used and that intervention studies appear sparse.(32)

Since the CADTH rapid response review in 2010, guidelines from different international organizations have been developed to address management of diabetes in older aged adults and long term care/residential care facilities.(29, 33-36) Guidelines for diabetes in long term care include recommendations on policy requirements, care planning, screening and clinical management [Table 2], however, there is inconsistency on areas of recommendations and recommendations are largely based on consensus level evidence.

The third reason for focussing on diabetes in residential care facilities is a result of conversations with administrative operators of Edmonton-based residential care facilities. These administrators have observed that residential care facilities are often not equipped with policies and procedures

for diabetes management in general, or in special circumstances like acute illness. In the absence of policies and procedures, management practices in these facilities are often inconsistent.(37, 38) Facility administrators are also highly interested in diabetes management for seniors as a method that provincial governments determine funding for facilities include funding based on the complexity of the individual.(39, 40)

Seniors in residential care facilities with diabetes require additional care to monitor blood glucose, monitor for complications (for example, routine monitoring for diabetic foot complications), and respond to hypoglycemic or hyperglycemic events. Perhaps more importantly, administrators voiced concerns that they may not be aware of all the residents with diabetes because some may be living with undetected or undiagnosed diabetes. Both known and undiagnosed diabetes presents a greater risk of hospitalization and turnover at the facility, which would incur administrative, nursing and vacancy costs to the facility. Management of people with undiagnosed diabetes has been shown to cost $5,190 per person to the overall healthcare system compared to $680 per person with pre-diabetes.(41)

As a result of discussions with administrators of Edmonton-based residential care facilities and a review of guideline recommendations for screening, one important area of need is the identification of seniors living with undetected elevated blood glucose. Studies from the early 2000s reported that 7% of long term care or nursing home residents were living with undiagnosed diabetes.(42, 43) This proportion, accounting for 30% of all people with diabetes in these facilities, is consistent with wider population-based studies reporting that 1 in 3 people with diabetes are undiagnosed.(44, 45) There is, however, a lack of information on prevalence of undiagnosed diabetes in the subgroup of seniors in assisted living and senior independent living facilities.(43) Special task groups and clinical guidelines for diabetes in residential care facilities

have suggested the current prevalence of undiagnosed diabetes is closer to 1 in 5 and consistently recommend screening seniors for diabetes on admission to the facility.(29, 30, 35, 36)

Although there is general consistency among guidelines that screening should be conducted on admission to a care facility, there is little guidance on how seniors should be screened. Two guidelines specify the screening process to use. The McKellar Guidelines for Managing Older People with Diabetes in Residential and Other Care Settings recommend using a shortened version of Australian type 2 diabetes risk assessment tool (AUSD Risk tool) to triage high risk then complete a blood glucose sample.(35, 46) The Task and Finnish Group (TAFG)-UK recommends either an A1c test or a fasting glucose with an isolated 2h post prandial blood glucose test on admission.(34)

While using a fasting blood glucose or an A1c test may appear to be the most accepted method to screen for diabetes, laboratory testing can be challenging in residential care facilities, specifically assisted living facilities and congregate living where seniors are expected to have more mobility and home collections is not always automatically accessible. There are barriers to blood glucose testing using FPG, OGTT or A1c to screen for undiagnosed diabetes in residential care facilities, including restricted ability to visit a lab, coordination of homecare collection for laboratory samples, skilled staffing requirements to collect samples, and scope of practise or regulatory barriers. In recent years, non-invasive measures of diabetes risk have emerged.(47, 48) These surveys have been validated in different countries and used to identify risk of developing diabetes over a predetermined time period.(46-49) These studies have demonstrated that the diabetes risk surveys have acceptable abilities to identify people with elevated blood glucose and subsequently direct further diabetes screening.(50, 51)

In Canada, two screening tools have been endorsed, the Canadian Diabetes Risk Questionnaire (CANRISK) by the Public Health Agency of Canada and the Finnish Diabetes Risk Score (FINDRISC) by the Canadian Task Force on Preventative Health Care.(52, 53) Despite the potential advantages of these diabetes risk surveys, they have only been validated in community dwelling adults up to the age of 74 years. The CANRISK survey is recommended for population based screening in those ages 45-74, while the Canadian Task Force for Health recommends the FINDRISC tool in those greater than 18 without an upper age limit.(47, 54) Of particular relevance to residents of residential care facilities, no study has evaluated the effectiveness of either the CANRISK or FINDRISC survey in people over the age of 74 or in residents of residential care facilities.

1.3 Allied Health Professional Management

There is a substantial amount of evidence to support the involvement of pharmacists and nurses in chronic disease management.(55-58) In ambulatory and hospital settings, adding pharmacists to the medical team has led to significant benefits to clinical outcomes in chronic disease management, such as atrial fibrillation, hypertension, hyperlipidemia and diabetes.(58-61) Indeed, pharmacist- and nurse practitioner-led diabetes management programs in various settings have had a significant impact on blood glucose, blood pressure, and cholesterol management as well as beneficial effects on other health outcomes.(62-67) Collectively, the results of these studies are encouraging and support the addition of pharmacists and nurse practitioners to primary care and ambulatory care teams. However, it is unclear if the benefits observed and the path to better diabetes related outcomes in these settings can be translated to diabetes management in residential care facilities.

Governments and administrators of residential care facilities are recognizing the growing need for structural changes to support chronic disease management.(16, 68, 69) An integral part of this evolving need is the development of multidisciplinary teams by shifting the role of pharmacists and nurses in residential care facilities.(70-72) Although pharmacists and nurses have been involved in the care of seniors for years, traditional pharmacy services have included monitoring for formulary compliance, quarterly drug regimen reviews, and review of prescriptions for appropriateness.(73) Over the last decade, the pharmacists' role has evolved to a more proactive focus on medication management and health outcomes.(70, 72-75) These changes have been supported by important policy and regulatory changes affecting healthcare practice. For example, changes to the Health Professions Act and regulations to pharmacy practice in Alberta have given pharmacists the ability to initiate pharmacotherapy for chronic disease management.(76, 77) As health professional roles evolve, other practice tools, such as electronic health records, have also evolved. In Alberta, electronic health records continue to be implemented at a provincial level while point of care and electronic medication administration record (eMAR) technology use at the home level continues to increase. Although pharmacists and nurse practitioners are now able to access required labs and vitals, it is not clear how this improved access will impact on patient care.(78)

As more government investment is put into funding new assisted living and the role of pharmacists and nurses in assisted living facilities continues to evolve to more proactive clinical management, it will be important to integrate evidence-based practice and interventions.(79, 80) Existing evidence of advanced practise nurse involvement in long term care settings have been summarized in systematic reviews.(81-83) However, similar reviews of studies examining the effects of pharmacist involvement in long term care or assisted living facilities have not been

reported. Although there are differences in the staffing model and care requirements in assisted living facilities compared to long term care facilities, there are many similarities that allow for multidisciplinary practise in these environments. Furthermore, it would seem appropriate that evidence from one setting can be generalized to the other because both assisted living and long term care fall under the same continuing care standards in Alberta,.(84) Therefore, a review of pharmacist involvement in diabetes management in residential care facilities is greatly needed.

In summary, pharmacists and nurse practitioners are situated in ideal positions to lead diabetes management in residential care facilities and benefit the residents. These healthcare professionals are already in these settings, the major change will be a shift in the role played – evolving from a reactionary, monitor for medication regulations - to more proactive disease management. However, to facilitate implementation of diabetes disease state management there is only descriptive evidence of diabetes management in residential care facilities and expanding guidelines on diabetes care in long term care are relatively new. Debate on appropriate glycemic control strategies and other priorities and complexities of long term care create a barrier to development of an effective program. Implementation of a disease state program requires an understanding of what are effective interventions and what are the appropriate procedures for different situations. Pharmacists and nurses need to understand what tools and process will provide the largest impact for their efforts.

1.4 Objective

The purpose of this thesis is to develop the foundational program blocks to facilitate creation of a pharmacist led diabetes management program in residential care facilities. Two projects were conducted to assist in development of the process of care.

The first project aimed to determine if a simple screening questionnaire was effective in identifying people with unrecognized diabetes in residential aged care facilities. This project was a cross sectional study conducted in 10 assisted living facilities in Edmonton to measure the effectiveness of the CANRISK and FINDRISC surveys to identify seniors with elevated A1c.

The second project identified evidence-based interventions by pharmacists and nurses to improve diabetes management in residents of aged care facilities. This project was a systematic review of clinical trials that have already been completed in residential care facilities.

Table 1.1 Provincial Nomenclature for Residential Care Facilities

Province	Continuing Care	Assisted/Supportive	Long Term Care
BC	Continuing Care	Assisted Living	Residential Care
AB	Continuing Care	Supportive Living	Long Term Care
SK	Home and Community Care	Personal Care Home	Special Care Home
MN	Continuing Care	Supportive Housing	Personal Care Home/Nursing Home
ON	Home, Community and Residential Care	Retirement Homes	Long Term Care
NB	Long Term Care	Special Care Homes	Nursing Home/Community Residences
PEI	Community Care Facilities and Nursing Homes	Private Nursing Homes	Long Term Care
NS	Continuing Care	Residential Care Facilities	Nursing Homes/Homes for the Aged
NL	Long Term Care	Personal Care Home/Community Care	Nursing Homes
QC	Long Term and Residential Care Centre	Residential Care Centre	Long Term Care Centre

Table 1.2 Recommendations for Diabetes Management in the Elderly from Clinical Practice Guidelines

Organization	Year	Country	Subject	Screening	Medication Therapeutics	Sliding Scale Insulin	Blood Glucose Monitoring	End Of Life	Treatment Target	Acute Hypo/ Hyperglycemia Management	Complication Management	Management in Nursing Homes	Careplans	Policy and Procedures	Education of Staff	Transition of Care	Quality Assurance Audit
American Diabetes Association (ADA) (33)	2016	United States	Diabetes in Residential/Long Term Care	No	Yes	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	Yes
American Medical Directors Association (AMDA)(85)	2015	United States	Diabetes in Residential/Long Term Care	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	No
Task and Finnish Group of Diabetes UK (TFGD-UK) (34)	2011	Finish/UK	Diabetes in Residential/Long Term Care	Yes	Yes	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes
The Mckellar Guidelines (35)	2014	Australia	Diabetes in Residential/Long Term Care	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
Diabetes Care Program of Nova Scotia (DCPNS) and Palliative and Therapeutic Harmonization (PATH) Program (86)	2013	Canada	Diabetes Guidelines for the Frail Elderly in Long Term Care	No	Yes	No	Yes	No	Yes	Yes	No	Yes	Yes	No	No	No	No
American Geriatric Society (AGS) (87)	2013	United States	Diabetes in Older Adults	No	Yes	Yes	Yes	No	Yes	No	Yes	No	No	No	No	No	No
IAGG and EDWPOP (30)	2012	Europe	Diabetes in Older Adults	No	Yes	No	No	No	Yes	Yes	No	Yes	No	Yes	Yes	No	No
International Diabetes Federation (IDF) (29)	2013	Inter-national	Diabetes in Older Adults	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Canadian Diabetes Association (CDA) S184-190 (32)	2013	Canada	Diabetes	No	Yes	Yes	No	No	Yes	No	Yes	Yes	No	No	No	No	No

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Chapter 2. CROSS SECTIONAL STUDY

Limited Effectiveness of Diabetes Risk Assessment Tools in Seniors Facility Residents

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Abstract

BACKGROUND: Undiagnosed diabetes can create significant care gaps and risks of hypo and hyperglycemia for our seniors. This study evaluated the effectiveness of two diabetes risk surveys to identify elevated glucose levels in seniors.

METHODS: Cross-sectional study conducted in seniors living facilities in Edmonton, Alberta, Canada. Those with known diabetes, without capacity, considered frail, or unable to communicate in English were excluded. Participants completed the Canadian Diabetes Risk Assessment Questionnaire (CANRISK) and Finnish Type 2 Diabetes Risk Score (FINDRISC) and had their A1c measured. Correlation between seniors identified as elevated risk on the surveys and also having an A1C ≥6.5% (or an A1c ≥6.0%) was assessed.

RESULTS: A total of 290 residents participated; mean age was 84.3 (SD 7.3) years, 82 (28%) were men, mean A1c was 5.7% (SD 0.4). Mean CANRISK score was 29.4 (SD 8.0) (range 0-93). Of the 254 (88%) considered moderate or high risk, 10 (4%) had an A1c≥6.5 and 49 (19%) had an A1c≥6.0%. Mean FINDRISC score was 10.8 (SD 4.2) (range 0-26). Of the 58 (20%) considered high or very high risk, 4 (7%) had an A1c≥6.5% and 15 (26%) had an A1c≥6.0%. The surveys were weakly correlated with A1c (CANRISK: r=0.13; p=0.031 and FINDRISC: r=0.12; p=0.035). The area under the receiver operating characteristic curve was 0.57 (95% CI 0.42-0.72) for the CANRISK survey identifying participants with an A1c≥6.5% and 0.59 (95% CI 0.51-0.67) for identifying A1c≥6.0%. Similar characteristics were observed for the FINDRISC survey.

CONCLUSION: In this group of seniors with no known history of diabetes, mean A1c approximated the general population and neither survey effectively identified those with elevated

blood glucose. These findings should be confirmed in a larger study; however, routine use of these surveys as a diabetes screening strategy does not appear to be warranted at this time.

2.1 Background

Diabetes is a chronic disease that significantly increases the risk of morbidity (complications to the eyes, kidneys, nerves, and heart) and mortality.(1, 2) This disease places a significant burden on the individual as well as the health care system, costing an average of $6,700 US per person with diabetes to manage the diabetes and its complications in 2015.(3) Currently, the prevalence of diagnosed diabetes is estimated to be 9% and by 2020, it is expected to reach 12%.(3, 4) As diabetes is chronic in nature, it is not surprising that prevalence increases with age, with population-based studies reporting 20-25% of people aged 65 years and older having diabetes.(4-6) In residential care facilities, diabetes prevalence approaches 1 in 3 residents.(7-9)

While the high rate of diagnosed diabetes in our senior population is concerning, there are indications this is an underestimation of the true prevalence. When population-based studies have included the consideration of blood glucose levels, it appears that 1 in 3 people are living with unrecognized or undiagnosed diabetes(4, 10, 11). Undetected diabetes in seniors can have serious implications for management because of the higher risk of falls, urinary incontinence, and hospitalizations associated with this disease.(1, 11-15) Furthermore, the economic burden associated with a case of undetected diabetes is estimated to be 8 times that of a person with pre-diabetes.(16) Concern regarding undetected diabetes in seniors is illustrated in guidelines and position statements from Australia, United States, United Kingdom and the International Diabetes Federation that recommend screening for diabetes on admission to care homes.(17-20). Despite the recommendation to screen guidelines are inconsistent in the process to follow with one recommending blood glucose testing, another using a screening questionnaire and the other two unspecified.

Although testing blood glucose levels is considered the gold standard for identifying

diabetes,(21) coordinating seniors' care to obtain blood samples can be challenging. A simple, non-invasive method to evaluate an individual's diabetes risk and prioritize for additional screening is needed. Indeed, some organizations recommend using a self-administered survey identifying risk factors for diabetes to measure a patients' level of overall diabetes risk and guide further assessment.(17, 21, 22) Of the many diabetes risk scores that have been developed, the Finnish Type 2 Diabetes Risk Score (FINDRISC) questionnaire is perhaps the most widely recognized internationally.(23, 24) However, the FINDRISC was developed in a predominantly Caucasian population and its applicability in an ethnically diverse population has been questioned. The Canadian Diabetes Risk Assessment Questionnaire (CANRISK) was developed by adapting the FINDRISC to include consideration of ethnicity and other variables, such as sex and gestational diabetes.(25) Both surveys utilize a scoring system with different risk categories to assist people in determining their risk of diabetes and whether follow up is required (Table 2.1). (24, 26)

Although both surveys have been tested in community-dwelling adults ≤78 years of age and shown to have acceptable levels of discrimination (c-statistic 0.69-0.85) to identify people with elevated blood glucose, their utility in seniors residing in facilities, is uncertain.(24, 26-28) In contrast to community-dwelling seniors, those living in facilities have unique characteristics that may impact perceived risk. For example, seniors living in residential care facilities have a 3-fold higher need for physical assistance for daily living activities (personal hygiene, toilet use, locomotion, eating), 3-4 fold higher prevalence of cognitive problems, and significantly more residents take 9 or more medications compared to community-dwelling seniors.(29)

With these issues in mind, the purpose of this study was to evaluate the effectiveness of the CANRISK and FINDRISC surveys as screening tools to identify elevated blood glucose levels in

residents of senior living facilities.

2.2 Methods

2.2.1 Setting

This cross-sectional study was conducted in 10 seniors' facilities comprised of independent senior lodges and multi-care senior assisted living/retirement facilities within Edmonton, Alberta, Canada. Residents of independent facilities are given a minimal level of nursing support and are responsible for their own healthcare, meals, and daily activities. Assisted living/retirement facilities with nurse assisted residents only and long term care facilities were excluded.

The University of Alberta Research Ethics Board approved the conduct of this study and all participants provided informed, written consent. In addition, the Alberta Health Services Continuing Care Research Committee and administrative leadership at each facility reviewed the study protocol and approved implementation of the study.

2.2.2 Study Population

All residents aged 55 years and older with no known history of dementia were eligible for participation. Residents were excluded if they had a known history of pre-diabetes or diabetes, were currently using antidiabetic medications, were unable to communicate in English, did not have capacity to sign their own consent, or were considered frail (Clinical Frailty Scale ≥7).(30) Residents were initially identified with these conditions based on the facility residents listing with each condition with a second screening question asked of the resident on recruitment. The remaining residents were contacted by mail distribution and in person follow up with in each of the facilities by the research assistants. Research assistants attempted to contact the residents on

the facility's scheduled days.

2.2.3 Instruments and Measurements

Participants completed a questionnaire and also had their A1c measured. The questionnaire contained questions from the CANRISK and FINDRISC surveys to gather information on diabetes risk (Figure 2.1).(24, 25) The CANRISK groups respondents into 3 risk categories, low (scores 0-20), moderate (scores 21-32) and high (scores 33-91) (Table 2.1).(26) The Canadian Task Force groups respondents to the FINDRISC survey into 3 risk categories, low to moderate (scores 0-15), high (scores 16-20) and very high (scores 21-26) where 10 year risk of diabetes development is 1-17%, 33% and 50% respectively.(26, 31) A research assistant was available if the participants needed help interpreting a question. Since these surveys have overlapping items (age, body mass index, waist circumference, physical activity, dietary consumption of fruits and vegetables, use of antihypertensive medications, history of high blood glucose and family history of diabetes) we adjusted the response options to facilitate calculation of both CANRISK and FINDRISC scores. For example, when asked about family history of diabetes, FINDRISC response options are: grandparent, aunt, uncle, first cousin / parent, brother, sister, child / No; while the CANRISK response options are: Mother / Father / Brother or Sister / Child / Other / No. The response options for our survey were: Mother / Father / Brother or Sister/ Children / Grandparent or Uncle or Aunt or 1st Cousin / None. In addition to the common items, the CANRISK survey also gathers information about having gestational diabetes, giving birth to a macrosomic baby, education level, and ethnicity. (Table 2.1)(25)

After the survey was completed, a trained research assistant obtained a blood sample to measure the participant's A1c. The A1c was measured using the DCA Vantage™ (Siemens, Tarrytown, NY, USA), which is a National Glycohemoglobin Standardization Program (NGSP) certified

point-of-care device.(32) The DCA Vantage™ was calibrated and maintained performance based on manufacturer specifications.(33)

2.2.4 Statistical Analysis

Characteristics of the participants were summarized using mean and standard deviation for continuous variables and counts and proportions for categorical variables. Differences between participants with an A1c below or above 6.0% were compared using Student's t-test for continuous variables and Chi-square for categorical variables. Correlation between survey score and A1c was measured using the Pearson correlation coefficient. The 2013 Canadian Diabetes Association clinical practice guidelines were used to define categories elevated blood glucose (A1c ≥6.0%), and diabetes (A1c ≥6.5%).(34) The CANRISK categories of medium or high risk and the FINDRSIC categories of high or very high risk were then evaluated for the ability to identify seniors with an A1c≥6.0% and A1c≥6.5% using the area under the receiver operating characteristic (AUCROC c-statistic) curve method and likelihood ratio.(35, 36)

Performance of the CANRISK and FINDRISC survey was also evaluated in three pre-planned secondary analyses. First, we used the American Diabetes Association threshold for pre-diabetes (A1c≥5.7%) to identify participants with elevated blood glucose.(37) Second, we evaluated the ability to identify people with an A1c≥6.0% in age-stratified subgroups. We stratified participants into those above and below 78 years of age because previous validation studies of these surveys have enrolled participants aged ≤65 and 65-78 years.(26, 27, 38-40) Third, we repeated the stratified analysis by separating participants according to sex.

Stata v.13.1 (Stata Corp College Station, Tx, USA) was used to complete all statistical analyses.

2.3 Results

2.3.1 Patient Characteristics

There were 1,800 residents in the 10 facilities and we identified 1,081 residents who were eligible to participate. From this group, 372 (35%) were not available when study staff visited the facility, 399 (37%) declined the invitation to participate, and 310 (29%) consented to participate in the study (Figure 2.2). We collected 309 completed surveys and 290 of these participants also had their A1c measured. Of the 20 (6%) people who did not complete the survey or provide a blood sample for the A1c measurement, 2 died, 3 were in hospital, 4 were not available, 1 moved out of the facility and 10 declined having their A1c measured. We found no statistically significant differences in age or sex between the group who completed the study and those who did not provide complete information.

There were 54 (19%) participants with an elevated glucose (A1c≥6.0%) and 10 (4%) had an A1c that was above the CDA threshold for diabetes (≥6.5%).(34) There were no significant differences in patient characteristics between those with an A1c above or below 6.0% (Table 2.2). Overall, the mean age was 84.3 (SD 7.3) with 244 (87.2%) ≥79 years old, 82 (28.3%) were men, and 284 (97.3%) were Caucasian. Smokers accounted for 3.9% (11) of the sample, the mean body mass index was 25.8 (SD 5.1) and 164 (56%) had some high school or a high school diploma (Table 2.2).

2.3.2 Survey Performance

The CANRISK scores ranged from 14 to 56, with a mean of 29 (SD 8) (Figure 2.3). Based on the CANRISK categories, 36 (12%) were Low Risk, 167 (58%) were Medium Risk, and 87 (30%) were High Risk. Among the 36 low risk participants, none had an A1c ≥6.5% and 5 (9%) had an A1c ≥6.0%. Of the 254 participants categorized as moderate or high risk, 10 (4%) had an

A1c≥6.5% and 49 (19%) had an A1c ≥6.0% (Table 2.3). The CANRISK survey scores were weakly correlated with A1c values (r=0.13; p=0.031) (Figure 2.3). The AUROC curve for CANRISK scores in the moderate or high risk categories was 0.59 (95% CI 0.51-0.67) for identifying an A1c ≥6.0% and was 0.57 (95% CI 0.42-0.72) for identifying an A1c ≥6.5% (Figure 2.4). The likelihood ratio for a CANRISK score in the moderate or high risk categories identifying someone with an elevated A1c was 1.04 and 1.78 respectively.

Similar results were observed for the FINDRISC survey. The FINDRISC scores ranged from 3 to 23, with a mean of 10.8 (SD 8) (Figure 2.5). Based on the FINDRISC categories, 232 (80%) were low-moderate risk, 54 (19%) were High Risk, and 4 (1%) were Very High Risk. Overall, 6 (3%) of the 232 participants in the low to moderate risk category had an A1c ≥6.5% and 39 (17%) had an A1c ≥6.0%. Among the 58 participants categorized as high or very high risk, 4 (7%) had an A1c ≥6.5% and 15 (26%) had an A1c ≥6.0% (Table 2.3). The FINDRISC survey scores were weakly correlated with A1c values (r=0.12; p=0.035) (Figure 2.5). The AUROC curve for FINDRISK scores in the high or very high risk categories was 0.57 (95% CI 0.48-0.66) for identifying an A1c ≥6.0% and was 0.60 (95% CI 0.43-0.77) for identifying an A1c ≥6.5% (Figure 2.6). The likelihood ratio for a FINDRISC score in the high or very high risk categories identifying someone with an elevated A1C was 1.52.

2.3.3 Secondary Analyses

Using the American Diabetes Association threshold of A1c ≥5.7%, we identified 141 (48%) people with elevated blood glucose (Table 2.3). The AUCROC curve for CANRISK scores in the moderate or high risk categories to identify these individuals was 0.56 (95% CI 0.49-0.62). Similarly, the AUCROC curve for FINDRISC scores in the high or very high risk categories to identify these individuals was 0.52 (95% CI 0.46-0.59).

Ability of the CANRISK survey to identify people with elevated blood glucose (A1c ≥6.0%) was similar when we stratified our analysis based by age (Table 2.3). The AUCROC curve was 0.62 (95% CI 0.38-0.87) in the 46 people who were ≤78 years old and 0.58 (95% CI 0.49-0.67) in the 244 people who were 79 years of age or older. Stratification by age resulted in similar observations for the FINDRISC survey to identify people with elevated blood glucose (A1c ≥6.0%). The AUCROC curve for FINDRISC scores in the high or very high risk categories was 0.54 (95% CI 0.22-0.86) in the 46 people who were ≤78 years old and 0.58 (95% CI 0.48-0.67) in the 244 people who were 79 years of age or older.

The CANRISK survey also appeared to have a similar ability to identify elevated blood glucose in women and men. The AUCROC curve in women was 0.59 (95% CI 0.48-0.67) and 0.58 (95% CI 0.40-0.72) in men. Stratification by sex produced similar observations for the FINDRISC survey, the AUCROC curve in women was 0.56 (95% CI 0.45-0.65) and 0.57 (95% CI 0.41-0.73) in men.

2.4 Discussion

This study examined the effectiveness of 2 self-administered diabetes risk surveys in residents of seniors living facilities with no known history of diabetes. The majority of participants had an A1c below 6%, which is consistent with population averages, and only 3% had an A1c above the CDA definition for diabetes (≥6.5%).(41) Although we observed a statistically significant correlation between A1c and both CANRISK and FINDRISC scores, the clinical utility of the measures in this population is extremely low, with both performing only marginally better than chance at identifying residents with elevated A1c.

Our findings are not consistent with previous observations that the CANRISK and FINDRISK

surveys perform reasonably well at identifying patients with elevated blood glucose (AUCROC curves ranging from 0.69 to 0.85).(24, 26, 27, 39) We believe there are four possible explanations for this difference. First, our study enrolled an older group of participants, with 84% of our group aged 79 years or older, while all previous studies enrolled people ≤78 years of age.(24, 26, 27, 39) Performance of the surveys in this age group was therefore previously unmeasured and unknown. Second, participants in our study had fewer diabetes risk factors compared to previous studies. For example, the mean BMI in our study group was 25.8 (±5.1) kg/m^2 whereas the mean BMI in other studies was 28.8 (±4.6) kg/m^2 or higher.(27, 39, 40) In addition, more participants in our study exercised regularly and ate fruits and vegetables daily compared to other study groups.(40) Third, prevalence of elevated blood glucose was lower in our study group (19%) compared to others (29% to 44%).(27, 39, 40) Fourth, we used A1c as a reference measure, while previous studies measured survey performance against development of diabetes in the next 10 years or an oral glucose tolerance test.(24, 26, 39) There are some concerns that A1c may not accurately identify elevated blood glucose in the elderly as compared to other blood glucose tests, like an oral glucose tolerance test (OGTT) or fasting blood glucose. For example, previous studies have shown A1c will identify less people with diabetes in comparison to OGTT. (39, 42)

Our observation that a small (<5%) proportion of participants had an A1c ≥6.5% would suggest the prevalence of undiagnosed diabetes in this seniors' population is much lower than expected from other population-based studies.(5, 11, 12) Furthermore, the observed A1c range in this group of seniors without diagnosed or treated diabetes was 4.7% to 7.5%. As the 2013 CDA clinical practice guidelines recommend treating seniors to an A1c target of 7.1% to 8.5%, it is unlikely that any of the participants in our study would require medical intervention to manage

blood glucose levels.(43) These observations would suggest that the prevalence of undetected diabetes may be lower in seniors compared to younger age groups.(4, 10) In combination with the poor discrimination performance, it appears that neither risk survey provides clinically important information in this age group. In addition, the administrative burden of administering and interpreting this questionnaire would further diminish utility of these risk surveys.

2.4.1 Limitations

Our observations should be considered in light of several important limitations. First, the FINDRISC questionnaire was originally designed to assess the risk of developing diabetes over a 10 year period.(24) However, recent validation studies of the FINDRISC and CANRISK questionnaires have been conducted to evaluate effectiveness of survey risk scores to identify elevated blood glucose levels, as we did in this study.(26, 27, 39) Second, our study used A1c measured using a point-of-care device. Although there are concerns regarding accuracy of A1c identifying elevated blood glucose compared to other measures in seniors, we used a device that is certified by the National Glycohemoglobin Standardization Program and recognized by the CDA as a valid diagnostic tool.(32, 34) In addition, we used the lower ADA A1c threshold to identify elevated blood glucose and found the surveys had comparable discrimination.(37) Third, our sample represented 27% of the total eligible population living in the facilities; therefore, representativeness may be a concern. However, the average age of our sample was consistent with the average age (84 vs 84) and BMI (26 vs 26) found in the Alberta designated assisted living program, suggesting participants in our study were representative of residents of the Alberta seniors living facilities as a whole but applicability of these findings to individuals aged 79 years and older living in other environments is unknown.(44) Fourth, our observations are based on a convenience sample of individuals who agreed to participate. Our observations may

be subject to volunteer bias as we are unable to compare characteristics of those who accepted our invitation to participate with the larger proportion who declined.

2.5 Conclusion

In this group of 290 seniors living in facilities with no known history of diabetes, mean A1c approximated the general population. Although there were significant, positive correlations between the surveys and A1c, neither screening tool effectively identified elevated blood glucose levels. Our unexpectedly low elevated hyperglycemia observations should be confirmed in a subsequent study with a larger sample size; however, routine use of these surveys as a diabetes screening strategy in seniors' facility residents does not appear to be warranted at this time.

Table 2.1 CANRISK and FINDRISC Comparison Table

VARIABLE	FINDRISC Response Categories (CTFPHC, 2012)*	CANRISK Response Categories (PHAC, 2011)**
Age	18-44 / 45-54 / 55-64 / ≥65	40-44 / 45-54 / 55-64 / 65-74
BMI	<25 / 25-29.9 / ≥30	<25 / 25-29 / 30-34 / ≥35
Waist Circumference (cm)	Women <80 / 80-88 / >88 Men <94 / 94-102 / >102	Women <80 / 80-88 / >88 Men <94 / 94-102 / >102
Physical Activity >30 minutes daily	Yes / No	Yes / No
Eat vegetables and fruits daily	Yes / No	Yes / No
History of high blood pressure	Taken medication for high blood pressure on a regular basis? Yes / No	Told by a doctor or nurse you have high blood pressure OR taken high blood pressure pills? Yes / No or don't know
History of high blood glucose	Yes / No	Yes / No or don't know
Family History of Diabetes	Grandparent, aunt, uncle, first cousin / Parent, brother, sister, child / No	Mother / Father / Brother or Sister / Child / Other / No or don't know
Sex		Female / Male
Birth to a large baby (>4.1 kg)		Yes / No
Parents' Ethnic Group		White / Aboriginal / Black / East Asian / South Asian / Other non-white
Highest level of education		Some high school or less / High school diploma / Some college or university / University or college degree
Minimum Score	0	0
Maximum Score	26	93
Low Risk Score	0-11	0-20
Moderate Risk Score	12-14	21-32
High Risk Score	15-20	>33
Very High Risk Score	>21	

*CTFPHC: Canadian Task Force for Preventative Health Care

**PHAC: Public Health Agency of Canada

Table 2.2 Participant Characteristics according to A1c*

	All	**A1c<6.0%**	**A1c≥6.0%**	**p-value**
	(n=290)	**(n=236)**	**(n=54)**	
Age, years	84.3 (±7.3)	83.9 (±7.5)	86.2 (±6.6)	0.21
Age Categories, n (%)				0.33
55-64 years	11 (3.9)	10 (4.2)	1 (1.9)	
65-78 years	35 (12.5)	31 (13.1)	4 (7.4)	
≥74 years	244 (84.1)	195 (82.6)	49 (90.1)	
Men, n (%)	82 (28.3)	65 (27.5)	17 (31.5)	
BMI, kg/m^2	25.8 (±5.1)	25.5 (±4.9)	26.9 (±6.0)	0.75
A1c, %	5.7 (±0.4)	5.6 (±0.2)	6.2 (±0.3)	<0.01
Smoker, n (%)	11 (3.9)	10 (4.2)	1 (1.9)	0.41
Ethnicity, n (%)				0.55
Caucasian	284 (97.9)	232 (98.3)	52 (96.3)	
Aboriginal	1 (0.3)	1 (0.4)	0	
East Asian	2 (0.7)	1 (0.4)	1 (1.9)	
South Asian	2 (0.7)	1 (0.4)	1 (1.9)	
Other	1 (0.3)	1 (0.4)	0	
Education, n (%)				0.40
Some High School or less	90 (31.0)	70 (29.7)	20 (37.0)	
High School Diploma	74 (25.5)	61 (25.8)	13 (24.1)	
Some College/University	47 (16.2)	42 (17.8)	5 (9.3)	
College/University Degree	79 (27.2)	63 (26.7)	16 (29.6)	

*Data are reported as mean (standard deviation) unless otherwise specified

Table 2.3 Participants According to Diabetes Risk Score Category and A1c

Survey	Risk Category (Scores)	Group, n	A1c≥5.7% n (%)	A1c≥6.0% n (%)	A1c≥6.5% n (%)
CANRISK	Low (0-20)	All, 36	12 (33)	5 (14)	0
		≤78 years old, 6		0	
		>78 years old, 30		5 (16)	
		Men, 0		0	
		Women, 36		5 (14)	
	Moderate (21-32)	All, 167	84 (50)	26 (16)	6 (4)
		≤78 years old, 30		3 (10)	
		>78 years old, 137		23 (17)	
		Men, 44		6 (14)	
		Women, 123		20 (16)	
	High (≥33)	All, 87	45 (52)	23 (26)	4 (5)
		≤78 years old, 10		2 (20)	
		>78 years old, 77		21 (27)	
		Men, 38		11 (29)	
		Women, 49		12 (24)	
FINDRISC	Low to Moderate (0-15)	All, 232	110 (47)	39 (17)	6 (3)
		≤78 years old, 34		3 (9)	
		>78 years old, 198		36 (18)	
		Men, 71		12 (17)	
		Women, 161		27 (17)	
	High (16-20)	All, 54	29 (54)	14 (26)	4 (7)
		≤78 years old, 12		2 (17)	
		>78 years old, 42		12 (29)	
		Men, 11		5 (45)	
		Women, 43		9 (21)	
	Very High (≥21)	All, 4	2 (50)	1 (25)	0
		≤78 years old, 0		0	
		>78 years old, 4		1 (25)	
		Men, 0		0	
		Women, 4		1 (25)	

Figure 2.1 Adapted CANRISK Survey

Date Completed:	**Participant:**
Study ID: ___ ___ - ___ ___ ___	**Facility:**
	Regular Family Physician:

Remove after data collection and entry verification is completed

CANRISK Survey (2011)

Adapted from: http://www.pharmacists.ca/cpha-ca/assets/File/education-practice-resources/DiabetesCANRISKstandardEN.pdf

Question	Score	Question	Score
1. Select your age group: (Age:_____ or YOB:19__) ☐ 40-44 years — 0 points ☐ 45-54 years — 7 points ☐ 55-64 years — 13 points ☐ ≥65 years — 15 points		**7. Have you ever been told by a doctor or nurse that you have high blood pressure OR have you ever taken high blood pressure pills?** ☐ Yes — 4 points ☐ No — 0 points	
2. Are you male or female? ☐ Male — 6 points ☐ Female — 0 points		**8. Have you ever been found to have a high blood sugar either from a blood test, during an illness, or during pregnancy?** ☐ Yes — 14 points ☐ No or don't know — 0 points	
3. How tall are you and how much to you weigh? **Height:_____ Weight:_____** **Calculated BMI:_____ (kg/m²)** ☐ BMI < 25 — 0 points ☐ BMI 25 to 29 — 4 points ☐ BMI 30 to 34 — 9 points ☐ BMI ≥35 — 14 points **Ht Source**: ☐ Chart ☐ Measured ☐ Asked ☐ Estimated **Wt Source**: ☐ Chart ☐ Measured ☐ Asked ☐ Estimated		**9. Have you ever given birth to a large baby weighing 4.1 kg (9 pounds) or more?** ☐ Yes — 1 point ☐ No, don't know, or not applicable — 0 points	
Waist Circumference:_____ ☐ cm ☐ inches **4a. Men – Waist Circumference** ☐ < 94 cm or 37 inches — 0 points ☐ 94-102 cm or 37-40 inches — 4 points ☐ >102 cm or 40 inches — 6 points **4b. Women – Waist Circumference** ☐ < 80 cm or 31.5 inches — 0 points ☐ 80-88 cm or 31.5-35 inches — 4 points ☐ >88 cm or 35 inches — 6 points **Source**: ☐ Chart ☐ Measured ☐ Asked ☐ Estimated		**10. Have any of your blood relatives ever been diagnosed with diabetes? Check ALL that apply.** **(Add your score, do not count multiple children or siblings twice, maximum 8 points)** ☐ Mother — 2 points ☐ Father — 2 points ☐ Brothers/Sisters — 2 points ☐ Children — 2 points ☐ Grandparent, Uncle, Aunt, 1st Cousin — 0 points ☐ No or don't know — 0 points	
5. Do you usually do some physical activity such as brisk walking for at least 30 minutes each day? ☐ Yes — 0 points ☐ No — 1 point		**11. What is the highest level of education that you have completed?** ☐ Some high school or less — 5 points ☐ High school diploma — 1 point ☐ Some college or university — 0 points ☐ University or college degree — 0 points	
6. How often do you eat vegetables or fruits? ☐ Every day — 0 points ☐ Not every day — 2 points			

12. Please check off which of the following ethnic groups your biological (blood) parents belong to:
(Choose only the highest score, do not add the scores. Maximum 11 points)

Mother	Father		
☐	☐	White (Caucasian)	0 points
☐	☐	Aboriginal	3 points
☐	☐	Black (Afro-Caribbean)	5 points
☐	☐	East Asian (Chinese, Vietnamese, Filipino, Korean, etc.)	10 points
☐	☐	South Asian (East Indian, Pakistani, Sri Lankan, etc.)	11 points
☐	☐	Other non-white (Latin American, Arab, West Asian)	3 points

13. At the present time, do you smoke cigarettes? ☐ Yes ☐ No **Total Score:**

Lower than 21 -> LOW RISK Your risk of having pre-diabetes or type 2 diabetes is fairly low, though it always pays to maintain a healthy lifestyle.	**21-32 -> MODERATE RISK** Based on your identified risk factors, your risk of having pre-diabetes or type 2 diabetes is moderate. You may wish to consult with a health care practitioner about your risk of developing diabetes.	**33 and over -> HIGH RISK** Based on your identified risk factors, your risk of having pre-diabetes or type 2 diabetes is high. You may wish to consult with a health care practitioner to discuss getting your blood sugar tested.

Investigator's Initials _____

Figure 2.2 Subject Flow Diagram

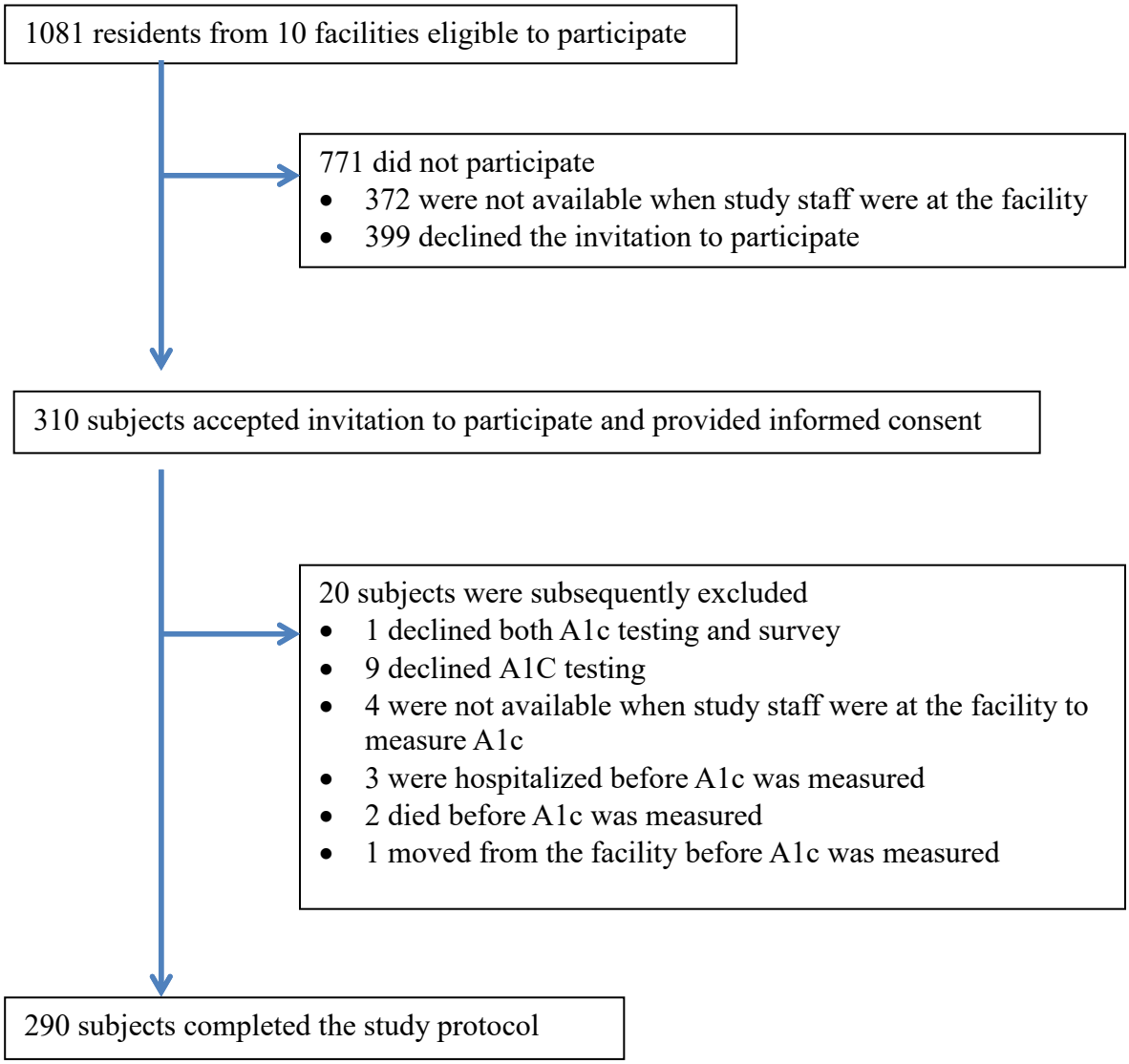


Figure 2.3 Scatterplot of CANRISK Score with A1C with CDA Thresholds

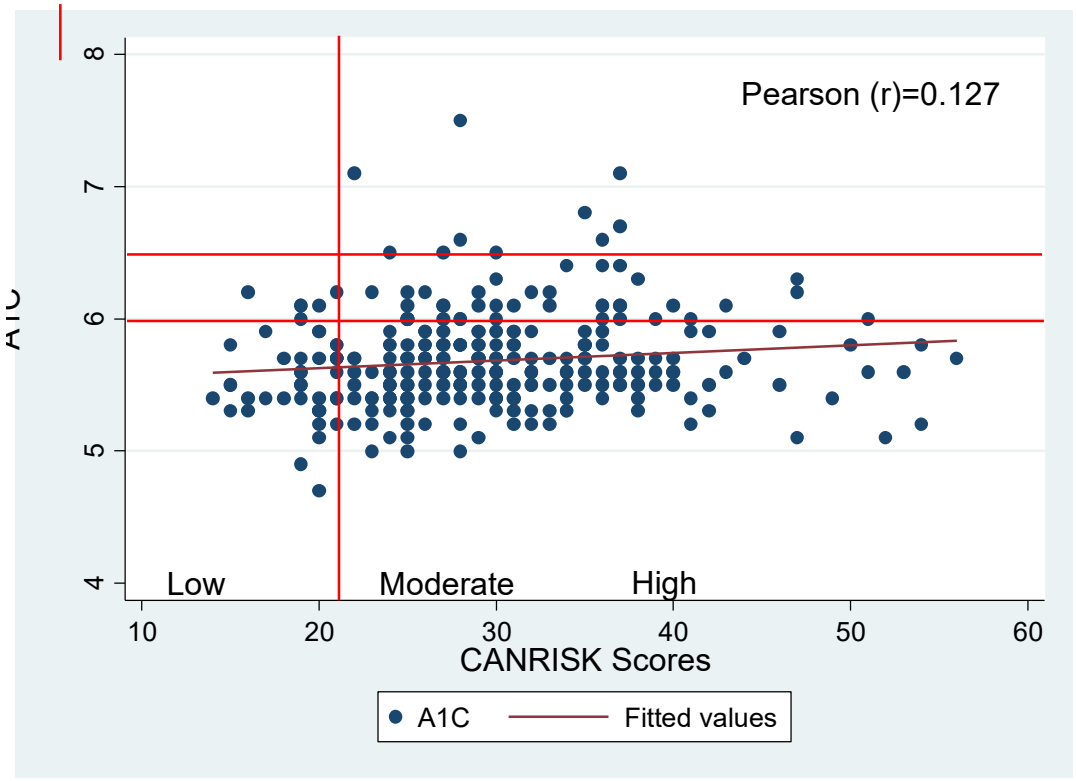


Figure 2.4 Prevalence of Elevated Blood Glucose (A1c≥6.0%) by CANRISK Score

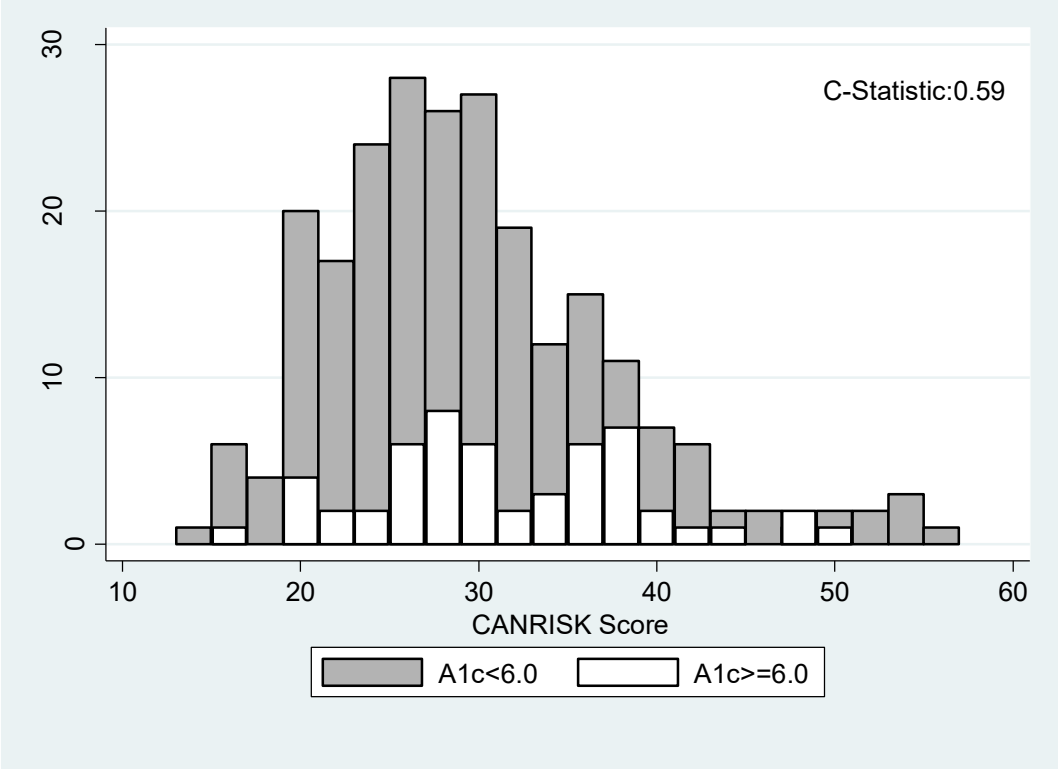


Figure 2.5 Scatterplot of FINDRISC Score with A1C with CDA Thresholds

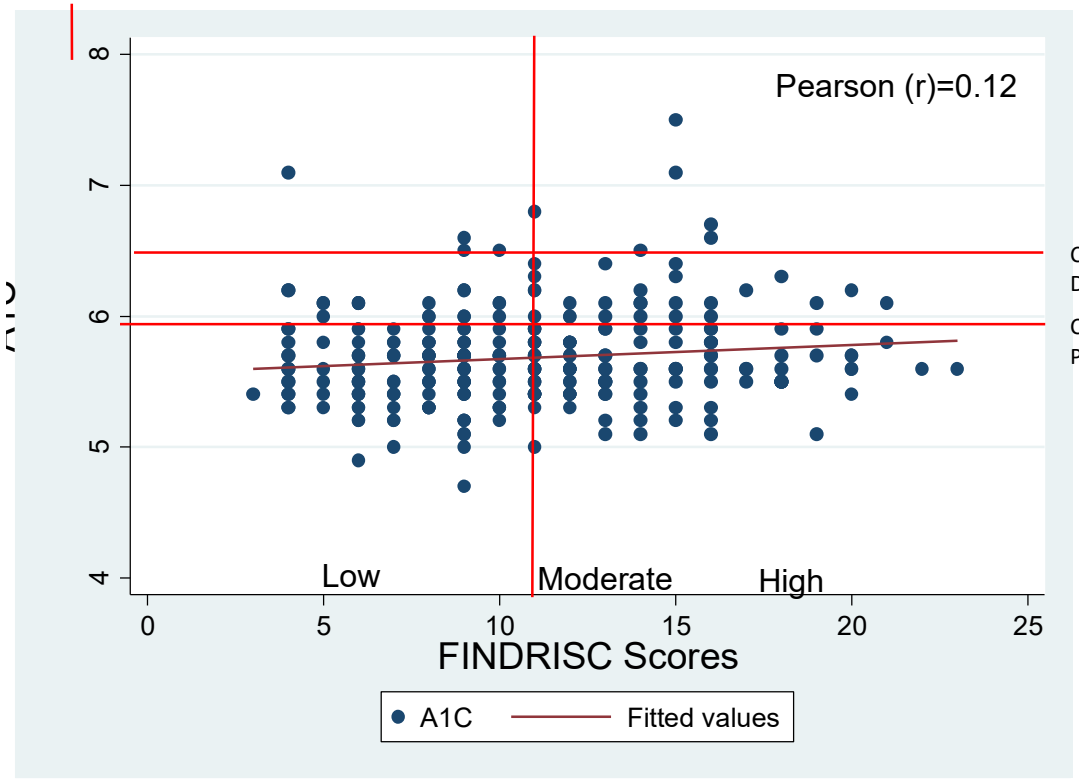
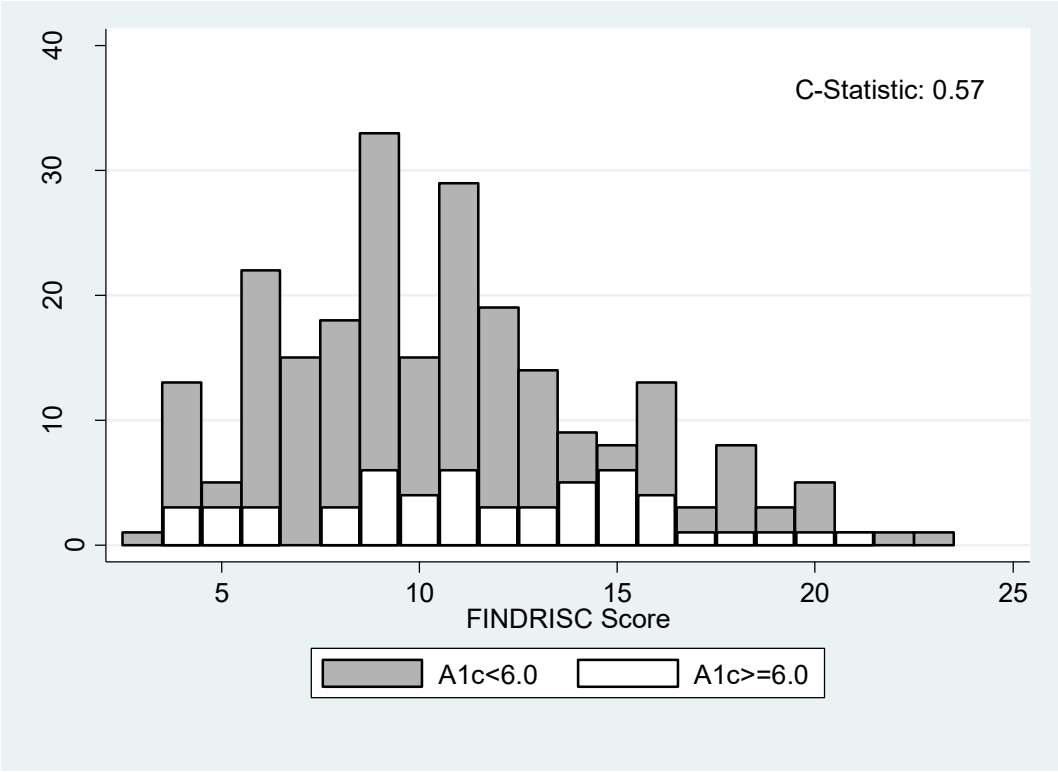


Figure 2.6 Prevalence of Elevated Blood Glucose (A1c≥6.0%) by FINDRISC Score



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Chapter 3. SYSTEMATIC REVIEW

Diabetes Management in Residential Care Facilities by Pharmacists and Nurses - A Systematic Review

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ABSTRACT

BACKGROUND: Diabetes is a disease with debilitating potential requiring additional care resources to manage. Prevalence of this chronic disease is highest in seniors, a segment of our population that is projected to double in the next 15 years. Additional residential care facilities are being built to meet capacity needs; however, funding and other resources are limited. A potential solution for the gap between needs and resources is to build on the expanding scopes of pharmacist and nurse practice and increase their involvement in chronic disease management. To facilitate integration of these healthcare professionals into this role, the purpose of this systematic review is to describe evidence-based diabetes practices or which practices delivered by a pharmacist or nurse have benefit in the available literature in residential care facilities.

METHODS: Electronic medical literature databases (CINAHL, Cochrane Library, EMBASE, Medline) were searched from inception to December 2015 for articles describing diabetes management in residential care facilities by pharmacists or nurses. Articles were included in this review if changes to diabetes-related outcomes or differences in hospitalization or mortality associated with the intervention were reported.

RESULTS: A total of 1639 articles were screened and 3 studies with a combined sample of 685 residents met the inclusion criteria. Two were uncontrolled before and after studies and one was a non-randomized controlled trial. Two trials were led by a pharmacist and one was led by a nurse practitioner. Common elements among the programs included an educational component and interventions to improve diabetes management. Glycemic control was the most common measure of program efficacy, along with rates of hypoglycemia. Other measured benefits included the reduction in sliding scale use and better screening practices.

CONCLUSION: This review identified a limited number of studies reporting the effect of pharmacist or nurse management of diabetes in residential care facilities. In general, programs

that included an educational component and interventions to improve diabetes management appeared to provide benefit in terms of better glycemic control and lower rates of hypoglycemia.

3.1 Introduction

The proportion of seniors is growing in developed countries. In Canada, the proportion of the population aged 65 years and older is expected to grow from 14.8% to greater than 20% by 2032, and over 25% by 2056.(1) Over this time the proportion that is made up of those aged 85 years and older will grow from 13% of seniors and 2% of the total population to 24% of seniors and 6% of the total population.(1, 2)

In Alberta, older adults who require care support on a daily basis are either provided home care or live in residential care facilities. To assess older adults for an appropriate level of care, case managers complete assessments using the international standardized InterRai assessment tools (Resident Assessment Instrument-Home Care [RAI-HC]) and aids to daily living assessment tools.(3-5) Based on their care needs identified from these tools, seniors may then be placed into a residential care facility.(3-5) While provincial variations exist, residential care facilities in Canada have been organized into two main categories, generally referred to as assisted living and long term care.(4)

Diabetes, a chronic condition that affects up to 33% of the residential care facility population, has been linked to an increase in comorbidities, complications, frailty, and falls in this population.(6-11) Further, diabetes is linked to an increase in potentially avoidable hospitalizations in long term care residents.(12) Similar to the trends in the aging population, diabetes is expected to see unprecedented growth of an estimated 300% in the seniors population through to 2050.(13) The prevalence of diabetes is expected to have the largest increases occurring in the oldest age groups (those 75 years and older).(13-15) Indeed, diabetes of the older adults has been described as the most important epidemic for the 21st century.(16)

Despite the well-known consequence of acute diabetes emergencies and long term complications, residential care facilities are slow to create the necessary supports and

foundational framework for frontline healthcare providers and managers. However, only 15-18% of facilities surveyed in 2001 and 2009 had procedures for residents with diabetes and 40% had management policies and procedures for hypoglycemia.(17, 18)

Before 2010, there was little expert guidance to assist facility managers on how to manage diabetes in residential care facilities. (19) Since this time, several international organizations have developed guidelines or position papers for diabetes in older adults and residential care facilities but the large majority are limited with consensus level recommendations [Table 3.1].(20-26) In Canada, the Canadian Diabetes Association provided a chapter in the most recent clinical practice guidelines on diabetes in the elderly; however, it contained only a paragraph on nursing homes.(27) Although another organization developed guidance for diabetes management in residential care facilities, this working group was located in one Canadian province and therefore recommendations may not be applicable across other provincial settings. (27, 28) In general, recent guidelines acknowledge that diabetes prevalence is high and will increase significantly over the next 30 years.(13, 20, 24) In addition, these guidelines acknowledge that diabetes management in residential care facilities have different complexities compared to management in hospital or ambulatory settings. These complexities include high turnover of staff that provide care at the front line, eating inconsistencies of residents, cognitive impairment of residents, and polypharmacy.(27, 29) Furthermore, facility staff do not receive education for, and have limited procedural direction to assist in, managing diabetes and its complications.

A systematic review published prior to the most recent guidelines looked at 20 studies of diabetes management in long term care and made three major observations.(30) First, it summarized patterns of drug utilization and found that insulin was administered to 40% of the

residents and another 40% were not taking any diabetes medications. Second, it examined adherence to practise guideline recommendations and found that 10% of studies did not reference practise guidelines and only 15% of studies measured guideline adherence, with rates ranging from 0% to 85%. Third, it examined the association between diabetes management and resident outcomes and found that although one in four studies measured a diabetes related outcome, none of these studies related the association to a specific practise.(30) This systematic review had several notable limitations, as its search excluded EMBASE, and used a restrictive time frame of 2000-2010, thus potentially missing a substantial number of relevant articles. In addition, the included articles were described as low quality descriptive studies.

Residential care facilities have looked for solutions that will assist in streamlining care. One option that has gained a substantive amount of support is the evolution of a multidisciplinary team approach for chronic disease management whereby interdisciplinary teams are active in therapeutic management once a diagnosis is made.(31, 32) Within this context, pharmacists can be valuable contributing members as their scope of practice has expanded in many Canadian health jurisdictions. (33-36) These expanded scopes include renewal of prescriptions, adapting for therapeutic substitution, and initial access prescribing.(37, 38) With or without the expanded scope of practise, pharmacists and nurses (especially nurse practitioners) have demonstrated benefit managing diabetes in community ambulatory settings.(39-41)

With these issues in mind, there is a need for a more contemporary review of the literature to examine the impact of pharmacist and nurse involvement in diabetes management in residential care facilities. Knowledge gained from this review could be used to develop a process of care and translate guideline recommendations into a diabetes management program for residential care facilities.

3.2 Methods

3.2.1 Literature Search

A total of four databases (CINAHL, Medline, Embase, and Cochrane Library) were searched via the internet websites from inception to December 18, 2015. The search strategy included the combination of relevant terms describing three categories: the target setting of residential care facilities; the healthcare professionals (pharmacists and nurses) involved in the intervention or management program; and diabetes outcomes. The search was initially designed and executed in Medline (Table 3.2) then adapted for each database using database appropriate terms and syntax. A health sciences librarian with expertise in systematic review searches reviewed the database search process for quality assurance. As the electronic search for each database was completed, the citation list was added to a single folder in Refworks. Duplicates were removed through an automated search for duplicates that was screened by the investigators.

3.2.2 Study Selection

Two researchers independently screened the titles and abstracts of all citations located through the electronic search strategy to identify potentially relevant articles. A citation was included for further analysis if at least one researcher considered it potentially relevant. After the initial screening, the full article for all potentially relevant citations were retrieved for the second level of screening. We did not have to contact any authors for articles. As we reviewed each potentially relevant article for inclusion in the systematic review, we also completed a search of the reference list to determine if any articles had been missed with the electronic search.

The full article for each potentially relevant citation was independently reviewed to determine if it should be included in the systematic review based on a predefined set of criteria. The initial inclusion criteria required that the article was published in English and published in a peer-reviewed journal (reports in the gray literature were not included); the intervention was delivered by a nurse, a pharmacist, or by both health care professionals; the intervention was specifically for diabetes management; the study used a controlled design (randomized or non-randomized controlled trial, controlled before and after, or interrupted time series) to examine change or difference in diabetes-related outcomes; and the managed facility provides nurse care as a service to residents. These initial inclusion criteria were developed with the intention to provide the foundation to develop an evidence-based care pathway to pharmacists and nurses providing care as preliminary review of the literature suggested anecdotal and commentary level of publication in the area. However, after an initial review of the potentially relevant articles, we determined that the scientific rigor required in the inclusion criteria was too stringent and we would exclude all studies. We decided to revise the criteria to be more inclusive at the expense of lower study quality. The expanded criteria allowed the intervention to be comprehensive, but still needed to include glycemic control as one element; the study design could be uncontrolled; and, the study setting was more broadly defined as residential care facilities where care is provided by a nurse or care aid that is overseen by a nurse. Two researches reviewed full articles independently and disagreements on study allocation were resolved through discussion.

3.2.3 Assessment of Quality

Our initial review protocol included quality assessment of included articles using the Downs and Black tool. (42) As a result of our requirement to broaden our inclusion criteria, the

methodological quality was reduced and Downs and Black's tool was not appropriate for the majority of our studies. Therefore, we chose not to use a quality assessment tool.

3.2.4 Data Extraction and Synthesis

One investigator used a standardized form to collect predetermined data from the articles and compile the information in a table. A second investigator checked data abstraction for completeness and accuracy. Variables collected include facility characteristics, characteristics of the healthcare professional providing the intervention, characteristics of the intervention, study design, number of seniors with type 2 diabetes in the study, duration of follow up, outcomes measured, major findings, and conclusion. Data were retrieved from the articles and supplements; authors were not contacted for further information. Once the data were retrieved and organized into tables, the information was reviewed to identify common themes within the intervention program, team members involved, and outcomes measured.

3.3 Results

The literature search identified 1639 unique citations and 97 articles were considered potentially relevant after the titles and abstracts were reviewed. After review of the full text, we disagreed on the allocation of 11 (12.6%) articles and ultimately decided that 3 (3.1%) articles met the expanded inclusion criteria (Figure 3.1).

Study characteristics of the two uncontrolled before and after studies and the non-randomized controlled study are summarized in (Table 3.3). One study was from Canada and two studies were from the United States. The facility sizes were 112, 254, and 411 residents, with 35%, 30%, and 30% having known diabetes, respectively. (11, 43, 44)

Day and colleagues examined an intervention provided by a nurse practitioner,(43) Clement and colleagues examined an intervention provided by a certified diabetes educator pharmacist,(11) and Horning and colleagues examined an intervention provided by a consulting pharmacist.(44) The setting for two of the studies was described as a multidisciplinary assessment/involvement(11, 43) while the third study did not describe the health professional interaction and organization in the care process(44).

Two studies focused on diabetes as the disease state of interest,(11, 43) while the third study included diabetes as one of seven disease states examined.(44) All three studies used diabetes guideline recommendations to guide practise; however, they all used different guidelines. (45-47) Two of the studies used the national diabetes association (Canadian and American) guidelines and one study used the American Medical Directors Association (AMDA) guideline for diabetes management in long term care. (45-47)

Although the overall interventions varied across the three studies, there was some consistency within the components (Tables 3.4; 3.5). First, an education-based strategy was implemented in two of the studies.(11, 43) One study saw a nurse practitioner provide a one hour educational session with all front line nursing and aid staff,(43) while the other provided an undefined education program by a certified diabetes educator pharmacist to staff and physicians over a period of five months.(11) Second, both pharmacist-led interventions contained therapeutic recommendations to optimize pharmacotherapy.(11, 44) Third, two studies focused on the reduction of sliding scale insulin (SSI) use because of their prominence in the facilities. At the end of the studies, SSI use was either eliminated or reduced to one resident.(11, 43) Only one study described the implementation of a chronic care model and used care planning as a

component of the intervention.(43) One study included implementation of policies and procedures for hypoglycemia management, sick day management and injection site rotation.(11)

All three studies reported on different diabetes outcomes (Tables 3.5-3.7). Clement and colleagues reported on the frequency of hypoglycemic events requiring glucagon and blood glucose levels before and after a change in SSI usage.(11) Horning and colleagues reported the proportion of residents with an A1c under 7%, and mean A1c according to disease state management or drug regimen reviews. As this study compared these management approaches across a number of chronic conditions, the authors also assessed antiplatelet use, as well as achievement of blood pressure and cholesterol targets.(44) Day and colleagues measured change in hypoglycemic and hyperglycemic events, SSI usage, diabetes complication screening rates, medication use and care factors before and after a one-hour training session to staff, development of care plans for nursing care and implementation of a coordinated diabetes disease management model (CDDM).(43) None of the studies measured outcomes of hospitalization rate or mortality.

3.4 Discussion

This systematic review evaluated the effects of a pharmacist or nurse led diabetes management program in residential care facilities. Despite use of broad inclusion criteria, only three studies provided relevant information for this review. (11, 43, 44) Two studies included therapeutic recommendations or changes to the residents' medication regimen and two studies included education to site staff. (11, 43) In all three studies, the intervention demonstrated a benefit of the diabetes program relative to either baseline or the comparison group for the diabetes outcomes measured. (11, 43, 44) However, the measurements were limited to surrogate endpoints and drug utilization. None of the studies reported clinical events, such as hospitalization, emergency department visits, complication rates, or mortality.

Although all three studies drew on clinical practice recommendations to develop the diabetes management programs, each focused on different guidelines. (45-47) Despite utilization of different guidelines as references, there were some notable consistencies among the studies. For example, recommendations to reduce the use of SSI were integrated into the diabetes management programs for two studies.(20, 22, 23) Both studies demonstrated a reduction in SSI use and a reduction in hypoglycemic events. Another comparable finding across studies is the recommendation to integrate staff education into rollout of the programs.(21, 22) Day and colleagues completed one-hour education sessions that provided a best practises update, different medications, expected disease state complications and workflow process conversation.(43)

All three studies measured glycemic control, with Clement and colleagues and Horning and colleagues using an A1c <7.0% as a target and Day and colleagues an "individualized goal".(11, 43, 44) At the time of Clement and colleagues and Horning and colleagues publications, the practise and using <7.0% A1c as a target for blood glucose may have been acceptable, whereas adherence to the 2005 American Diabetes Association guidelines for seniors would be considered clinically controversial by today's standards.(47) With the results of ACCORD, ADVANCE and VADT, guidelines adjusted their A1c targets to 7.0-8.5%(48-51). Recent guidelines focus on individualizing and relaxing A1c targets with an emphasis on using a medication regiment that avoids hypoglycemia and hyperglycemia which is a potential explanation for the shift in A1c target found in the study by Day and colleagues. (43)

One area of diabetes care that was not evaluated was complications of diabetes. While one study looked at screening for chronic kidney disease and retinopathy,(43) none of the studies included incidence of microvascular or macrovascular complications. Addressing comorbidities associated with diabetes is important as there has been previously demonstrated association

between complication and emergency room visits in this population.(52) Similarly, diabetes has an association with frailty, leading to poorer outcomes in long term care residents.(53)

The previously published systematic review by Garcia and colleagues was designed to provide a summary of current diabetes medication practises, provide descriptions of guideline use and associate medication regimens to outcomes.(30) In contrast, our systematic review used a broader search strategy that focused on processes used to manage diabetes and outcomes measured. There was one article (Horning) of overlap in the included studies.(44) Garcia's review described two implications for practise, the first was wide spread education and the second stating further research was required to determine if the reason for guideline non-compliance is as a result of lack of documentation pertinent to diabetes care. While we find agreement with Garcia's support for education of staff and others, we also found the reduction of SSI was an intervention in two studies where by the reduction in hypoglycemia events occurred with the SSI reduction. Despite Garcia's call for further research, which has been reiterated by recent guidelines and other publications of diabetes in residential care, our findings show that there has not been significant research progress since 2010.

Quality and quantity of studies were major limitations of this systematic review. The lack of high-quality health services research studies in residential care facilities was first identified at the search level, requiring a broadening of inclusion criteria to allow inclusion of studies with less internal validity. As a result, we were only able to find 3 studies, with the best level of evidence coming from one nonrandomized controlled trial.(44) In addition to the study design issues, there are multiple reasons to be concerned with the internal validity of the study by Horning and colleagues.(44) First, two of the three authors were also the subject of the assessment, and the lead author performed all the data collection. Second, the 4 control facilities were selected based

on convenience of location relative to the intervention sites. Third disease state management was self-defined and there was no further elaboration on this process. Therefore, despite the disease state management model providing a benefit to achieve clinical practise guideline targets, application of the intervention program in other settings is limited.

Despite the limitations of poor quality evidence contained in the three studies identified in this systematic review, there was sufficient information to meet the primary objective. Based on common elements of the diabetes management programs, integration strategies, and assessment methods, we were able to develop an initial framework for processes of care in residential care facilities (Figure 3.2). Each step is described briefly below.

During the initial status assessment, pharmacists and nurses should determine the current status of practise and documentation at the site through a chart review. Specific areas of focus should include facility-specific information on: drug utilization patterns, patterns and values for glucose measurements, and clinical events, like glucagon use or hypoglycemic events. This initial status assessment will provide insight into current management processes and identify areas lead to poor outcomes.

The design of the policy and procedure stage should take into account results from the initial status assessment, areas to target for improvement, and the working structure of the facility. Care models, such as the CDDM care model and clinical practice recommendations, like those from the AMDA guidelines, should be used as a framework for developing policies and procedures for the facility. Staff and other health professionals at the facility should be involved in the development of these policies to ensure there is endorsement and facilitate uptake once they are ready to be integrated.

Once the policies and procedures are developed, the next stage is to educate staff, healthcare professionals, the residents, and their families. The education sessions do not need to be extensive, for example the 1-hour session provided in the study by Day and colleagues seemed to be helpful for introducing the procedures and up to date information to help transition practices. (43)

The next stage would be development of therapeutic interventions focused on improving patterns of drug utilization. For example, these interventions should focus on improving glycemic control while minimizing the risk of hypoglycemic events.

The last step is to come full circle and reassess the impact of the changes. As reported in two of the studies included in the systematic review,(11, 43) a simple before-and-after comparison may be the most pragmatic method for assessment. However, given the paucity of high-quality evidence in this area, clinicians and investigators should strive to develop more robust assessment methods.

3.5 Conclusion

Interest in multidisciplinary programs for chronic disease management in residential care facilities is steadily increasing. Evidence of effective management strategies would facilitate development of policies and processes for these programs. However, this systematic review identified a substantial gap in well-designed experimental studies examining the effect of pharmacist or nurse management of diabetes in residential care facilities. Although there is good evidence that pharmacist or nurse involvement can benefit chronic disease management in other settings, such as community-based primary care,(54-58) it is not clear if this evidence can be generalized to seniors' care. Despite these limitations, however, this review identified that

effective diabetes management programs should include educational strategies for staff, residents, and their families; along with targeted therapeutic interventions, like the elimination of sliding scale insulin regimens.

Figure 3.1 Citation Flow Diagram

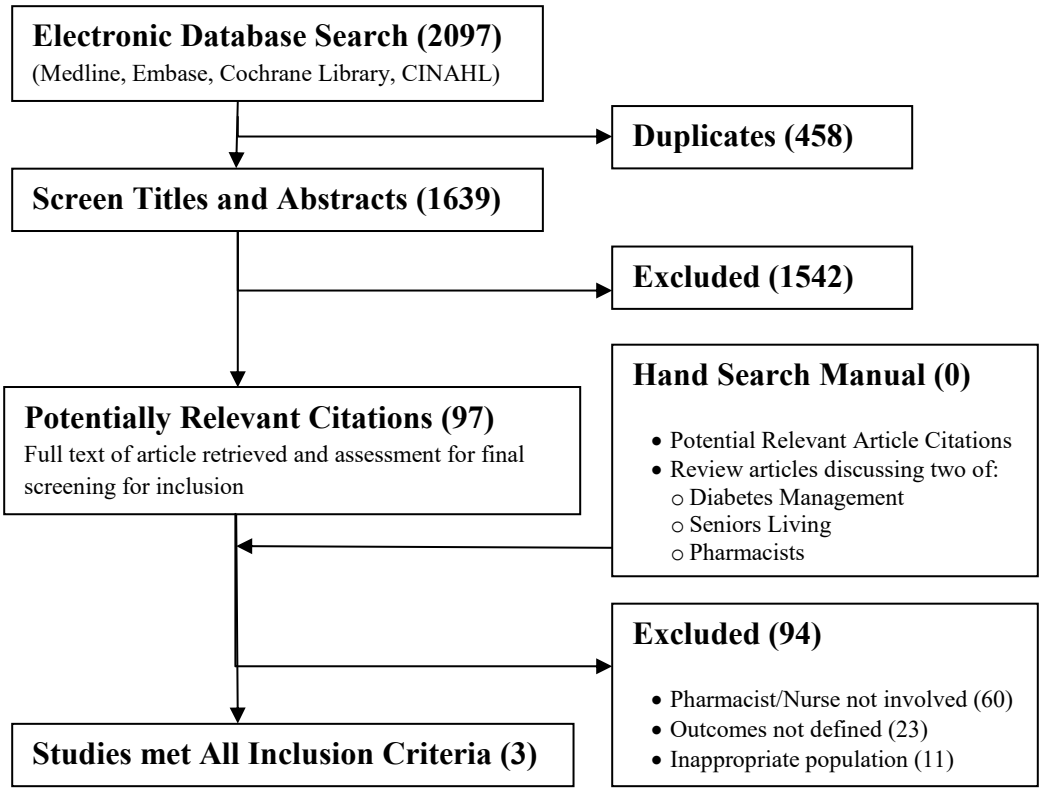
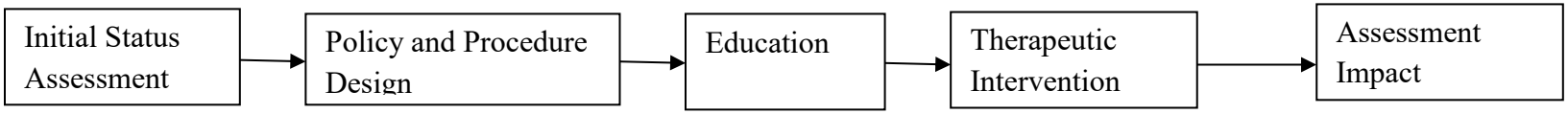


Figure 3.2: Process of Care



Initial Status Assessment	Policy and Procedure	Education	Therapeutic Intervention	Assess Impact
• Audit of Site Practices • Interview with Staff • Chart Audit Blood Glucose and relevant other data • 1-2 days	• Assess Gaps • Focus on High Risk • Hypoglycemia • 1-2 days	• 1-2 hours • All Staff • Physicians • Residents Optional • Policy and Procedures • Best Practices • 1 day	• Focus on residents with hypoglycemia 1st • Eliminate SSI • Address Inappropriate Drugs • Address Hyperglycemia >15mmol/L	• Chart Audit of same information to previous • Assess staff compliance with policy and procedures • 1-2 days

Table 3.1: Guidelines for Diabetes in Older Adults

Organization	Year	Country	Subject	Screening	Medication Therapeutic	Sliding Scale Insulin	Blood Glucose Monitoring	End Of Life	Treatment Target	Acute Hypo/ Hyperglycemia Management	Complication Management	Management in Nursing Homes	Care plans	Policy and Procedures	Education of Staff	Transition of Care	Quality Assurance Audit
American Diabetes Association (ADA) (33)	2016	United States	Diabetes in Residential/Long Term Care	No	Yes	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	Yes
American Medical Directors Association (AMDA)(85)	2015	United States	Diabetes in Residential/Long Term Care	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	No
Task and Finnish Group of Diabetes UK (TFGD-UK) (34)	2011	Finish/UK	Diabetes in Residential/Long Term Care	Yes	Yes	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes
The Mckellar Guidelines (35)	2014	Australia	Diabetes in Residential/Long Term Care	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
Diabetes Care Program of Nova Scotia (DCPNS) and Palliative and Therapeutic Harmonization (PATH) Program (86)	2013	Canada	Diabetes Guidelines for the Frail Elderly in Long Term Care	No	Yes	No	Yes	No	Yes	Yes	No	Yes	Yes	No	No	No	No
American Geriatric Society (AGS) (87)	2013	United States	Diabetes in Older Adults	No	Yes	Yes	Yes	No	Yes	No	Yes	No	No	No	No	No	No
IAGG and EDWPOP (30)	2012	Europe	Diabetes in Older Adults	No	Yes	No	No	No	Yes	Yes	No	Yes	No	Yes	Yes	No	No
International Diabetes Federation (IDF) (29)	2013	Inter-national	Diabetes in Older Adults	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Canadian Diabetes Association (CDA) S184-190 (32)	2013	Canada	Diabetes	No	Yes	Yes	No	No	Yes	No	Yes	Yes	No	No	No	No	No

Table 3.2 Medline Search Strategy

1. Homes for the Aged/
2. residential facilities/ or assisted living facilities/ or group homes/ or exp nursing homes/
3. (nursing adj2 (home*1 or unit*1 or center*1 or centre*1 or facilit*)).ti,ab.
4. (group adj2 home*).ti,ab.
5. (long-term care adj2 facilit*).ti,ab.
6. (care adj2 (home* or facilit*)).ti,ab.
7. (rest adj2 home*).ti,ab.
8. (residential adj2 (home* or care)).ti,ab.
9. (geriatric adj2 (home* or unit* or facilit* or institution*)).ti,ab.
10. Long-Term Care/
11. ((long-term or longterm or continuing) adj2 care).ti,ab.
12. ((supportive or assisted or institutional) adj2 living).ti,ab.
13. Institutionalization/
14. or/1-13

15. exp Diabetes Mellitus/
16. Blood Glucose/
17. exp Hypoglycemic Agents/
18. Hemoglobin A, Glycosylated/
19. (diabet* or insulin or blood glucose or hypoglyc?emia or glycemic control).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
20. or/15-19
21. 14 and 20

22. Community Pharmacy Services/
23. Pharmacies/
24. nurses/ or nurse administrators/ or nurse clinicians/ or nurse practitioners/ or family nurse practitioners/ or nurses, community health/ or nurses , international/ or nurses, male/ or nurses, public health/ or nursing staff/ or pharmacists/
25. exp Pharmacy/ or exp "Pharmacy and Therapeutics Committee"/
26. pharmaceutical services/ or medication therapy management/
27. (managed care service* or managed care pharmac*).mp.
28. exp Geriatric Nursing/ or exp Nursing Care/ or exp Home Health Nursing/ or exp Home Nursing/ or exp Nursing Assessment/ or exp Community Health Nursing/ or exp Advanced Practice Nursing/ or exp Nursing/
29. (pharmacist* or pharmacy or pharmacies or nurse*).mp.
30. or/22-29
31. 21 and 30

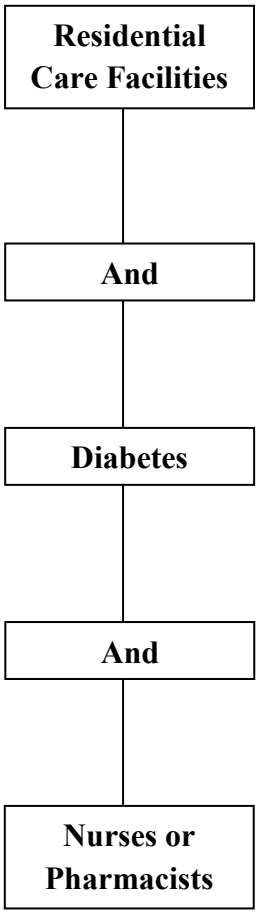


Table 3.3 Study Characteristics

	Country	Facilities	Facility Type	Bed Total	Residents with known Diabetes (%)	Included Residents	Health Care Professional Intervention	Practise Environment	Study Type
Day (2014)	USA	1	Long Term Care Corporate For Profit	112 (88 charts reviewed)	31 (35%)	22	Nurse Practitioner	Multi-Disciplinary	Uncontrolled Before-After Study
Horning (2007)	USA	6	Long Term Care **DSM** ▪ 2 For Profit **DRR** ▪ 2 For Profit ▪ 2 Non Profit	411 (Total) **DSM** ▪ 107 **DRR** ▪ 304	129 (31%)	129	Pharmacist	Consulting Role	Non-Randomized Control Study
Clement (2009)	Canada	1	Long Term Care Not Specified	254	75 (30%)	75	Pharmacist CDE	Multi-Disciplinary	Uncontrolled Before-After Study

DSM – Disease State Management

DRR - Drug Regimen Review

Table 3.4 Interventions and Outcomes Measured

	Intervention Time	**Nurse/Pharmacist Led Intervention**	**Diabetes Related Measurements**
Day (2014)	6 months	• One Hour Training to Staff • Develop Care Plan • Implement CDDM • Coordinate Care Between Disciplines	• A1c Goal Reached • CKD Screening • Retinopathy • Diabetes Medication • Resident Participation • Proportion of Residents with using SSI
Horning (2007)	20 months	• Pharmacist Consultant Disease State Management Services • Comparison Pharmacist Consultant Drug Regimen Review	• Antiplatelet agent use • Last A1c≤7% • A1c mean (SD) • BP≤130/80mmHg • LDL at goal
Clement (2009)	5 months	• Education for staff and physicians • Barrier to Care Assessment • Procedures and protocols for sick day management • Resident specific therapeutic recommendations • Standardize Medication Administration Times • Integrating Diabetes Medication Log • Injection site selection and rotation guideline implementation • Performance monitoring with BG meter	• Average Blood Glucose Reading by Category above 4.0mmol/L • Glucagon Administration Frequency • Percent of Patients with SSI Use

Table 3.5 Blood Glucose Outcomes

	Blood Glucose Outcomes														
	Average A1c (%)			**A1c Below goal (%)[1,2]**			**Average BG <4.0mmol/L**			**Average BG 4.0-7.0mmol/L**			**Average BG >10.0mmol/L**		
	Intervention	Comparison	p value	Intervention	Comparison	p value	Intervention	Comparison	p value	Intervention	Comparison	p value	Intervention	Comparison	p value
Day (2014)	NR	NR	NR	82	32	0.01	0.09 *	0.59 *	0.018	NR	NR	NR	15.6 %	18.0 %	0.60
Horning (2007)	6.2	6.6	0.041	86.2	62.0	0.014	NR	NR	NR	NR	NR	NR	NR	NR	NR
Clement (2009)	7.6	NR	NR	33.0	NR	NR	3.7%	4.6%	NR	26.6%	15.5%	NR	21.8%	28.0 %	NR

1. Day (2014): Resident tailored goal
2. Horning (2007) and Clement (2009): <7.0%

*Paired T-Test Mean

Comparison

1. Day: Before Intervention
2. Horning: Control
3. Clement: Before Intervention

Table 3.6 Diabetes Medication Utilization

	Diabetes Medication Utilization									
	Sliding Scale (%)			**Glucagon Administrations (n)**			**Oral Diabetes Medication Before Intervention (%)**			
	Intervention	Comparison	p value	Intervention	Comparison	p value	Insulin	Metformin	Secretagogues	DDP4
Day (2014)	29.4	61.3	0.04	NR	NR	NR	63	36	23	5
Horning (2007)	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Clement (2009)	0	60	0.01	6	35	NR	44	46	24	N/A

Comparison

1. Day: Before Intervention
2. Horning: Control
3. Clement: Before Intervention

Table 3.7 Other Outcomes Measured

	Other Outcomes											
	CKD Screening (%)			**Retinopathy Screening (%)**			**BP <130/80mmHG (%)**			**Last LDL<2.59mmol/L (%)**		
	Intervention	Comparison	p value	Intervention	Comparison	p value	Intervention	Comparison	p value	Intervention	Comparison	p value
Day (2014)	100	18	0.01	91	14	0.01	NR	NR	NR	NR	NR	NR
Horning (2007)	NR	NR	NR	NR	NR	NR	55.2	54.0	0.911	86.2	62.0	0.014
Clement (2009)	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR

Comparison

1. Day: Before Intervention
2. Horning: Control
3. Clement: Before Intervention

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CHAPTER 4: SUMMARY

4.1 General Discussion

Management of seniors with diabetes living in residential care facilities is an area that is receiving increasing attention from numerous stakeholders, including facility managers, health care professionals, national organizations, and governments. Reasons for this increasing recognition is multifactorial, including: unprecedented growth in the proportion of seniors in the Canadian population as baby boomers start to become seniors; substantial increases in diabetes prevalence, with an expected increase of 300% by 2050 in seniors where diabetes prevalence is already high; the high cost to manage residents with diabetes; and well known complications and higher risk of avoidable hospitalizations with diabetes.(1-3)

Growing international attention to diabetes in this patient group is reflected by recent clinical practice guidelines and position statements with specific recommendations for diabetes management in residential care facilities. Since 2010, 7 international guidelines on diabetes management in residential care facilities or older adults have been published.(4-10) Despite the number of guidelines, integration of recommendations into practice is less than ideal. Indeed, it has previously been reported that residential care facilities require support and guidance as the majority of facilities do not have policies and procedures specific to diabetes management. (11, 12) Furthermore, facility managers have specifically asked for help in evolving the diabetes management practices that are monitored and managed in a sustainable manner. Facility management require solutions that maximize staff scope, time and optimize facility funding. Alberta Health had previously announced that residential care facilities in Alberta would be partially be based on the complexity of the resident.(13) This has led to incentivizing the use of

screening tools where available, promoting interdisciplinary teams within their facilities, and transitioning more chronic disease management responsibilities to non-physician health professionals.(14)

Pharmacists have started to realize a larger role with multidisciplinary teams in residential care facilities. Further expansion of scope of practices in addition to the natural position that pharmacists have in medication management workflow, positions pharmacists to assist in transforming processes, creating policy and procedures and clinically implement diabetes disease state management. However, there are currently no process of care publications on diabetes management in residential care.

With these issues in mind, this thesis focused on two distinct, but related projects with the overall aim of providing evident to develop a process of care for diabetes management in congregate living and residential care facilities.

4.1.1 Utilization of CANRISK and FINDRISK to identify residents with elevate blood glucose

The first project was a cross sectional study comparing the Canadian Diabetes Risk Questionnaire (CANRISK) and Finnish Diabetes Risk Score (FINDRISC) tool to A1c levels. (15, 16) Data for this study were collected through an interview and point of care A1c test with residents at their homes in residential care facilities. The aim of the study was to assess the effectiveness of the tools to identify seniors living with elevated blood glucose in the independent and supportive living sub group of residential care facilities. We used the 2013 Canadian Diabetes Guideline definition of prediabetes (6.0%) and diabetes (6.5%) to define elevated blood glucose.

While we found that there was a statistically significant correlation between the risk tool score and A1c, the tools were not able to meaningfully distinguish between seniors with elevated blood glucose levels and seniors without elevated blood glucose levels (c-statistic 0.57). Our findings differed from previously published articles in the adult population that reported reasonable discrimination (c-statistic of 0.69-0.85).(15-18) We believe this discordance was due to three factors. First, the tools were previously tested in adult age groups (40-74), whereas 84% of our group was 79 years and older. Second, we used A1c instead of an oral glucose tolerance test, which may not have as strong of correlation to the screening tools.(18) Third, the prevalence of elevated blood glucose was not as high as initially anticipated.

Perhaps the most striking finding of this study was the low prevalence of elevated blood glucose in our study sample, with only 10 (4%) having an A1c above the Canadian Diabetes Association threshold for diabetes (≥6.5%). From a clinical consideration, guidelines recommend an A1c treatment target of 7.0-8.5% and an emphasis on avoiding hypoglycemic and acute hyperglycemic events in this population. Therefore, with our highest A1c found to be 8.5%, it is unlikely that any study participants would be treated for elevated blood glucose.(5, 6, 19) Prior to conducting the study, we expected to find a substantial proportion of residents living with undiagnosed diabetes based on population based estimates suggesting between 20% and 33% people with diabetes are undetected.(4, 20)

There are four possible explanations for our observation of a lower than expected number of undiagnosed diabetes. First, the nature of our recruitment strategy to generate a convenience sample of residents who agreed to participated may have been influenced by selection bias, specifically healthy participant bias. Of our sample, 18.6% had elevated glycaemia using an A1c of 6.0% whereas 48% had elevated glycaemia with an A1c of 5.7%. Using an American

definition, our sample had comparable overall elevated glycaemia results to the other screening studies.(21, 22) Second, population estimates were completed in younger adult populations, which may not be generalizable to our population. The incidence rate for diabetes is highest before 79 years old, suggesting all residents with diabetes could have been already diagnosed preadmission.(23) Third, we used A1c to measure glucose levels due to practical requirements for the testing. Previous reports suggest A1c will identify less people with diabetes compared to OGTT, which could result in lower overall levels in our study population.(24, 25)

Our observations suggest that undiagnosed diabetes may be lower in seniors independent and assisted living than would be expected based on position paper/guideline statements and general population data. Moreover, we determined that the CANRISK and FINDRISC screening tools are not useful in distinguishing seniors with or without elevated blood glucose who have not been previously diagnosed with diabetes. In conclusion, we do not recommend using these tools in this population.

4.1.2 Systematic Review of Pharmacists Managing Diabetes in Residential Care Facilities

The purpose of the second study was to gather evidence-based recommendations that would assist in developing a process of care for pharmacists working in residential care facilities. Patient care in residential care facilities is becoming more interdisciplinary as pharmacists and nurses become more actively involved in disease state management. Therefore, in order to facilitate disease state management for diabetes we need to identify interventions and activities that are proven to improve health outcomes of residential care facility residents.

Our initial approach was to conduct a systematic review to identify interventions that were delivered by a nurse, a pharmacist, or by both health care professionals; the intervention was

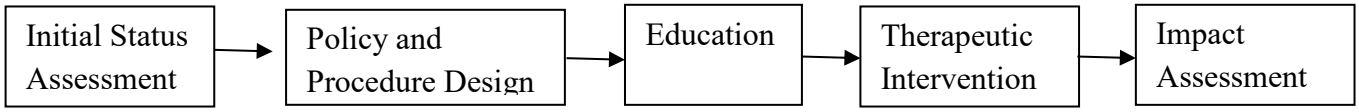
specifically for diabetes management; the study used a controlled design (randomize or non-randomized controlled trial, controlled before and after, or interrupted time series) to examine change or difference in outcomes related to diabetes; and the managed facility provides nurse care as a service to residential care facilities. However, this approach failed to identify a meaningful group of studies to draw observations from. We determined that we required a need to expand criteria by allowing the intervention to be comprehensive, but still needed to include glycemic control as one element; the study design could be uncontrolled; and, the study setting was more broadly defined as residential care facilities where care is provided by a nurse or care aid that is overseen by a nurse. In short, we modified the "P", "I", and "O" of our PICO question.

Our literature search identified a large number of papers providing anecdotal information and commentaries on diabetes care in residential care facility residents. In general, the scientific rigor of literature in this area is low, which is consistent with commentaries within recent guidelines(4, 5, 19) Almost all diabetes management recommendations in this population are based on consensus opinion rather than clinical trial evidence. One exception in this area is the recommendation to eliminate sliding scale insulin in nursing homes because of clear evidence this leads to a higher risk of hypoglycemia.(6) A systematic review of diabetes management in long term care identified similar concerns, that better quality evidence is required to help guide management in this setting.(26)

Despite these shortcomings, the literature review identified three studies, two uncontrolled before after and one non-randomized controlled trial, that met our expanded inclusion criteria.(27-29) Common elements of successful pharmacist involvement in diabetes programs included education strategies, implementation of policies and procedures for diabetes management, and targeted reduction of sliding scale insulin use. Based on information gathered

from these studies, pharmacists working in residential care facilities could follow the process illustrated in [Figure 4.1] to develop a diabetes care program.

Figure 4.1 Process of Care for Pharmacist-Led Diabetes Management in Residential Care Facilities



During the initial status assessment, pharmacists should review charts to identify facility-specific drug utilization patterns, glycemic readings, and important clinical outcomes like glucagon use, hypoglycemic and hyperglycemic events, or hospitalizations. This will provide important baseline information for future comparisons as well as insight into areas lead to poor outcomes. The design of the policy and procedure stage should take into account results from the initial status assessment, areas of target for improvement, regulatory and accreditation requirements, and the scope of practice of the staff. Care models, such as the coordinated diabetes disease management (CDDM) care model, can be used as a framework for developing policies and procedures provided they have the required professional supports. The next stage is to educate staff and other health professionals involved in the process as well as the residents and their families. The education does not need to be extensive, but will help to introduce the procedures and up to date information to help transition practices. The next stage is to develop therapeutic interventions focused on improving patterns of drug utilization. For example, these interventions should focus on improving glycemic control while minimizing the risk of hypoglycemic events through individualized assessment and recommendations. The last step is to come full circle and reassess the impact of the changes through a chart review, for example.

Our overall findings from the systematic review suggest that a pharmacist involvement in directing management of diabetes in residential care facilities should have a positive impact on health outcomes. For example, the percent of residents with A1c below goal and the rate of hypoglycemia both improved when pharmacists were involved in diabetes care of residential facility residents.(27, 28) Similarly, pharmacists can optimize medication practices in long term care, which have also resulted in beneficial patient outcomes.(30) These observations are consistent with benefits seen in ambulatory care settings where pharmacists have been involved in diabetes management.(31) Although the collective observations suggest that pharmacist involvement in residential care facilities could provide benefit to patient outcomes, this hypothesis needs to be tested in a well-designed controlled study.

4.2 Implications and Future Direction

4.2.1 Implications for Clinical Practice

The expected population growth of seniors will require care facilities to evolve disease state management practices. As residential care facility needs change and evolve, pharmacists are well positioned to make an important impact in this patient care area. However, there is a great need to shape how this role for pharmacists develops.

In evaluating components of implementation of a diabetes program in residential care, pharmacists will need to consider the variety of interventions to implement. Despite the allure of including the CANRISK or FINDRISC for screening through self-assessment or utilizing unskilled labor to complete this assessment, the tools implemented in either assisted living or seniors independent living residents would result in unnecessary administrative burden. As OGTT is logistically impractical, alternative screening practices like A1c testing or FPG should be used as a preferred alternative. Despite the limitations that we stated in our study regarding

A1C results, decision of whether or not and what to start with to treat a senior will be based on the A1C.

Based on our findings, the Canadian Task Force for Preventative Health should adjust their recommendation for use of the FINDRSIC for anyone over the age of 18 to an age restriction of 74 years to stay in line with validation studies. Secondly, we recommend that practice guidelines remove reference to screening questionnaires for seniors and specify a blood glucose test (FPG or A1C) as the preferred screening practice for this segment of the population.

Pharmacists practicing in residential care facilities need to be aware that success of disease state management requires a system improvement approach, whereby improvement is not only determined by medication recommendations and prescribing, but staff influence through policy and procedures and education. Despite the added complexities to consider, pharmacists should remain optimistic that a change in practice and resulting difference in diabetes measurements were realized over a short 3-6 months.

In completing a preliminary assessment of the facilities, guidelines written for diabetes in long term care can be used as a template. Where residential care facilities do not have policy and procedures and knowledge translation practices like staff education, initial efforts should include these two areas to direct and influence care practices. Equally important is an evaluation of drug utilization patterns for high risk hypoglycemia medication like sliding scale and glyburide to tailor medications to avoid hypoglycemia and hyperglycemia emergencies.

4.2.2 Implications for Practice-Based Research

Our studies confirm that there is scarce evidence in diabetes management in residential care facilities despite international interest and discussion on the need for better evidence in this area.

The previous systematic review of diabetes in long term care searched for articles from 2000-2010 and found limited quality evidence. Our systematic review, which was broader in search methods and narrower in scope for inclusion, suggested that limited progress has been made in the past 5 years.

For disease state management in diabetes in residential care facilities, controlled trials should be encouraged for future study planning as these are considered the highest level of evidence in this area. Studies should include glycemic outcomes, including hypoglycemic events, hyperglycemic emergencies, and changes in A1c, along with hospitalization and mortality outcomes. Practical considerations that may be considered include frequency of measuring blood glucose and nursing time requirements.

Previous studies have focused on long term care/nursing homes for studying diabetes in residential care. As assisted/supportive living facilities increase in prevalence and the difference in resident demographic narrows, future research should include assisted/supportive living settings.(32) Research in assisted living could include confirmation of lower levels of undiagnosed diabetes, pharmacists' involvement in medication management and diabetes management practices.

4.3 Conclusion

This thesis examined different areas of potential intervention for a pharmacist integrating diabetes disease state management practices in residential care facilities. Findings from two different study designs provide guidance on the intake of new residents and ongoing diabetes management. First, use of risk surveys, such as CANRISK or FINDRISC are not recommended as they do not effectively identify seniors with elevated blood glucose levels. Instead,

pharmacists should consider using their expanded scope of practice to order laboratory values, such as an A1c if screening for diabetes in congregate living facility and residential care facilities is required. Second, pharmacists practicing in residential care facilities should adopt a process of care framework, beginning with an initial assessment of current practice in the facility, development of policies and procedures, provision of education, and development of targeted therapeutic interventions. Limited evidence in this area would suggest this approach provides the highest chance of improving diabetes management for seniors in residential care facilities.

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