Examining Differences in Oral Health Status Based on Assessments Conducted by Long-term Care Staff Versus a Dentist

by

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Abstract

Long-term care demand is increasing as Canada's population ages and experiences a growing prevalence of dementia. Long-term care residents are highly dependent on health care providers for ongoing assessment and care due to complex cognitive and other medical conditions. One aspect of health requiring particular attention is the oral cavity. The oral health status of older adult long-term care residents is generally poor and access to dental professionals is limited. Residents require regular oral assessments by health care providers to identify unmet oral health needs which may be detrimental to residents' oral health, systemic health and psychosocial well-being. The only assessment of oral health considered compulsory in Alberta's long-term care facilities is a component of the Resident Assessment Instrument Minimum Data Set (RAI-MDS 2.0).

The present study describes the oral health conditions in a sample of older adult (65+) LTC residents taken from a retrospective chart review from 2009-2012. Each resident had received two independent oral assessments: one by a dentist and another by long-term care staff. Oral health data were extracted from RAI-MDS 2.0 records and were then compared with oral health assessments completed by a dentist on the same resident. Additionally, differences between oral health conditions recorded by a dentist and cognitive impairment using the RAI-MDS 2.0 Cognitive Performance Scale were explored.

Oral health issues were frequently documented during the dentist's oral assessment. Although the percentage of residents with oral health conditions identified by a dentist were generally comparable to other Canadian studies, some notable differences emerged from our study. These discrepancies may be related to varying definitions of oral health items, assessment methods used, and inclusion of residents with cognitive impairment. The findings highlight the challenges and complexities involved when assessing oral health of LTC residents who are frequently affected by cognitive impairment.

In contrast to the dentist's oral assessment, the RAI-MDS 2.0 oral assessments rarely identified unhealthy or problematic conditions. Comparisons between the RAI-MDS 2.0 oral health items and the

oral health assessments recorded by a dentist on the same resident displayed low rates of agreement. These findings suggest that the RAI-MDS 2.0 oral health assessment process may not be meeting the oral health needs of older adults in LTC.

Comparisons of residents who were cognitively intact to those with cognitive impairment revealed significant differences in the proportions of residents with certain oral health conditions. The differences between residents with and without cognitive impairment highlights the need for research specifically capturing the oral health status of cognitively impaired individuals. The cognitively impaired population who are frequently excluded from research samples appear to have unique oral health needs and challenges.

Preface

This thesis is an original work by Nicole Francis Hannigan. The research project, of which this thesis is a part, received research ethics approval December 4, 2012 from the University of Alberta Health Research Ethics Board, Project Pro00034278 – "Does the RAI-MDS 2.0 predict dental need among long-term care residents in Alberta". Alberta Health Services Operational Approval was obtained for accessing data at the Glenrose Rehabilitation Hospital Dental Clinic, and Covenant Health Operational/Administrative Approval was obtained for accessing data at the long-term care facilities.

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List of Abbreviations

CAPs	Clinical Assessment Protocols
CCHSS	Alberta's Continuing Care Health Service Standards
CPS	Cognitive performance scale
HCAs	Health Care Aides
LTC	Long-term Care
OHAT	Oral Health Assessment Tool
RAI-MDS 2.0	Resident Assessment Instrument – Minimum Data Set 2.0
RAPs	Resident Assessment Protocols
RN	Registered Nurse

Glossary of terms

For the purpose of this thesis, terms are defined as follows:

Auxiliary hospital: a hospital for the treatment of long-term or chronic illnesses, diseases or infirmities and provides the basic care of nursing homes [1]

Cognitive impairment: Defined in the present study as a score of 2 or greater on the RAI-MDS 2.0 Cognitive Performance Scale, which indicates deficiencies in short term memory, decision making ability and communication.

Dental condition: health condition or disease specific to the tooth structures

Dental examination: comprehensive, visual and tactile diagnostic examination by a dentist of all oral anatomy; assesses both hard and soft tissues

Full RAI-MDS 2.0: The version of the Resident Assessment Instrument – Minimum Data Set completed for each resident upon admission, annually thereafter, and when a quarterly RAI-MDS identifies a significant change in health status.

Health care aide: Long-term care staff member responsible for providing personal assistance and support services such as bathing, grooming, dressing, toileting, feeding, mobility and exercise as needed. Other titles for this role include nursing aides, residential support workers, nursing attendants, personal support workers and personal care attendants

Long-term care: In Alberta and for the purposes of this study, nursing homes and auxiliary hospitals are considered long-term care facilities. Long-term care provided in both nursing homes and auxiliary hospitals is designed for individuals who have highly complex and unpredictable health needs that require 24-hour on-site management by a registered nurse. Ongoing registered nurse assessment and/or treatment defines the level of care as distinct and more intensive than other levels of continuing care, such as supportive living facilities.

Nursing home: A facility that that provides accommodations and meals; facilities services; necessary nursing services; personal services; therapeutic and special diets as required; drugs and medicine for use on a routine or emergency basis as prescribed by a physician; routine dressings as required; and life enrichment services.[2]

Older adult: Adult aged 65 or older.

Oral: Relating to the anatomy of the mouth

Oral assessment: Screening assessment of all structures and tissues relating to the mouth, which may include the teeth, dentures, gingiva, palate, mucosa, tongue, lips, and saliva, to identify unhealthy or problematic conditions.

Oral care: Personalized mouth care performed with the goal of achieving adequate oral hygiene, and can includes activities such as tooth brushing, flossing, use of interdental brushes, tongue cleaning, denture cleaning and therapeutic oral rinsing.

Oral health: A state of being free from mouth pain and diseases that limit ability to bite, chew, smile, speak and achieve psychosocial wellbeing.[3]

Oral hygiene status: State of oral cleanliness that allows for optimal oral health and prevention of disease that is generally defined by plaque or debris levels.

Quarterly RAI-MDS 2.0: A brief version of the RAI-MDS completed at quarterly intervals.

Resident: Individual who resides in a long-term care facility

Chapter 1: Introduction

Canada's population is aging with an estimated one quarter of the population projected to be over the age of 65 in the next 50 years.[4] Physical and cognitive limitations continue to increase over time in this aging population, resulting in higher demand for professional care delivered in a long-term care (LTC) setting. Competing demands on staff time[5] combined with the increasing health complexity of LTC residents make for an environment in which comprehensive care provision is challenging. Furthermore, cognitive impairment is one prevalent condition in this population[6] that also significantly influences resident care needs. Given these challenges, LTC residents face barriers achieving and maintaining oral health.[7]

For residents in LTC, poor oral health is an ongoing and complex area of concern.[8–14] Moreover, cognitive impairment, a condition afflicting 80% of residents,[6] has been associated with specific negative oral health conditions such as caries,[15,16] poor oral hygiene,[17] and denture compliance.[18] Due to the physical, cognitive, and communication barriers this population faces, residents are often unable to advocate for their own oral health needs. Therefore, oral heath assessments by health professionals are a key component of determining residents' oral health status so that necessary referrals to dental professionals are made and facilities can implement appropriate individualized daily oral hygiene care.

As a requirement of Alberta's Continuing Care Service Standards,[19] long-term care residents receive standardized comprehensive assessments, using the Resident Assessment Instrument, Minimum Data Set 2.0 (RAI-MDS), of their health service needs upon admission to a facility and at set time-points after admission. The findings from RAI-MDS are then used in the development of a personalized care plan that describes the necessary interventions to address each unmet health care need and goal. Two of the twenty-two RAI-MDS sections record oral health information, and serve as the only compulsory oral health assessment in Alberta's LTC facilities.

Documented RAI-MDS assessments of oral health by LTC staff have often conflicted with dentists' findings.[20–24] Additionally, validity analysis of RAI-MDS oral health items has shown a significant underdetection of oral health problems.[25] Health care providers from various disciplines

participate in assessment and care of LTC residents, yet dental professionals have minimal involvement in interdisciplinary health care teams,[26] and nursing or dietary team members are often responsible for assessing RAI-MDS oral health items. Non-dental health care providers without specialized oral health knowledge may have limited understanding and assessment skills,[20,27] contributing to inaccuracies when recording oral health items on the RAI-MDS. As a consequence, the objectives of these assessments, such as evaluation of oral hygiene care and referrals for treatment of oral health problems, may be difficult to achieve.

The present study utilizes data available from RAI-MDS 2.0 assessments and data from oral health assessments completed by a dentist on the same residents at separate time points but within a set time-frame. Although some oral health conditions can change quite rapidly, as in the removal of debris via toothbrushing, other oral conditions remain quite stable over time. For example, dental caries cannot be restored without dental treatment. Likewise, a resident can only acquire dentures by visiting a dentist or denturist. Because of the stability of many oral conditions and low documented rates of dental visits by LTC residents,[11,14] it was possible to compare specific information from the same resident despite the time intervals between analyzed data.

Lastly, this sample included residents with cognitive impairment, a group that is frequently excluded from research.[28] It was possible to include oral health data from residents with cognitive impairment as this project design was a retrospective chart review and did not require any direct intervention or informed consent from individual residents. Other Canadian studies describing the oral health condition of LTC residents excluded residents based on criteria related to cognitive impairment, [11,14] which may result in limited generalizability of their findings to LTC populations with a high prevalence of cognitive impairment. Considering this limitation of other studies, the present study aimed to describe the oral health of both cognitively intact and impaired older adults living in LTC, and to explore the differences between two different oral health assessments completed in this population using a sample inclusive of all levels of cognitive performance.

Research Objective

The overall aim of the present study was to describe and compare the findings from an oral assessment using the RAI-MDS 2.0 completed by long-term care staff, with a separate oral assessment completed by a dentist. This data was available retrospectively using resident charts. Additionally, the presence of oral health conditions was explored based on a resident's cognitive performance status.

Specific Research Questions:

1. What are the oral conditions reported in a LTC population based on an oral health assessment completed by a dentist?
2. How do oral health assessments completed by LTC staff compare with oral health assessments completed by a dentist?
3. What is the oral health condition of residents in LTC with cognitive impairment and how does it compare to residents with intact cognitive performance?

Chapter 2: Background

Canada's Aging Population

Older adults (65+) make up the fastest growing age group in Canada.[4] Many older adults require complex medical care and assistance with activities of daily living, resulting in a large number of people with greater needs who require accommodations with on-site nursing care. In 2011, 4.5% of Canadian older adults resided in nursing homes, chronic care and long-term care (LTC) hospitals.[29] Among older adults, cognitive impairment is the leading predictor of admission to a LTC facility.[30] Once admitted, cognitive impairment impacts the majority (79.9%) of residents and 61.5% of individuals have a diagnosis of dementia.[6] The prevalence of dementia in the Canadian population is projected to rise, creating a 10-fold increase in demand for LTC services.[31] As a result, there is a growing cohort of older adults with unique and complex care needs due to their physical and cognitive impairments.

Long-term Care in Canada

Long-term care facilities provide living accommodation for individuals who require 24-hour supervised care. This includes professional health care, personal care and hygiene as well as meals, laundry and housekeeping. LTC services are not under the governance of the Canada Health Act but rather are independently governed by each province and territory. This provincial governance structure results in a lack of consistency in the services provided, as well as how facilities can be owned and operated.[32] Each province has their own quality assurance standards and process of monitoring and/or licensing LTC sites.[32]

In Alberta, LTC facilities are required to follow the Continuing Care Health Service Standards (CCHSS)[19] to achieve quality health care delivery by using a multidimensional definition of quality that includes acceptability, accessibility, appropriateness, effectiveness and safety. A key aspect of the CCHSS is mandatory completion of standardized assessments for each resident. Based on the findings from these assessments, an interdisciplinary team must create a care plan that includes resident needs, goals and interventions. Additionally, LTC facilities must ensure that the identified needs and

goals are being met, and that the interventions provided are effective. Overall, ongoing standardized resident assessment is a primary focus of the CCHSS.

Standardized Assessment in Long-Term Care - Resident Assessment Instrument – Minimum Data Set 2.0

Development of mandatory, whole-person standardized assessments in LTC facilities was initiated with the Omnibus Budget Reconciliation Act of 1987, which identified a need for improved quality of care in United States nursing homes.[33] Soon after the Act was put into place, the first Resident Assessment Instrument – Minimum Data Set (RAI-MDS) was created, with the intent to facilitate individualized care planning and implementation of quality assurance systems.[34] The RAI-MDS was designed to be a reliable overall health assessment when used by various health care providers and to enable better communication about a resident among multidisciplinary teams. Along with RAI-MDS, over 20 assessment tools for various settings such as home care, palliative care and mental health have been created with the intent that compatible assessment tools can be used across health care sectors.[35]

Currently, many regions throughout the world have adopted a version of the RAI-MDS for use in LTC, including 18 countries and most Canadian provinces and territories.[36] In Alberta, LTC facilities are mandated by the CCHSS[19] to use the Resident Assessment Instrument, Minimum Data Set 2.0 (RAI-MDS 2.0). The full RAI-MDS 2.0 is completed in its entirety upon admission to a facility and repeated annually or when significant changes in health status are detected. Canadian provinces and territories that use the RAI-MDS 2.0 submit both full and quarterly RAI-MDS assessments to a nation-wide database managed by Canadian Institute for Health Information (CIHI) Continuing Care Reporting Service (CCRS). This large compilation of data about LTC residents provides a level of quality assurance across Canadian facilities. Over one decade of data is available in the CCRS to guide LTC funding and quality improvement initiatives as well as enhance accountability for clinicians, facility management and policy makers.[37]

The full RAI-MDS 2.0 reports health status, physical functions, cognitive ability, social supports and resident preferences. The majority of the RAI-MDS 2.0 sections are completed by nursing staff, however other specialized health professionals such as dietitians participate in assessing and recording RAI-MDS 2.0 information, depending on facility-specific policies and staffing structure. Using the information documented by health professionals, the RAI-MDS 2.0 is also designed to generate assessment instrument components and algorithms that identify resident resource requirements, highlight resident care quality indicator items, calculate embedded scales and indices of resident status and prompt additional in-depth assessment protocols to further investigate certain functional, cognitive, social and health conditions. Two versions of these detailed assessment protocols were integrated into RAI-MDS 2.0 assessments: Resident Assessment Protocols (RAPs) and more recently, Clinical Assessment Protocols (CAPs). The CAPs were revised from the RAPs in two major ways: 1) the term 'resident' was eliminated, as some individuals may not be LTC residents, and 2) the content and number of assessment protocols were restructured in order to align with criteria for high quality clinical practice guidelines.[38] In essence, the purpose of a CAP is to guide care planning for the resident through investigation of underlying issues relevant to the condition identified on the RAI-MDS 2.0, with a goal to either resolve the problem, reduce risk of health decline or increase likelihood of health improvement.[39]

Oral Health Assessment: Resident Assessment Instrument – Minimum Data Set 2.0

The RAI-MDS 2.0 records information about oral health and is documented in two sections: Section K—*Oral/Nutritional Status; K1 Oral Problems* and Section L—*Oral/Dental Status; L1 Oral Status and Disease Prevention*. All of the oral health items are recorded on the full (annual) format of the RAI-MDS; however, only the chewing problem item from section K is recorded on the brief quarterly assessments. For this reason, the present study collected RAI-MDS 2.0 oral health data from the full (annual) assessment.

An early version of the RAI-MDS 2.0 also included a detailed assessment protocol for dental and oral health, as part of the Resident Assessment Protocols (RAPs). Documentation of select problematic oral health conditions in Section K or Section L would trigger the dental RAP and subsequently prompt

the assessor through an in-depth investigation of oral health issues by exploring confounding problems, dental treatment history, care planning objectives, risk factors and the need for a referral to a dental professional. After a review was published pointing out weaknesses of the RAPs,[40] new Clinical Assessment Protocols (CAPs) were developed and the dental RAP was dropped from the RAI-MDS.[38] In 2012, at the time of data collection for the present study, participating facilities switched from RAPs to CAPs, eliminating any in-depth assessment protocols regarding oral health. The CAPS do not cover oral health and Alberta's CCHSS[19] do not state any requirements for additional oral health examinations, care-planning or collaboration with dental professionals; therefore, attention to oral health is limited to the content of the RAI-MDS assessment in sections K and L of the form.

Existing literature on RAI-MDS 2.0 Section K—*Oral/Nutritional Status; K1 Oral Problems* and Section L—*Oral/Dental Status; L1 Oral Status and Disease Prevention* has focused on examining the accuracy of oral health information recorded by LTC staff.[20-25,41,42] Problematic oral health conditions are rarely documented on RAI-MDS 2.0 assessments[22] despite poor oral health of LTC residents being identified in the literature.[11,12,14] In addition, when responses by dentists and LTC staff have been directly compared, there has been low agreement across the RAI-MDS 2.0 oral health items.[20,21] Similarly, inconsistencies between findings by a dental professional and RAI-MDS 2.0 data are identified in other comparative studies.[22-24,41] A study by Nordenram and Ljunggren[24] found that documentation of both dental treatment needs and oral hygiene status were markedly different between RAI-MDS 2.0 records and dentist's assessments. Furthermore, a study involving assessments by dental hygienists[41] reported discrepancies in both oral hygiene status and debris level findings when compared to RAI-MDS 2.0 assessment records. The findings from these studies reveal issues about the accuracy of documented RAI-MDS 2.0 assessment items for institutionalized older adults.

Furthermore, a large Canadian study investigated the validity of the oral health items on the RAI-MDS 2.0 (n=73,829).[25] This study was the first to assess relationships of these items with proven predictors for oral health, and concluded that the lack of association of oral/dental items with other variables demonstrates validity concerns and a severe underdetection of oral problems.[25] These conclusions point to a need for further investigation of reasons for the lack of validity, and emphasize

the potential impact that routine, widespread use of assessment tools like the RAI-MDS can have on the quality of oral health care in long-term care facilities.

To date, implementation of the RAI-MDS 2.0 assessment has not been shown to have a positive impact on resident oral health outcomes. Specifically, documentation of RAI-MDS items has not been associated with subsequent dental treatment, raising concerns about the function of the RAI-MDS tool in the current approach to oral health screening and referrals in LTC.[43] Another investigation of the functionality of the RAI-MDS oral health assessment found that the gingival inflammation item was not an accurate measure of clinically significant changes in oral hygiene.[42] This inaccuracy is problematic when attempting to utilize RAI-MDS records as a measure of oral hygiene effectiveness and tailoring appropriate oral hygiene care plans based on RAI-MDS findings. In essence, the RAI-MDS items do not appear to detect the true condition of residents' oral health and have limited utility for referrals and individualized oral care.

Although the RAI-MDS oral health data collected in Canadian LTC facilities has been shown to have low validity,[25] the RAI-MDS assessment process is the only mandated oral health assessment in many Canadian provinces. In Alberta, the RAI-MDS assessment provides information for LTC staff care planning for daily oral care assistance, and is used to evaluate effectiveness of LTC facility interventions to meet residents' oral health care needs. The potential for inaccurate oral health assessment data may substantially impact the direct care of Canadians residing in LTC facilities. As a result of inaccurate individual resident data, the data compiled in the Canadian Continuing Care Reporting Service may also lack validity, limiting its usefulness for both research and policy-making.

Oral Health Assessment Challenges in Long-term Care

The complex conditions and circumstances of LTC residents result in unique challenges to oral health assessment. Dentists who treat older adult LTC residents encounter complex circumstances not present in a healthy population that influence comprehensive care.[44,45] Systematic models for dental examinations of older adults have been proposed to assist dentists in complex situations by guiding the assessment and risk-benefit decision-making process.[45] The components of these models include

clinical examination of hard tissues, soft tissues, dentures and saliva. Comprehensive dental examination goes beyond the oral cavity and also includes medical and cognitive conditions, impact of prescribed medications, personal and caregiver preferences, financial and transportation situations, ability to tolerate the stress of treatment, severity of pain, impact of treatment on quality of life, likelihood of oral hygiene maintenance, and patient's anticipated lifespan, among other issues.[45] Residents in LTC are rarely seen by a dentist,[11,14] so many residents do not routinely experience having a complete dental examination by a dental professional. Ideally, LTC residents would be examined by a dentist upon admission to a LTC facility and at set intervals thereafter.[46] Instead, nursing or other staff (e.g dietitians) are responsible for completing brief oral assessments and identifying oral health needs that require further investigation by a dentist or other dental professional.

Accuracy of nurses' brief oral health assessments in LTC is often low when compared with those of dentists.[21,23,47] Nurses' limited knowledge of oral health may contribute to this inaccuracy. A review of undergraduate nursing textbooks has revealed variation in both quality and quantity of oral health information, as well as outdated or inappropriate information when compared with the recommendations of the American Dental Association.[27] Identifying additional concerns with nurses' oral health knowledge, a survey of undergraduate nursing programs across multiple countries revealed a need for improved oral health education in nursing and found the majority of students in these programs were not being instructed on how to perform an oral assessment.[48] To address this knowledge gap, multiple studies have been conducted to investigate whether providing an educational intervention for LTC staff would improve nurses' oral health assessments.[20,21,41,47] These studies demonstrated short-term improvements in agreement with dentists' assessments. However, long-term studies are required to determine if educational interventions can achieve adequate accuracy in oral health assessment, or if other strategies are required, particularly considering that continuing education seminars have not often demonstrated sustained changes in practice of healthcare providers.[49–51]

Another challenge of oral health assessment is the assessment tool itself. Few oral health assessment tools have been developed and implemented for use by LTC staff and the Brief Oral Health

Status Examination[46] (BOHSE) is the only published, validated and reliable tool that assesses multiple aspects of oral health. The BOHSE has been simplified in response to LTC staff feedback and renamed the Oral Health Assessment Tool (OHAT).[52] The OHAT looks at multiple oral health items(lips, tongue, gums and tissues, saliva, natural teeth, dentures, oral cleanliness and oral pain), and provides descriptive comparisons for users to report the oral health status of residents. Reliability and validity testing has been conducted on the OHAT content specifically for use by non-dental healthcare providers for LTC residents diagnosed with dementia.[52] The OHAT has also received favorable feedback from users, with almost all questionnaire responses indicating that the OHAT improves ability to detect residents' oral pain and problems.[52] However, not all sections of the OHAT have shown adequate validity, and validity testing has not been repeated across multiple samples, which indicates a need for further research on oral health assessment in LTC. Use of the OHAT or another valid and reliable oral assessment tool has been recommended in nursing best practice guidelines,[53] but implementation of the OHAT is currently not mandated across Canada to the same degree as the RAI-MDS 2.0.

Oral Health in Long-Term Care

In 2015, the World Health Organization[54] stated that "life-long oral health is a fundamental human right", and called for recognition that "maintenance of oral and dental health throughout life is a fundamental factor for improving quality of life, helping to protect against non-communicable diseases and contributing towards preventing the aggravation of such disease - it can also contribute to longer healthy life expectancy". Supporting this view, both the Canadian Dental Association[55] and Canadian Dental Hygienists' Association[56] have published statements prioritizing the oral health of this vulnerable population, calling for improved standards and increased access to oral care in LTC. Although these agencies emphasize oral health as a fundamental right and priority in the aged population, studies show that oral disease in LTC remains common.[8–14]

In residents who can communicate their health concerns, poor self-perceived oral health has been documented.[9–11] Common complaints communicated by residents are persistent dry mouth, concerns with function of the dentition and psychological problems such as embarrassment resulting from a poorly functioning dentition.[9–11] It has been suggested that poor oral health may contribute

negatively to the social well-being of long-term care residents, and that more research exploring oral health in the context of body image, social behaviours and quality of life in this population is needed.[57] The oral cavity does not exist in isolation, and the impacts on the whole person – social, psychological and systemic – are significant.

Infrequent access to dental professionals contributes to poor oral health, and Canadian older adults aged 65+ have reported visiting a dentist less frequently than younger adults.[58] In LTC populations specifically, it has been reported that 65% of residents do not have a regular dental care provider and that most residents go longer than one year between dental visits.[11,14] Location of dental care, residents' financial limitations, limited desire by dentists to treat LTC populations, and inadequate assessment of residents' dental needs by LTC staff all are barriers to accessing dental professionals.[59-62] As a result, most residents do not experience timely dental treatment or regular dental hygiene therapy and preventive care.

Regardless of remaining dentition, all LTC residents are at risk of problematic oral health conditions. Problematic soft tissue conditions occur in residents with and without teeth, causing pain, discomfort and infection. Edentulous residents may experience improper denture fit leading to pain and/or difficulties chewing.[11] Residents with natural teeth may experience diseases specific to the teeth, including periodontal disease and dental caries. More people are retaining their natural teeth into old age[13,63], and a high prevalence of dental caries has been noted in LTC residents.[11,12] Additionally, residents' frequent consumption of carbohydrates[64] and use of medications that reduce salivary production[14] result in increased risk of dental caries.

Assessment of dental plaque and calculus deposits have revealed that a state of poor oral hygiene is commonly experienced by residents in LTC.[11] Older adults' teeth are not brushed as frequently in LTC as in the community,[10] contributing to a state of poor oral hygiene. It is recommended by the Canadian Dental Association that teeth are brushed at least twice each day; however, one study revealed that close to half of LTC residents were brushing their teeth less often.[11] In addition to infrequent tooth brushing, daily flossing is also uncommon.[11] Further research on daily oral care routines is needed to fully understand frequencies of other oral hygiene habits, such as use of

interdental brushes, and to determine differences in oral hygiene practices between residents who are brushing independently and those who require assistance from LTC staff.

These basic preventive oral hygiene practices, which include daily tooth brushing, are of minimal risk to older adult LTC residents when compared to dental treatment and are beneficial in helping residents retain functionally and aesthetically valuable natural teeth. This daily care can also prevent serious and potentially painful oral abscesses and infections, for both individuals with and without teeth. In contrast, invasive dental treatment requires a risk-benefit analysis for each resident and may not be an ideal approach for many individuals in this medically complex population.[44,45] For this reason, daily oral care standards have been emphasized by the CDHA,[56] and the inclusion of mandated daily oral hygiene care in Alberta's updated 2016 Continuing Care Health Service Standards[19] is a positive step. However, ongoing and accurate assessments of residents' oral hygiene status are necessary to evaluate whether this standard of daily oral hygiene is adequately maintaining residents' oral health.

Oral-Systemic Health Associations

The high prevalence of both chronic health conditions and oral diseases in LTC residents increases the potential impact of detrimental oral-systemic associations. One such chronic oral disease, periodontitis, has been linked to many age-associated, and biologically complex conditions,[65,66] including diabetes,[67-69] cardiovascular disease[70] and respiratory diseases.[71,72] These associations highlight the importance of oral health on wellness beyond the oral cavity.

Oral health interventions may impact systemic health conditions in LTC, including the outcomes of prevalent conditions such as diabetes and pneumonia. One quarter of Canadian LTC residents have a documented diagnosis of diabetes[6] and observational epidemiological studies have found that periodontal disease is associated with worsened diabetes outcomes.[67,69] In response to this relationship between oral health and diabetes, evidence-based oral health interventions for periodontal disease, such as professional mechanical periodontal debridement along with consistent and effective daily oral care,[69] have been suggested to reduce adverse diabetes outcomes.

Aspiration pneumonia, a common cause of hospitalization and death in LTC residents,[73] is also associated with oral health. Periodontal pathogens in saliva or dental plaque have been shown to be a risk factor for aspiration pneumonia.[74] Accordingly, good oral hygiene and frequent professional oral care can reduce risk of pneumonia and respiratory tract infection in hospitalized elderly people and nursing home residents.[74,75] Although development of aspiration pneumonia is multifactorial and includes aspiration and host response specific risk factors,[76] accurate oral assessments would help to identify LTC residents with the risk factor of poor oral hygiene and increased bacterial load of oropharyngeal secretions. Appropriate oral hygiene interventions to address this specific risk can be subsequently care planned for residents based on the findings from an oral assessment.

Cognitive Impairment and Oral Health

Cognitive impairment includes diagnoses of dementia along with other non-dementia conditions, such as delirium, depression, psychiatric illness, vascular disorders, brain tumors and memory impairments not associated with the normal aging process.[77] Cognitive impairment is defined in the present study as a score of 2 or higher (see Table 2.1) on the Cognitive Performance Scale (CPS), which is a validated algorithm calculated from the RAI-MDS 2.0 assessment. The CPS uses responses from RAI-MDS 2.0 in the areas of short-term memory, cognition skills for daily decision making, expressive communication, eating and comatose status. For a resident to be classified as intact or borderline intact (score of 0-1), the resident must have no more than one impairment in any of the areas of decision making, being understood in communication or short-term memory ability. Two or more impairments in these areas, for example having impairments in both decision making and being understood, would place a resident's score at a 2, representing mild cognitive impairment. As a resident's level of impairment increases in severity, the score increases accordingly, with the highest scores indicating complete inability to make decisions, complete dependence on others with eating and/or being in a comatose state. When individuals are identified as having cognitive impairment, regardless of the score (2-6), it indicates that they have difficulties with decision making and/or short-term memory, which can subsequently affect their ability to perform effective daily oral care. More advanced impairment, specifically regarding communication and being understood, can result in

individuals being unable to self-report oral health problems and therefore become even more dependent on health care providers for oral health care and assessment.

TABLE 2.1 Cognitive Performance Scale Scoring

Score	Category
0	Intact cognitive performance
1	Borderline intact cognitive performance (*One impairment in decision making, making oneself understood or short term memory)*
2	Mild cognitive impairment (*Multiple impairments in decision making, making oneself understood or short-term memory)*
3	Moderate cognitive impairment (*Moderately impaired decision making or severe impairment in making oneself understood.)*
4	Moderately severe cognitive impairment *(Moderately impaired decision making AND severe impairment in making oneself understood.)*
5	Severe cognitive impairment *(Severely impaired decision making)*
6	Very severe cognitive impairment *(Totally dependent on others for eating/comatose status)*

The prevalence of cognitive impairment of residents living in LTC is extremely high, with nearly 80% of Canadian residents identified as having cognitive impairments according to the RAI-MDS 2.0 Cognitive Performance Scale.[6] Despite the high number of LTC residents affected by cognitive impairment, research about older adult populations has frequently excluded these individuals.[28] This exclusion from a research study sample may be appropriate, depending on the aims of research; however, in many cases, no reason or justification has been given for the exclusion.[28] Consequences of

this exclusion include limited generalizability and clinical applicability of research findings to older adults with cognitive impairment, and reduced research benefits for this population.

Furthermore, studies reporting specifically on the oral health condition of Canadian LTC residents have had limited inclusion of residents with cognitive impairment.[9,11,12,14] Based on the sample selection criteria described in these studies, percentages of residents with cognitive impairment are likely far lower than the overall 79.9% documented in Canadian LTC facilities. In one study,[12,14] it was stated that 85.4 % of residents were able to give their own consent, indicating a high level of cognitive ability of participants, particularly regarding communication and decision making. Consequently, the exclusion of residents with cognitive impairment from research capturing the oral health condition in Canadian LTC facilities results in a gap in knowledge in this area.

Cognitive impairment creates specific challenges to maintaining optimal oral health and warrants further investigation to better understand the impact of this impairment on oral health outcomes. Cognitive limitations in the LTC population affect a person's ability to perform oral hygiene, resulting in dependence on others for daily oral hygiene care.[78,79] Poor oral hygiene is a significant concern in LTC populations, affecting up to 92% of residents.[11,14] When residents are dependent on caregivers for oral hygiene, care is sometimes overlooked or omitted by staff.[5,80-82] Moreover, even a mild level of cognitive impairment has been significantly associated with poor oral hygiene.[83] Cognitive impairment can also influence resident behaviour, which can present as a specific barrier for LTC staff attempting to assist residents with daily oral care. Aggressive behaviour is displayed in 42% of non-comatose residents in Canadian LTC facilities,[6] and responsive behaviours such as biting, hitting, or simply refusing to open his/her mouth can make access to the oral cavity challenging for health care providers performing daily oral care.[5,80,81,84,85]

Cognitive impairment has been associated with a lack of compliance with denture usage,[18,86] poor oral hygiene,[17,86-88] higher prevalence of active tooth decay,[15-17,86-88] and lower oral health related quality of life.[89] Research has also shown that LTC staff do not accurately detect oral pain and problems requiring treatment by a dentist when completing oral health assessments of residents with

cognitive impairment.[23] The summation of these many factors explained above suggests a need for more research about the oral health of LTC residents affected by cognitive impairment.

Addressing a gap in knowledge of the oral health of cognitively impaired Canadian LTC residents, this study was able to access oral health information from assessments that had been completed on residents who had a wide range of cognitive performance. This inclusion of residents with cognitive impairment allowed for descriptions of oral health conditions specific to this group of residents, and for comparisons to be made with residents who were cognitively intact. These findings add to the existing literature describing the oral health of Canadian LTC residents by expanding knowledge specific to residents with cognitive impairment.

Chapter 3: Methods

Study Design

A retrospective chart review was conducted using residents' records from two long-term care (LTC) facilities situated in the Edmonton area, Alberta, Canada. Data were retrieved and analyzed from the RAI-MDS 2.0, specifically sections K and L that document oral health information. Secondly, data were also retrieved and analyzed from oral assessments conducted by a dentist that were completed within six months of the RAI-MDS assessment. Resident's records from 2009-2012 were used for this pilot study.

The chart review design of this project allowed the investigator to use standardized RAI-MDS 2.0 data already collected in Alberta's LTC facilities along with data available from existing oral assessment records, which had been recorded by a dentist. The consistent protocol of oral health assessments completed by a single dentist across both LTC facilities reduced concerns of inter-rater reliability of the assessments. Additionally, the retrospective chart review design used existing data which therefore eliminated the need for additional oral assessment of residents and allowed for inclusion of residents with a wide range of health concerns and cognitive abilities.

Research Ethics Approvals

Review by a research ethics board was required for the use of this data. Approval to proceed with the study was attained from the University of Alberta Health Research Ethics Board (Pro00034278) as well as Covenant Health, the Glenrose Rehabilitation Hospital and the Northern Alberta Clinical Trials and Research Centre.

Chart Selection

Charts were selected for review of long-term care residents who had undergone an oral assessment by a dentist. After selecting these dental charts, the residents who also had documentation of a (full) RAI-MDS 2.0 assessment completed within 6 months of the dentist's oral assessment were

identified and included in the research sample. The setting of this 6-month range of time was based on the assumption that minimal changes to oral conditions had occurred in the time between the two assessments. Because LTC residents are infrequently seen by dental professionals, generally less than once per year, it was assumed that most conditions requiring dental treatment would not have changed in this six-month time frame. Recognizing that some oral conditions can rapidly change over time, this assumption of minimal change was further investigated through a secondary analysis comparing the dentist's oral assessment of the same resident that had occurred in two different years.

Inclusion Criteria:

1. Records of both a dentist's assessment and full RAI-MDS 2.0 assessment were available in the 2009-2012 date range.

2. The dentist's assessment and full RAI-MDS 2.0 were completed within a six-month period.

3. The resident was at least 65 years of age at the time of both assessments.

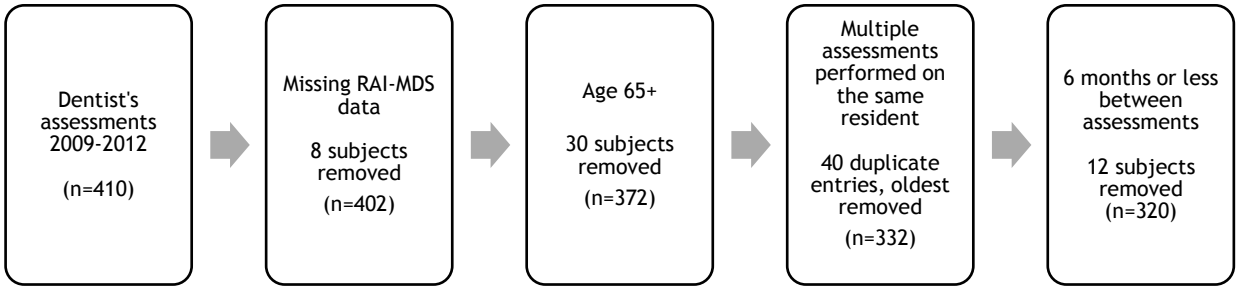
4. For subjects that had multiple oral health assessments completed by a dentist over the 2009-2012 timeframe, the most recently completed assessment was selected to compare with their RAI-MDS 2.0. Older oral health assessments recorded for the same subject were excluded from the primary analysis. The subjects with multiple assessments were used in a separate exploratory analysis of the changes in oral health.

Data Collection

The process for selecting the resident data files for this study is displayed in Figure 3.1. A convenience sample containing all available records of the dentist's oral assessments at selected LTC sites from 2009 to 2012 was obtained. The dentist's oral assessment data was accessed on-site at a hospital clinic, and data was entered by one person into an encrypted Microsoft® Excel® 2008 spreadsheet. Following this step, the data from the full RAI-MDS 2.0 was retrieved through PointClickCare electronic health record software and entered by the same person into a Microsoft® Excel® 2008 spreadsheet. The full RAI-MDS 2.0 was selected to correspond with the dentist's

assessment that had been completed within six months of the date of the RAI-MDS. A random 25% sample of the assessment data was selected to verify accuracy of the collected data. Results from data verification are included in Appendix A, displaying 99.8% accuracy of data entry.

FIGURE 3.1: Chart selection process



Dentist's Oral Assessment Records

The dentist who completed the oral assessments described the process as a visual exam using a flashlight to increase visibility. Additional equipment such as dental explorers or mirrors were also used as required. The brief assessment took approximately 10 minutes per resident to complete. The findings were recorded on the oral assessment form shown in Appendix B by the dentist and a dental assistant. The primary purpose of the dentist's oral assessment in the LTC setting was to serve as a brief screening process to identify residents who would benefit from dental treatment and/or improved daily oral care. The dentist was contracted by a local hospital dental clinic to conduct the oral assessments in various long-term care settings.

Data recorded by the dentist for the oral assessments is shown in Table 3.1. Some items had binary or categorical responses, such as "treatment necessary", while "pain", "xerostomia" and "oral hygiene" allowed for open ended descriptive responses. The original responses shown in Table 3.1 were grouped and organized during preliminary data analysis to provide clarity when describing and comparing the results to the RAI-MDS 2.0 findings. Further explanation of the grouping of these variables is found later in this chapter.

TABLE 3.1: Dentist's Oral Assessment Items

Item	Response Options
Pain Xerostomia Oral Hygiene	Written description
Cervical Caries Caries	Yes / Yes? / No / No?
Dentures (complete or partial)	Yes / No for each type
Number of teeth	Actual numbers recorded
Gingivitis Calculus Plaque	Within Normal Limits / Moderate / Severe
Palate Upper Ridge Lower Ridge	Healthy / Inflamed
Treatment Necessary	Yes / No

Resident Assessment Instrument – Minimum Data Set 2.0 Records

Full RAI-MDS 2.0 assessments were completed and documented by LTC staff according to Alberta's Continuing Care Health Service Standards[19]– within 14 days of admission to the facility, and annually thereafter or when significant changes in health status developed. Only full RAI-MDS 2.0 records were collected in the present study. Quarterly RAI-MDS assessments were not used because they lacked oral health assessment data.

The following data were recorded from the RAI-MDS assessment: date of birth, gender, cognitive performance scale (CPS) score, and information specifically relating to oral health. The date of the first assessment - either RAI-MDS or dentist's assessment, was used to calculate age and length of stay. Table 3.2 provides the list of oral health information recorded from the annual RAI-MDS assessments and the staff member typically responsible for each section. The dental/oral items of the RAI-MDS are recorded in section K (Oral/Nutritional Status) and section L (Oral/Dental Status, Oral Status and Disease Prevention). Staff member(s) completing the RAI-MDS 2.0 oral health sections are instructed to record all conditions that have occurred in the last seven days. Although the exact process used for each resident RAI-MDS assessment was not documented and was therefore not included in our data collection, the LTC staff may have acquired the RAI-MDS oral assessment information in multiple ways such as asking the resident, asking the direct care staff, observing the

resident during meals, inspecting or examining the resident's mouth or reviewing the resident's clinical record. It was also not known if there was collaboration during the assessment and recording of items when more than one staff member documented RAI-MDS oral health findings. The PointClickCare software that is used to record RAI-MDS 2.0 assessments only allowed for a binary response (Yes/No) for the oral health items.

TABLE 3.2 RAI-MDS Oral health information

RAI-MDS Section	Recorded by	Item Recorded	Response Options
K.1 Oral/ Nutritional Status Oral Problems	Dietary team member	Chewing Problem Mouth Pain	Yes/No (last 7 days)
L.1 Oral/Dental Status Oral Status and Disease Prevention	Nurse	Debris (soft, easily removable substances) present in mouth prior to going to bed at night Has dentures and/or removable bridge Some or all natural teeth lost - does not have or does not use dentures (or partial plates) Broken, loose, or carious teeth Inflamed gums (gingiva); swollen or bleeding gums; oral abscesses, ulcers or rashes Daily cleaning of teeth or dentures or daily mouth care - by resident or staff	Yes/No (last 7 days)

The Cognitive Performance Scale (CPS), recorded on the RAI-MDS 2.0, was used to document the resident's level of cognitive impairment. The CPS is calculated on a scale of 0-6, ranging from intact cognitive performance to very severe impairment (coma). The CPS is a valid instrument in assessing levels of cognitive impairment in long-term care residents.[90,91] Residents were classified as having cognitive impairment if their CPS score was 2 or greater.

Data analysis

Statistical analysis was performed using Stata version 13.0 (StataCorp LP 2013, College Station, TX). Statistical analysis was based on known data unless missing values were greater than 5% of the sample. The prevalence and exact 95% binomial confidence intervals were calculated for oral health

conditions recorded by the dentist. Two-sample tests of proportions were calculated for comparisons of oral health conditions between cognitive performance groups. When two sample tests of proportions were not appropriate, Fisher's exact test was used to compare the proportions. Results of comparisons are presented as percentages and corresponding *P* values. A $p<0.05$ was considered for statistical significance.

In order to describe the dentist's assessment findings as binary items, all open-ended responses other than those documented as a no or a no with a question mark, were grouped together and labeled as affirmative (yes) responses. Similarly, items recorded with three categories, such as plaque, were collapsed to a binary item by combining the moderate and severe categories. The sections recording caries in general or specifically recorded as cervical caries were combined to indicate a yes response for presence of caries to compare with the RAI-MDS "caries" item. This preliminary step allowed for calculations of agreement for comparable RAI-MDS 2.0 items with oral assessment items and presentation of p-values using McNemar's test. Because the dentist recorded information about certain conditions based on the presence of natural teeth, item agreement could not be calculated for the entire sample for all conditions. When appropriate, the item agreement is displayed for the subgroup of the sample with teeth.

In addition to presenting overall percentage of agreement between RAI-MDS and dentist's assessments, distinct agreement calculations were completed for residents who were and were not identified as having the selected oral health condition by the dentist. These distinct categories of agreement provided additional information about the LTC staff members' RAI-MDS 2.0 responses compared to the dentist's findings in the presence or absence of an atypical oral health condition. Because the dentist's assessments are assumed to be an accurate record of residents' oral health, these specific agreement rates provide a description of how frequently conditions went undetected by LTC staff or alternatively, how frequently a healthy mouth was misidentified as having an atypical condition.

Chapter 4: Results

Subject Characteristics

At the date of the earliest included chart record, the mean age of the residents was 85.0 years (65 to 105 years). The median length of stay in LTC was 1.6 years with a range extending from 0 to 42.6 years (IQR 0.5 to 3.6). Table 4.1 displays the breakdown of subjects by gender and cognitive performance score. The residents sampled were 71.2% female. Cognitive impairment was present in 81.2% of residents, with the remaining 18.8% having intact or borderline intact cognitive performance. The sample included residents with scores describing all levels of cognitive impairment, from intact (0) to very severe (6).

TABLE 4.1. Subject characteristics by gender and cognitive performance score (n=320)

Subject Characteristic	*n*	(%)	Mean Age	(95% CI)
Sex				
Male	92	(28.8)	83.0	(80.3 to 83.8)
Female	228	(71.2)	86.2	(85.2 to 87.3)
Cognitive Performance Score				
Intact (0-1)	**60**	**(18.8)**		
Intact (0)	17	(5.3)		
Borderline Intact (1)	43	(13.4)		
Impaired (2-6)	**260**	**(81.2)**		
Mild (2)	43	(13.4)		
Moderate (3)	124	(38.8)		
Moderate Severe (4)	44	(13.8)		
Severe (5)	21	(6.6)		
Very Severe (6)	28	(8.8)		

Oral Health Condition: Dentist's Assessment

The oral assessments completed by one individual general dentist (non-specialist dentist) were assumed to be an accurate record of oral health conditions in this study population. Natural teeth were present in 50.9% of residents and of those with teeth, the mean number of remaining teeth was 16.1. In residents with natural teeth, caries, gingivitis, plaque and calculus were common. Descriptive prevalence data of oral health conditions gathered from the dentist's assessment are shown in Table 4.2.

TABLE 4.2 Dentist's oral health assessment findings (n=320*)

Oral **Health** Condition	*n*	*%*	*(95% CI)*
Natural Teeth	163	50.9	(45.3 to 56.5)
Removable dentures (partial or complete)	161	50.3	(44.7 to 55.9)
Inflamed edentulous ridge or palate	67	20.9	(16.6 to 25.8)
Poor Oral Hygiene (fair-poor)	167	54.2	(48.5 to 59.9)
Xerostomia	19	6.0	(3.7 to 9.2)
Pain	46	15.0	(11.2 to 19.5
Treatment Needed	136	42.5	(37.0 to 48.1)
Caries **	96	59.3	(51.3 to 66.9)
Plaque (Moderate/Severe)**	110	70.1	(62.3 to 77.1)
Gingivitis (Moderate/Severe)**	118	75.2	(67.6 to 81.7)
Calculus (Moderate/Severe)**	86	55.1	(47.0 to 63.1)

* Percentages calculated based on known data unless missing values are greater than 5% of the sample.
** Only recorded for residents with natural teeth

Comparisons between RAI-MDS 2.0 Oral Health Assessments and the Dentist's Assessments

To compare the findings from the RAI-MDS 2.0 and the dentist's assessments, the data analysis required an assumption that minimal true changes to oral conditions had occurred in the time frame between RAI-MDS 2.0 assessment and the dentist's assessment. All of the dentist's assessments occurred within 6 months before or after the RAI-MDS 2.0. The mean interval was 79.9 days (SD: 48.1) between the date of the RAI-MDS and the date of the dentist's assessment.

Recognizing that oral health conditions may change over time, we conducted a secondary data analysis that presented frequency of changes in oral health conditions at two points in time in this LTC population. The data collection for this analysis included 40 pairs of oral assessments that were completed by the dentist at two different time points for the same resident. These records allowed for an analysis of what if any change had occurred in the time that had elapsed between the completion of two identical assessment forms by the same dentist. The percentage agreement between the two assessments by the dentist ranged from 70%-100% with an interval of 24 to 36 months between the compared assessments. Based on this subsample analysis, agreement rates between the RAI-MDS 2.0 and the dentist's assessments completed on the same resident up to six months apart were expected to be at least 70%. A table displaying the percentage of agreement for each condition recorded on the dentist's assessment forms at two points in time can be found in Appendix C.

The percentage of residents with documented oral health findings on the RAI-MDS 2.0 are provided in Table 4.3. Oral health conditions such as pain, problems with the teeth, and problems with soft tissues were seldom documented on the RAI-MDS 2.0. The occurrence of daily mouth care was documented for nearly all residents (98.8%).

TABLE 4.3: Number of 'yes' responses for each oral health related item. (n=320)

Assessment by		RAI-MDS n (%)	Dentist's Assessment n (%)
RAI-MDS	Dentist		
Chewing problem	--	141 (44.1)	--
Mouth pain	Pain	1 (0.3)	46 (15.0)
Has dentures and/or removable bridge	Denture	165 (51.6)	161 (50.3)
Some or all natural teeth lost - does not have or does not use dentures	--	69 (21.6)	--
Debris (soft, easily removable substances) present in mouth prior to going to bed at night	Poor oral hygiene	59 (18.4)	167 (54.2)
	Moderate to Severe Plaque*		110 (--)[a]
Broken, loose or carious teeth	Treatment need	14 (4.4)	136 (42.5)
	Caries*		96 (--)[a]
Inflamed gums (gingiva); swollen or bleeding gums; oral abscesses, ulcers or rashes	Moderate to Severe Gingivitis*	3 (0.9)	118 (--)[a]
Daily cleaning of teeth or dentures or daily mouth care - by resident or staff	--	316 (98.8)	--

* Only recorded when natural teeth present (n=163), [a] overall % not calculated.
-- Comparable item was not assessed
Note: p-values for the comparisons of responses for the same individual are presented in Table 4.4

When the RAI-MDS 2.0 assessment and the dentist's assessment captured the same oral health condition, percentages of agreement using assessments from the same resident are presented in Table 4.4. Calculations included overall agreement of the RAI-MDS as well as a breakdown of agreement in the presence or absence of the condition as identified by the dentist. These specific agreement

calculations based on the dentist's response give further information about which situations are associated with the lowest agreement rates between the two assessments

Some of the items on the RAI-MDS 2.0, specifically chewing problems and daily mouth care, could not be directly compared to the dentist's oral assessment because these same conditions were not recorded by the dentist. Additionally, some items on the RAI-MDS 2.0 broadly captured multiple conditions but were compared with more specific conditions documented by the dentist, so rates of agreement are expected to be a bit lower for these comparisons. Treatment need, as determined by the dentist, was selected for comparison with the "broken, loose or carious teeth" RAI-MDS item, with the assumption that the purpose of that item was to identify residents who require referral for treatment by a dental professional.

TABLE 4.4: Agreement between dentist's oral health assessment and RAI-MDS assessment completed by LTC staff (n=320)

Assessment by		Overall RAI-MDS Agreement with Dentist n (%)	RAI-MDS Agreement n (%) (n=Dentist Identified Condition)	RAI-MDS Agreement n (%) (n= Dentist did not Identify Condition)	p-value[a]
Dentist	RAI-MDS				
Pain	Mouth pain	260 (84.7)	0 (0.0) (n=46)	260 (99.6) (n=261)	<0.001
Denture	Has dentures and/or removable bridge	248 (77.5)	127 (78.9) (n=161)	121 (76.1) (n=159)	0.637
Poor oral hygiene	Debris (soft, easily removable substances) present in mouth prior to going to bed at night	161 (52.3)	38 (22.8) (n=167)	123 (87.2) (n=141)	<0.001
Treatment need*	Broken, loose or carious teeth	58 (35.6)	7 (6.7%) (n=105)	51 (87.9) (n=58)	<0.001
Caries*	Broken, loose or carious teeth	70 (43.2)	9 (9.4) (n=96)	61 (92.4) (n=66)	<0.001
Moderate to Severe Gingivitis*	Inflamed gums (gingiva); swollen or bleeding gums; oral abscesses, ulcers or rashes	42 (26.8)	3(2.5) (n=118)	39 (100) (n=39)	<0.001
Moderate to Severe Plaque*	Debris (soft, easily removable substances) present in mouth prior to going to bed at night	69 (43.9)	29 (26.4) (n=110)	40 (85.1) (n=47)	<0.001

*Only recorded for residents with natural teeth (n=163)
[a]Note: McNemar's χ^2 test used for calculation of all p-values. Items compared in calculations are not always identical, but assumed to be comparable for statistical analysis.

Rates of agreement varied depending on whether the dentist identified an atypical oral health condition. Aside from the denture usage item, agreement occurred infrequently when the dentist recorded the presence of an oral health condition (0%-26.4%), suggesting low accuracy of the RAI-MDS 2.0 assessment when an oral health condition was documented during the dentist's brief assessment. When the dentist recorded the absence of an oral health condition, indicating that the item being

assessed was healthy or normal, the corresponding RAI-MDS 2.0 item frequently agreed with this finding.

The only condition to show similar levels of agreement regardless of the dentist's recorded finding was the RAI-MDS item "Has dentures and/or removable bridge". When the dentist recorded an absence of dentures, the RAI-MDS 2.0 displayed the same finding for 76.1% of residents. The RAI-MDS also recorded dentures being present 79.9% of the time when the dentist identified use of at least one partial or complete denture.

Comparisons based on Cognitive Performance Score

The study sample was divided into two subgroups based on the presence of cognitive impairment. Proportions of residents with oral health conditions recorded by the dentist were calculated and compared between the groups. This allowed for differences in oral health to be detected between cognitive impairment status groups. Table 4.5 displays the breakdown of oral conditions according to the presence of cognitive impairment with p-values for the two-sample test of proportions.

TABLE 4.5 Comparison of dentist's findings by cognitive performance score (n=320)

Oral Condition	*% have Oral Condition*		*p-value**
	No cognitive impairment CPS<2 (n=60)	*Cognitive impairment CPS≥2 (n=260)*	
Natural Teeth Present	53.3	50.6	0.701
Removable dentures (partial or complete)	66.7	46.3	**0.005**
Poor Oral Hygiene	41.4	57.0	**0.031**
Pain	15.5	14.9	0.909
Xerostomia	0	7.4	**0.030**†
Treatment Needed	48.3%	40.9%	0.295
Oral Condition - Natural Teeth Only (n=163)	*No cognitive impairment CPS<2 (n=32)*	*Cognitive impairment CPS≥2 (n=131)*	*p-value**
Moderate-severe plaque	53.1	74.4	**0.019**
Moderate-severe calculus	31.3	61.3	**0.002**
Moderate-severe gingivitis	56.3	80.0	**0.006**
Caries	51.6	61.1	0.335

* Calculated using two sample tests of proportions, unless otherwise indicated
†Calculated using Fisher's exact test

Cognitive performance score was not associated with the presence of teeth; however, it was significantly associated (p=0.005) with the presence of dentures, fewer residents who had cognitive impairment wore dentures (46% vs 67%). Cognitive performance score was also significantly associated with documentation of xerostomia, with a higher proportion of reported xerostomia in residents with cognitive impairment (0% vs 7.4%, p=0.030).

The description of residents' oral hygiene was significantly different between the cognitive and non-cognitive groups. For the overall sample, residents with cognitive impairment had a higher proportion of poor oral hygiene (57% vs 41%) compared to those who were cognitively intact (p=0.031). When natural teeth were present, residents with cognitive impairment had significantly higher

proportions of moderate-severe gingivitis, calculus and plaque than those who were cognitively intact (all $p<0.05$).

Chapter 5: Discussion

The purpose of the present study was to describe 1) the overall oral health condition of older adult LTC residents as documented by a dentist, 2) comparisons between assessments completed by LTC staff versus a dentist and 3) comparisons of oral health conditions between residents who were cognitively intact and those who had cognitive impairment. Overall, the dentist's records suggest that atypical oral health conditions were common, a salient finding that frequently disagreed with the oral health assessments completed by LTC staff. Additionally, residents with cognitive impairment had higher proportions of select oral health conditions, when compared with residents who were cognitively intact. The oral health of residents in LTC is discussed in this chapter based on the findings taken from both the dentist's oral assessment records and the RAI-MDS 2.0 records. The findings documented from each of these assessments are compared, exploring percentage agreement between assessments and contrasting aspects of the assessment tools and processes. Associations between cognitive impairment and oral health are described and placed into the context of existing literature. Lastly, suggestions for future research are put forward, with a focus on oral health assessment of cognitively impaired residents in LTC facilities.

Study Population

The study sample was representative of Canadian long-term care populations; age and gender distributions were similar to population demographics reported by the Canadian Institute of Health Information Continuing Care Reporting Service (CCRS) database of RAI-MDS assessments.[37] Distribution of cognitive performance scores in the sample was also similar to both Alberta and Canada taken as a whole, based on CCRS records.[37] In contrast, much of the existing literature describing the oral health status of Canadian LTC residents has excluded individuals with cognitive impairment.[11,13,14,41] This exclusion criteria utilized in other studies has reduced the generalizability of such studies and provided limited information on the oral health status of the cognitively impaired older adult population residing in Canadian LTC facilities. This study was a retrospective chart review that did not require written informed consent from individual residents, but rather a waiver of consent was approved given the study design. Consequently, cognitively impaired residents represented 81% of this study sample, which

allows for greater generalization of these research findings to other cognitively impaired LTC populations.

Oral Health Condition

The findings recorded on the dentist's assessment forms were considered to be a true representation of the oral conditions present in the study sample due to the dentist's extensive knowledge and experience. The prevalence of oral health conditions identified by the dentist in this study are compared with previous studies of LTC populations in Canada and are summarized in Table 5.1. These comparisons are made using the overall sample where appropriate, and using only the subgroup of residents with natural teeth when conditions were only assessed in the presence of teeth.

TABLE 5.1 Prevalence of oral health conditions compared to other Canadian studies

Oral health condition	This Study (%)	Other Studies (%)
Natural teeth	50.8	45 (McKeown 2014)[41] 59 (Matthews 2012)[11] 68 (Locker 2003)[9]
Mean number of remaining natural teeth	16.1	16.4 (Wyatt 2002)[14] 15.8 (Locker 2003)[9]
Removable dentures	50.3	69 (McKeown 2014)[41]
Mouth pain	15.0	8.0 (self-reported joint pain, Matthews 2012) [11] 5.2 (self-reported toothache, Matthews 2012) [11] 6.6 (self-reported, Locker 2003)[9] 24.2 (self-reported, Kotzer 2012)[10]
Xerostomia	6.0	37.3 (self-reported, Matthews 2012) [11] 63.1 (self-reported, Locker 2003)[9] 78 (taking medications with xerostomic side effects, Wyatt 2002)[14]
Poor oral hygiene	54.2	88 (McKeown 2014)[41]
Inflamed edentulous ridge or palate	20.9	12 (denture stomatitis, Matthews 2012) [11]
Needing dental treatment	42.5	69 (Wyatt 2002)[14]
Moderate to severe gingivitis*	75.2	66 (Matthews 2012) [11]
Moderate to severe plaque deposits*	70.1	26 (Plaque Index ≥2, Wyatt 2002)[14]
Caries *	59.3	78.6 (Wyatt 2002)[12] 51 (coronal, 44% root, Matthews 2012) [11] 49 (Arpin 2008)[13] 54 (Locker 2003)[9]

* residents with at least one natural tooth

Natural teeth

The percentage of residents with at least one natural tooth was consistent with other studies in Canadian LTC facilities.[11,41] Similarly, the mean number of remaining teeth was also comparable to previously documented research findings.[9,14] Considering that identification of natural teeth is a straightforward item for dentists to assess, and that cognitive impairment was not associated with the presence of natural teeth in the present study, the prevalence of natural teeth in our sample falls into an expected range that was comparable to other literature.

Dentures

Denture use was less frequent in the present study than in another recent sample of Canadian LTC residents.[41] This difference can be explained by the higher prevalence of cognitive impairment in our sample and the association between cognitive performance and compliance with denture use.[18] Furthermore, our results were consistent with other literature in displaying differences in denture usage between cognitively intact and cognitively impaired residents (Cognitive impairment is explored in detail later in this chapter).

Pain

The percentage of residents with mouth pain (15%) was similar to other Canadian samples which ranged from 5% to 22%.[9-11] Previous studies that captured data on mouth pain selected samples of residents capable of participating in interviews or questionnaires to document self-reported mouth pain.[9-11] Long-term care residents with dementia or cognitive impairment face barriers in communicating the presence of pain of any origin.[92-94] Considering that this sample included 81% cognitively impaired individuals, reliance on self-reported mouth pain would likely under report the true prevalence of mouth pain.[95,96] Through visual assessment of residents, the dentist in the present study was able to recognize pain causing conditions and resident signs or behaviours that were indicative of mouth pain. Future research describing the prevalence of mouth pain in older adult LTC residents with cognitive impairment should strive to use valid assessment tools to identify residents experiencing mouth pain, with specific emphasis on behavioural indicators of pain.[96]

Xerostomia

When comparing the percentage of residents with xerostomia in this sample to other studies, variation in methods of assessment must be considered. Self-reported prevalence of xerostomia in other studies was five to ten times higher than the prevalence identified by the dentist in this sample.[9,11] Furthermore, a study using chart review to identify medications with dry mouth side effects reported that 78% of residents had xerostomia,[14] a prevalence again substantially higher than our results. In the present study, the details for how the dentist completed the oral assessment form was not known but rather, it was understood that the oral assessment was based primarily on a visual examination of the mouth. Therefore, given the high percentage of cognitively impaired individuals in our sample, it is possible that many residents may have struggled to communicate and self-report xerostomia to the dentist but this cannot be substantiated.

Varied methods of assessment of xerostomia provide contrasting prevalence data for the condition across multiple studies.[9,1114] Obtaining accurate data on salivary dysfunction and xerostomia is challenging, and validated assessment tools often rely on questioning the subject.[52,97,98] For this reason, more research is necessary to develop a valid and reliable assessment tool for xerostomia in LTC, with specific consideration for the prevalence of cognitive impairment and barriers to communication and accurate self-assessment[95] that influence residents' response to questions regarding dry mouth. Accurate collection of information on the presence of dry mouth is important for addressing oral health related quality of life concerns[99] as well as identifying a substantial risk factor for the progression of coronal and root caries.[100]

Oral Hygiene

In making comparisons to other research findings, we considered "good" to be equivalent to the term "clean" as it appeared in other studies, although the two terms are not synonymous. Individuals with "good" oral hygiene can be reasonably expected to have some soft removable deposit (plaque or food debris) depending on when oral hygiene was assessed, relative to the last time the teeth were brushed. The percentage of residents with good oral hygiene in this study was higher than

the percentage with clean mouths reported in other studies.[14,41] This can likely be attributed to variability in the definitions and indices used in each assessment process. Despite the lack of a defined index used to categorize resident's oral hygiene status, it is still concerning that less than half of the residents in this sample had a good level of oral hygiene, according to the dentist.

Inflamed Edentulous Ridge or Palate

Twenty percent of residents in this sample had documented inflammation on edentulous ridges or the palate. The most similar condition noted in other literature is denture stomatitis, which was reported at a slightly lower percentage of 12 % by Matthews et al.[11] Inflamed edentulous ridges or palate may be caused by conditions such as infections, poor denture hygiene or denture irritation. These underlying conditions are significant; ill-fitting dentures can be problematic for eating and quality of life, and infections need to be treated, especially in this medically compromised population.

Treatment Need

There are many factors to consider when determining the appropriateness of dental treatment for an older adult in LTC, particularly if they are frail or have a complex medical history.[44,45,79] The sample in the present study included residents with diverse medical and cognitive conditions; therefore invasive and/or restorative dental treatments may have been too risky or inappropriate for some residents. The complex decision-making process and large number of potential factors makes treatment need a challenging item to compare with other research findings. For example, the treatment planning process among dentists may be different, and the physical and cognitive state of residents included in each sample was not equivalent. The percentage of residents identified as needing treatment in this study was lower than the percentage reported by Wyatt[14], and this difference may be related to several factors including cognitive impairment in the research samples. Future research collecting more detailed information about the comprehensive factors contributing to the determination of treatment need would provide a more complete picture of dental treatment needs in LTC populations.

Residents with Natural teeth

The dentist's assessments provided information about the presence of dental caries along with additional oral hygiene details for residents with natural teeth. Specifically, gingivitis and the presence of above normal levels of plaque and calculus deposits were recorded. Each of these oral hygiene related items provides distinct details about oral hygiene care and the health of residents' mouths. Overall, the results of the present study add to the existing literature that generally describes the oral hygiene status of LTC residents who have natural teeth as poor[11,14] and identifies dental caries as a prevalent concern.[9,11-13]

Gingivitis

Gingivitis is defined as a reversible inflammation of the gingival tissues, and is visually identifiable through changes to the colour, contour and occurrence of bleeding. It has been demonstrated that sustained, inadequate plaque removal will result in the development of gingivitis within 1-3 weeks[101]. Furthermore, the presence of gingivitis provides information about longer-term ineffectiveness of plaque removal. Our results showed that 75.2% of residents with teeth had moderate to severe gingivitis, which is higher than the 66% presented by Matthews et al.[11]Although there is a difference in these two percentages, the findings from both studies consistently show that the majority of residents with teeth are affected by gingivitis.

Plaque

Documented levels of plaque deposits provide information on the cleanliness of the teeth at a single point in time. In our sample, 70.1% had moderate to severe plaque deposits at the time of the dentist's assessment, which corresponds with the percentage of residents with gingivitis. In contrast, this number is notably higher than the 26.0 % of residents reported by Wyatt.[14] As noted in the discussion of oral hygiene above, the dentist in the present study did not use a specific plaque index, making direct comparisons to other literature challenging.

Calculus

Calculus deposits consist of plaque deposits that have mineralized over time and can only be removed by a dental professional. The calculus prevalence of 55.1% appears appropriate given the infrequent dental visits noted in LTC populations,[11,14] prevalent plaque deposits[14,41] and the nature of calculus deposits to accumulate over time. It is also uncommon for LTC residents to have a dental hygienist as a regular healthcare provider[11]; therefore, many residents do not experience regular professional removal of calculus deposits .

Dental Caries

Dental caries (decayed teeth) were documented for 59.3% of older adult residents with natural teeth. This percentage was similar to numbers reported in other Canadian LTC samples, which ranged from 49%-79%.[9,11–13] Given the prevalent risk factors for dental caries in LTC, such as poor oral hygiene,[14,41] xerostomia,[9,11,14] and frequent carbohydrate intake,[64] the results of this study align with other findings. Infrequent dental visits[11,14] also contribute to a greater prevalence of untreated dental caries, which can progress to painful abscesses and infections. Considering the infrequent dental visits occurring in this population, residents with natural teeth require routine assessment of the remaining teeth allowing for early identification of potential caries and prompt referrals to a dentist so that residents can receive appropriate diagnosis and treatment.

Comparisons between oral assessments completed by LTC staff versus a dentist

A strength of this study design was the ability to calculate agreement percentages between the documented oral health conditions for the same individual LTC residents by two different assessors in order to answer the research question: How do oral health assessments completed by LTC staff compare with oral health assessments completed by a dentist? When recorded conditions from the two assessments could be directly compared, the analysis generally revealed low agreement, with least frequent agreement when an atypical oral health finding was reported on the dentist's oral assessment. Details about the agreement rates for each oral health condition found on the RAI-MDS are discussed in the following sections. Although some of the assessment information documented by LTC

staff on the RAI-MDS was not directly comparable to the data recorded by the dentist, discussion of these results are included and focus on the proportions of residents with affirmative responses documented on the RAI-MDS with relevant relationships of these findings to other literature.

Oral/Nutritional Status: Oral Problems (Subsection K1: RAI-MDS)

Chewing problems and mouth pain are recorded as part of section K Oral/Nutritional Status of the RAI-MDS. To contextualize the findings from these sections, it is important to first note some complexities in the RAI-MDS assessment process. In the facilities sampled in the present study, a dietitian or dietary team member usually completed section K (oral/nutritional status), while section L (oral status and disease prevention) was completed by a nurse. Staff at the facilities were not interviewed on their procedures while completing the RAI-MDS; therefore, it not known if both the dietician and nurse completed separate visual assessments of the oral cavity to complete their designated sections, and to what degree the dietary and nursing assessors collaborated and communicated oral health findings.

When completing section K Oral/Nutritional Status, the RAI-MDS 2.0 manual instructs the assessor to ask the resident about self-perceived difficulties and observe the resident during meal times. Direction is also given for the staff member to perform an inspection of the mouth to identify abnormalities that could contribute to chewing problems or pain, but no details are provided about the specific abnormalities that the resident should be screened for during this oral assessment. In contrast, information documented under section L, such as broken or loose teeth, oral abscesses or ulcers and use of dentures are examples of abnormalities that can contribute to mouth pain and chewing problems, but in the facilities sampled for this study, these are recorded by separate staff members. Communication between the dietary and nursing staff members completing the two separate sections is therefore an important factor that may influence the RAI-MDS responses and subsequent care planning for mouth conditions in each domain.

Chewing problems

Although it was not possible to calculate agreement between the assessments for this condition in the present study because it was not included in the dentist's assessment, problems with chewing are a critical component of oral health related quality of life[9] that warrants further discussion. Chewing problems were noted for 44.1% of residents, which is comparable to the highest of published RAI-MDS findings (13.1- 44.2%),[22,25,102] but less than 60.4% reported using an index of chewing capacity recorded by a dentist.[9] These findings suggest that a large number of older adult LTC residents experience chewing problems and may experience associated nutritional or quality of life concerns.[103]

A substantial limitation of the RAI-MDS assessment is the absence of details to determine the reason for a resident's chewing problem. For example, chewing problems in this population may be caused by dental concerns such as pain, lack of appropriate occlusal contacts or ill-fitting dentures.[104-106] In contrast, difficulties chewing might be unrelated to dental concerns and may instead be an outcome of neurological or muscular disabilities.[104] Without knowing this differentiation, the information recorded in section K alone provides minimal guidance for LTC staff who are creating a care plan to address a chewing problem and are determining when dental referrals are required. When combined with information about broken or loose teeth and denture use gathered as part of the oral assessment conducted for section L, it may be possible for the LTC staff to suspect a dental cause for the chewing problem and proceed with an appropriate referral; however, these oral health findings must be communicated between the staff members performing each section of the RAI-MDS as well as the individuals responsible for care planning and initiating referrals.

Mouth Pain

Only one resident (0.3%) was documented as having mouth pain on the RAI-MDS 2.0, and this percentage is consistent with other RAI-MDS 2.0 samples which have reported 0.8-1.9% of residents with mouth pain.[22,25,102] Further exploring the documentation of mouth pain revealed that none of the 46 residents (15%) recorded by a dentist as having mouth pain were recorded by LTC staff as having mouth pain on the RAI-MDS. This low rate of agreement on mouth pain aligns with other literature that

has noted discrepancies in the prevalence of mouth pain depending on the health professional conducting the assessment.[22,23]

To explore these discrepancies, methods of assessing mouth pain should be considered. This study was a retrospective chart review; therefore, it is not known how the presence of mouth pain was determined by the dietary staff member completing Section K. In contrast to a non-dental health professional, dentists are trained experts in oral health assessment, and are skilled in identification of potential pain-causing conditions. It was not known what level of knowledge the dietary team member had of oral assessment and identification of pain-causing conditions. Insufficient knowledge and assessment skill by the dietary team member recording mouth pain may contribute to the low rates of agreement found in our results.

Furthermore, mouth pain has been poorly detected in individuals with dementia.[23] This study had a high prevalence of people with cognitive impairment, a condition which may have influenced the low rates of documentation of mouth pain on the RAI-MDS. Similarly, with use of the OHAT, an assessment tool specifically designed for use with all LTC residents, including those who have dementia, limitations in the detection of mouth pain have been noted. [52] Considering the challenges in accurately assessing mouth pain, and the impact of such pain on an individual's quality of life, valid assessment of oral pain in residents with cognitive impairment is a topic that requires further research.

Oral Status and Disease Prevention (Subsection L1: RAI-MDS)

Debris (soft, easily removable substances) present in mouth prior to going to bed at night

In the present study, "debris present in mouth prior to going to bed at night" was documented as being visible in 18.4% of the overall sample. This percentage is higher than other studies that have reported the prevalence of debris on the RAI-MDS at less than 1%.[21,22,41] The dentist recorded moderate to severe plaque deposit on residents' teeth, and this documentation was used as a direct comparison to the "debris" item on the RAI-MDS to calculate agreement between the two assessments. Overall, there was only 43.9% agreement between these two items. The dentist recorded moderate or severe plaque deposits in 110 residents with natural teeth. Of those residents with documented plaque on the

dentist's assessment, the RAI-MDS only agreed with that finding for 26.4% of residents, an even lower number than the overall agreement for this item. Because plaque and "debris" documented on the RAI-MDS are by definition removable substances, it is not expected that assessments completed on different days would be in full agreement, yet the secondary analysis of residents who underwent two assessments by the dentist 2-3 years apart had 100% agreement on the "plaque" item, suggesting that oral hygiene status of the LTC residents in this sample may be somewhat stable over time. Additionally, other literature has reported plaque deposits to be prevalent in LTC residents[14]; therefore, it is unlikely that the low percentage agreement between the RAI-MDS and dentist's assessments can be attributed solely to the time elapsed between assessments, and is instead indicative of discrepancies in the assessment processes used by the nursing staff compared to the dentist. One discrepancy to note is the specification of "night" on the RAI-MDS item; in contrast, the dentist conducted assessments during the day.

Information recorded on the RAI-MDS provided a limited picture of residents' oral hygiene status. The item "Debris (soft, easily removable substances) present in mouth prior to going to bed at night" provides some information on the cleanliness of the oral cavity at that moment in time; however, there are issues regarding the assessment of debris. Firstly, it would require that someone is routinely checking the mouth at night and is either recording it on the RAI-MDS or is communicating this finding to the RAI-MDS assessor. Secondly, the definition and interpretation of debris is unclear. A dental professional may define debris as synonymous with obvious plaque and/or food deposits on the teeth and interpret the amount of debris as representative of poor oral hygiene, with sustained elevated debris levels as an excess risk factor for oral disease. In contrast, a nurse may interpret debris as a lingering food bolus tucked in a cheek or vestibule that presents as choking or aspiration hazard to the resident. The latter interpretation may mean that the "debris" item is not related to dental concerns and instead is indicative of physical or neurological difficulties with eating.[107] The unknown or varied interpretation of "debris" limits use of this item as a record of oral hygiene.

Has dentures or removable bridge

Two RAI-MDS items document information pertaining to denture use: “Has dentures and/or removable bridge” and “Some or all natural teeth lost - does not have or does not use dentures (or partial plates)”. The overall prevalence of “Has dentures and/or removable bridge” was recorded for 51.6% of residents and is similar to the percentage reported on the dentist’s assessments (50.3%). Although the overall percentages were similar, calculated agreement percentages of this RAI-MDS denture item with the dentist’s assessment, using the same resident, revealed some discrepancies.

Given that the staff and the dentist did not perform oral assessments on the same day, it is possible that dentures became lost or damaged in the time between assessments. The analysis conducted on the data from residents who had two assessments completed by a dentist 2-3 years apart showed 80% agreement of the recorded presence or absence of dentures, suggesting that denture use did change with time for 20% of residents. This secondary analysis suggests that the time between assessments by LTC staff and the dentist, set at less than six months, should not contribute to more than 20% disagreement between the assessments.

The presence or absence of dentures as recorded on the RAI-MDS agreed with the dentist’s findings from the same resident 77.5% of the time. Agreement was evenly distributed between the residents with and without dentures as recorded by the dentist. Although the dentist’s assessment can generally be considered accurate in this study because it was completed by licensed dentist who was experienced with older adult patients, the presence and use of dentures may have been susceptible to incorrect documentation. Both the staff members completing the RAI-MDS and the dentist may experience errors in documentation of denture use for reasons such as misplacement or storage of a denture at the time of assessment and/or lack of communication from resident, staff, or other caregivers regarding the use of dentures. The individual performing an oral assessment may also identify a denture with the resident’s belongings and conclude that the resident uses a denture, but be unaware that the resident does not actually wear it. Accurate documentation of denture use is critical, because it contributes to dietary modifications, oral hygiene care planning and referrals for denture fabrication and maintenance. A limitation of the RAI-MDS assessment is the lack of differentiation

between a resident having a denture but not wearing the denture and having a denture and using the denture.

Some/all natural teeth lost – does not have or does not use dentures

The item *"some or all natural teeth lost - does not have or does not use dentures (or partial plates)"* lacks important details, and consequently was not directly comparable to the dentist's assessment. For instance, one missing tooth may not negatively impact on a resident's ability to chew, but a substantial lack of opposing teeth and functional chewing surfaces may increase self-percieved chewing problems,[9] although some edentulous individuals do not report problems with chewing.[108] Many scenarios regarding lost natural teeth may have been present in the mouths of the residents sampled, including residents wearing dentures that do not replace all missing teeth, or residents with fixed bridges or implants replacing natural teeth as alternatives to dentures. *Some or all natural teeth lost - does not have or does not use dentures (or partial plates)* does not differentiate between these conditions, resulting in an item with very little clinical value on its own for both dental and nutritional aspects of care. This item also does not include critical information on the relationship between missing natural teeth and chewing function; However, it may be useful when considered in conjunction with the response to the chewing problem item in section K.

Broken, loose or carious Teeth

The RAI-MDS does not provide clear information on the presence or absence of natural teeth. The presence of removable dentures is addressed on the RAI-MDS, but determining whether an individual has remaining natural teeth is challenging using the RAI-MDS information alone. The assessment form used by the dentist in this study captured information on the number of natural teeth. Documentation of presence of teeth can be particularly useful to LTC staff when determining which daily oral hygiene procedures the resident requires such as tooth brushing or denture cleaning. Identification of existing natural teeth also alerts LTC staff to residents at risk for tooth-related diseases including tooth decay, broken teeth and periodontal disease.

"Broken, loose or carious teeth", the RAI-MDS item addressing tooth-related problems, was recorded for 4.4% of residents in this study. In other literature, this RAI-MDS item has been documented for a similarly low percentage of residents.[21,22,41,43] The dentist's assessment did not document information on loose or broken teeth, but the presence of caries was documented and compared with this RAI-MDS item. In residents with teeth, the dentist identified caries in 59.3%, compared to 8.2% of residents with "broken, loose or carious teeth" marked on the RAI-MDS. This difference in proportions is considerable, particularly noting the RAI-MDS item broadly covers multiple conditions yet was documented for a lower proportion of residents.

Considering that caries are only one of the three distinct items addressed in "Broken, loose or carious teeth", the documented prevalence of this item should therefore be even higher than caries alone, considering it encompasses multiple dental conditions. Because all three of these conditions are reasons for a dental referral and potential treatment, "broken, loose or carious teeth" was also compared with dentist determined treatment need in our sample of residents with teeth. This analysis revealed very low overall agreement at 35.6%, suggesting that the current assessment of broken, loose and carious teeth on the RAI-MDS is not identifying residents in need of dental treatment.

Of the 96 residents identified by the dentist as having dental caries only 9 (9.4%)were also documented on the "broken, loose or carious teeth" item. The secondary analysis of changes to documented dental caries identified by a dentist at two points in time yielded an agreement of 72%, suggesting that the large discrepancies between RAI-MDS and dentist's assessments may be due to challenges faced by the LTC staff when assessing for dental caries, rather than changes to the teeth in the time between assessments.

Low agreement of the documentation of broken, loose or carious teeth by LTC staff when compared to the dentist's identification of both caries and treatment need may be related to multiple factors. Accurate documentation of these tooth related conditions requires knowledge of normal and diseased or abnormal dental anatomy, appropriate equipment including gloves and optimal lighting along with adequate training and oral assessment skill to accurately determine if teeth are broken, loose and/or carious. Evaluation of loose teeth requires manual manipulation of individual teeth, an

action which may depend on the training and comfort level of the nurse conducting the assessment.[20] Brief assessments of oral health in LTC serve as screening tools for dental conditions that require further investigation and/or treatment by a dental professional, so the low agreement in our study raises concerns of whether appropriate referrals can be made based on RAI-MDS oral health assessments.

Inflamed gums (gingiva); swollen or bleeding gums; oral abcesses, ulcers or rashes

A single item on the RAI-MDS 2.0 encompasses multiple soft tissue concerns: "inflamed gums (gingiva); swollen or bleeding gums; oral abscesses, ulcers or rashes". Long-term care staff recorded soft tissue concerns for less than 1% of residents in the overall sample. Comparatively, other studies reporting on RAI-MDS assessments have also shown less than 1% reported prevalence of this item.[22,43] The dentist recorded inflamed edentulous ridges or palate in 20.9% of residents, and 75.2% of residents with natural teeth had moderate or severe gingivitis. Similarly, another Canadian study that conducted intra-oral assessments of LTC residents documented mucosal abnormalities in 41.2 % of residents and gingivitis in 65.6% of dentate residents.[11] In other words, the RAI-MDS item "inflamed gums (gingiva); swollen or bleeding gums; oral abscesses, ulcers or rashes" appears to under detect the prevalence of these conditions.

The percentage agreement between the dentist and RAI-MDS assessments in the present study further support the assertion that soft tissue concerns are not being identified through the RAI-MDS assessment process. There was only 26% agreement between the documentation of gingivitis by the dentist and "inflamed gums (gingiva); swollen or bleeding gums; oral abscesses, ulcers or rashes" by LTC staff. The agreement rate differed noticeably between the group of residents who had gingivitis recorded by the dentist (2.5% agreement) and those who had healthy gingival tissues (100% agreement). Based on the fact that the RAI-MDS item broadly recorded any of the multiple soft tissue concerns with a single "yes" response, it would be expected for there to be disagreement when the dentist documented healthy gingiva, but another soft tissue problem was present. For example, it was foreseeable that a resident may not have had gingivitis, but the RAI-MDS would be documented to indicate the presence of an oral ulcer, resulting in disagreement between the dentist's documentation

of “no gingivitis” and the LTC staff member’s documentation of “inflamed gums (gingiva); swollen or bleeding gums; oral abscesses, ulcers or rashes”; however, this type of disagreement did not occur. In contrast, disagreement was most frequent when the dentist had identified moderate or severe gingivitis, but the LTC staff had documented healthy soft tissues. The RAI-MDS specifically includes inflamed or bleeding gums (gingiva), which is synonymous with gingivitis, so agreement should occur in this scenario based on the definitions, but was only found to be the case for 2.5% of residents.

The low agreement rates and low percentage of residents with soft tissue concerns documented on the RAI-MDS compared to the dentist is concerning. Accurate detection of soft tissue abnormalities can lead to interventions and referrals to remedy pain or infection associated with these conditions. Identification and documentation of the signs of gingival inflammation, such as red or bleeding gums, assists LTC staff in identifying sustained oral hygiene care deficiencies, and initiating referrals to dental hygienists for subsequent assessment and treatment.

Daily cleaning of teeth or dentures or daily mouth care – by resident or staff

The RAI-MDS item “daily cleaning of teeth or dentures or daily mouth care – by resident or staff” was recorded as affirmative for 98.8% of residents. Upon initial observation, this finding indicates that the residents are either performing or receiving daily oral hygiene care. However, the findings documented by a dentist in this study reveal a contrasting state of suboptimal oral hygiene for many residents. It seems apparent that “daily cleaning of teeth or dentures or daily mouth care - by resident or staff” does not provide enough information to conclude that the 98.8% of residents in this sample receive or perform sufficient daily oral hygiene care.

If a “no” response to “daily cleaning of teeth or dentures or daily mouth care - by resident or staff” was recorded, this would indicate that no mouth care or denture cleaning is happening, whereas the “yes” response shows that some oral hygiene care has happened; however, without supplying any other necessary details about the daily care, this information is not useful in the overall care of the resident. Descriptions of specific mouth care activities are not given, and sufficiency of these activities is not assessed. For example, in one resident, “yes” could indicate that the resident removes, brushes

and soaks their partial denture daily, but this care may be inadequate if the remaining natural teeth are not being brushed. For another resident, a "yes" could mean that a staff member brushes the accessible front teeth but does not reach the back teeth due to responsive behaviours limiting access to the mouth. The details in these cases are important so that unmet oral care needs are identified and appropriate care planning can occur.

Independence of the resident for performing oral hygiene activities or assistance provided by staff is not explicitly documented for mouth care on the RAI-MDS. Independence of oral hygiene care is broadly captured in the personal hygiene activities of daily living section of the RAI-MDS, but the specific level of assistance provided for oral care is not known. Research has shown that time is one barrier for HCA's performing oral care[5,80] and in cases where autonomous residents refuse assistance, staff may be inclined to respect this refusal without supervising or assessing a resident's oral care performance, thus freeing up time to accomplish other tasks.[109]

If daily oral care is being provided routinely by HCA's, as the RAI-MDS records indicate (or observed, in the case of independent residents), there may be problems with the adequacy of the oral care. Factors such as time, staffing, training, and resistant behaviours by residents may all influence HCAs performance of thorough daily oral care.[5,80,84,110] Alberta's Continuing Care Service Standards include a requirement of daily oral hygiene care for all residents, but without valid and sensitive assessment of both the delivery and outcomes of oral hygiene care, compliance cannot easily be evaluated.[19,111] A record of who performs daily oral hygiene activities, along with documentation of the specific oral hygiene care performed would provide more information than this ambiguous RAI-MDS item. Furthermore, routine assessment of oral hygiene status, through a validated assessment tool is crucial to determining whether the daily oral hygiene care is meeting the residents' needs.

Another consideration when interpreting "daily cleaning of teeth or dentures or daily mouth care - by resident or staff" is communication between various LTC staff members. In order to complete the RAI-MDS assessment, the assessing nurse is not required to directly observe the daily oral care; therefore, it is possible that some assumptions are made about the completion of daily oral care, resulting in the high percentage of "yes" responses (98.8%). Barriers to communication between HCA's

and nurses affect resident care in LTC,[112] and this may extend to oral care. To further investigate this high affirmative response for this specific RAI-MDS item, communication between staff members regarding oral health and hygiene practices should be considered in future research.

Summary of comparison between RAI-MDS 2.0 and dentist's assessment

Sensitivity of an oral health assessment tool is particularly important for LTC populations, as residents of LTC facilities have a high prevalence of cognitive impairment[2] and may have difficulty self-reporting the presence of oral health problems.[6,92,95] The Alberta Continuing Care Health Service Standards[19] mandate the use of standardized assessments to identify resident care needs in all aspects of health, including oral health. This standardized assessment may be the only routine oral health assessment many residents receive; however, the low proportion of affirmative responses to RAI-MDS items in this sample shows that problematic conditions are frequently undetected. The PointClickCare software that was used to record RAI-MDS 2.0 assessments in the present study only allowed for a binary response (Yes/No) for the oral health items, meaning that if an assessor was unsure or did not obtain complete information about a particular item, it could not be left blank. This software response requirement could also result in a number of the no responses truly being uncertain or 'missing' data, because a yes or no needed to be documented.

There are consequences for LTC residents when an oral health assessment process leads to underreporting of conditions. Oral pain or infection may go undetected, affecting quality of life. Untreated oral problems cause difficulties in chewing and speaking, and may have a negative psychosocial impact on a resident.[9,10] These concerns are often more prevalent in LTC residents than in community-dwelling older adults,[10] and an assessment process should be able to detect individuals in need of dental interventions who cannot communicate those concerns themselves.

In addition to directly impacting the health and function of the oral cavity, oral health problems may also put the resident at increased risk for systemic diseases and complications. In research on LTC populations, oral health has been associated with aspiration pneumonia.[72,74] Oral diseases have been associated with other health conditions such as malnutrition, diabetes and

cardiovascular diseases.[65,66,68,71,113-115] Because the RAI-MDS assessment records in this study did not agree with the documented oral health conditions by a dentist, reliance upon RAI-MDS as the only oral health assessment received by residents may leave residents at an undetected increased risk for other adverse health outcomes.

Ideally, an assessment tool should be able to accurately record oral health information, minimizing errors that both under- and over-document true oral conditions. The RAI-MDS findings in this study suggest low documentation of atypical oral findings, and the impact of this low documentation has been discussed. However, the impact of incorrectly reporting the presence of a problematic oral condition that is truly absent must also be considered when seeking solutions to improve upon the RAI-MDS's weaknesses. In the case of oral diseases in an elderly long-term care population, the potential of incorrectly documenting problems that are not truly present can be detrimental to both the residents and facility resources. Residents who are incorrectly identified as needing dental treatment may be subjected to the challenges, stresses and financial burdens of travelling off-site for dental care when it may not be needed. Any oral health assessment tool implemented in long-term care facilities needs to be thoroughly assessed for accuracy, looking at both the sensitivity and specificity calculations along with evaluations of the risks associated with false negative and false positive screening of oral health problems. These accuracy calculations are necessary to ensure that the tool can identify all residents who have oral health problems, and to minimize unnecessary costs and risks associated with arranging dental care for individuals incorrectly identified as needing dental treatment.

Oral Health Condition: Cognitive Impairment

The results of the present study described oral health differences between residents with cognitive impairment and those who are cognitively intact. Due to the sampling and selection criteria implemented in the research methods of this project, the group with intact cognitive performance (n=60) was much smaller than the group with cognitive impairment (n=260).Two significant results emerged from our findings. Firstly, the proportion of residents with dentures was higher in the cognitively intact group and secondly, the proportions of residents with documented oral hygiene

problems were higher in the cognitive impairment group. In this section, our findings are placed in context with other literature that presents oral health comparisons between cognitively intact and cognitively impaired individuals. The differences between the residents with and without cognitive impairment highlights the need for research specifically capturing the oral health status of cognitively impaired individuals, because research on cognitively intact residents cannot always be generalized to residents with cognitive impairment.

Specific relationships between oral health and cognitive impairment have been documented, including caries,[15–17,86–88] oral hygiene[17,86–88] and denture use.[18,86] Our study did not find a significant association between active dental caries and cognitive impairment, but the number of actively decayed teeth was not used in the analysis, as was the case in other studies.[15–17,86] The information recorded by the dentist only described the presence of any dental caries, with no additional detail about the number of decayed teeth or surfaces.

Denture use

Denture use was significantly associated with cognitive impairment, with fewer residents using dentures in the cognitive impairment group. This aligns with research that has found that older adults with cognitive impairment have less frequent denture use.[18,86] Detailed analysis of denture use over time, presented by Chalmers,[86] has shown that use of dentures declines more rapidly in individuals with dementia. Taji et al[18] also found an association between severity of cognitive impairment and denture use. This information is helpful for dentists determining appropriate treatment plans for older adults with dementia, with the goal of maintaining quality of life and functional ability for eating and communicating, which may be achieved with or without fabrication of a new denture, depending on resident preferences and degree of dementia.[108]

Loss of masticatory functions have also been correlated with cognitive impairment in older adult populations,[103,116] with a specific relationship noted between mastication and cognitive functioning in individuals with full dentures.[117] Discovery of this relationship has lead to suggestions for further research investigating whether chewing as an intervention can influence cognitive function in

older adults with and without dementia.[117] Additionally, future research involving older adults with dementia is suggested to evaluate whether maintaing chewing function affects cognitive performance outcomes, specifically through dental treatment and daily oral care for prevention of oral problems.[103]

Xerostomia

The group of residents with cognitive impairment had a higher proportion of documented xerostomia than the cognitively intact group. Salivary dysfunction is a known side effect of medications used to treat some cases of dementia,[111] so a relationship between cognitive impairment and xerostomia may be present; however, none of the residents in the cognitively intact group had documentation of xerostomia by the dentist. This finding does not align with other studies of cognitively intact LTC residents, with xerostomia prevalence ranging from 37%-78%.[9,11,14] Furthermore, the difference in xerostomia prevalence noted between other studies (41%) is greater than the difference noted between cognitive performance groups (7.4%) in the present study. Although this comparison between cognitive performance groups is statistically significant, within the context of other literature it is apparent that the method of assessing xerostomia in LTC residents needs to be reliable and valid before conclusions can be made.

Plaque, Calculus and Gingivitis

Plaque, gingivitis and calculus levels were documented for residents with remaining natural teeth, and an overall description of oral hygiene status was recorded for all residents. The results of our comparisons of proportions of these conditions between residents with and without cognitive impairment revealed significantly higher proportions of moderate to severe deposits of plaque and calculus and moderate to severe gingivitis in residents with cognitive impairment. In the overall sample, the proportion of residents with poor oral hygiene was also higher in the group with cognitive impairment than the group that was cognitively intact. Similar findings of poor oral hygiene and higher rates of gingivitis have also been found in other LTC samples of residents with dementia.[118] Poor oral hygiene in residents with cognitive impairment may be a result of decreased ability to perform oral care, coupled with behavioural issues that may prevent effective assistance for mouth care from staff

and other caregivers.[119] Additionally, medications used in treating dementia and other conditions associated with cognitive impairment may also impair salivary function resulting in increased plaque retention and risk for plaque related diseases.[119]

Study Limitations

The sample size in this study was not pre-determined, and when the sample was divided into subgroups for analysis, the numbers reduced substantially. This was most apparent in the analysis of cognitive impairment in the subgroup of residents with natural teeth. Additionally, the existing records of dentists' assessments were not developed for research purposes. Valid and reliable indices were not used by the dentist when assessing and recording oral conditions. The findings from the dentist's visual examinations were recorded using broad categories with general descriptors, which were coded for our analysis, but are subject to misclassification. This study also did not include data on any individuals missing from the sample, to determine if there were any differences between the residents in LTC who did not receive an assessment by the dentist, and those who did.

It is a limitation of the study that the RAI-MDS and the dentist's oral assessments were completed at different time points rather than on the same day. As a result, some discrepancies between the two assessments may be a result of the time that had elapsed, not the assessment process itself. For example, visible plaque and soft removable debris can change daily and gingivitis may fluctuate in severity at different points in time. Gingivitis is dependent on plaque levels, but does not resolve or appear as rapidly as plaque. A trend of improved or worsened oral hygiene is required to see a shift in gingival health, making it a superior marker of sustained adequate oral hygiene provision than plaque or soft debris alone. The dentist's oral assessments at two points in time are presented in Appendix C to help explain the changes that occurred in oral hygiene status in this sample over a 2-3 year period of time.

Other conditions, such as broken, loose or carious teeth, mouth pain, and oral abscesses are unlikely or impossible to resolve without a dental intervention; Therefore, if one of these conditions was identified at the earliest oral assessment, it was likely to be present at the time of the second

assessment unless the individual had received dental treatment. However, individual dental treatment records were not obtained as part of this study to verify whether previously identified dental problems had been resolved between assessments through a visit to a dental office.

Additionally, denture use may be discontinued because of loss of dentures, damage to the dentures, poor fit of the dentures, or oral pain. Pain or irritation to the tissues, changes in alveolar bone, or worsening cognitive impairment may be reasons for discontinuing denture use.[18,120] In residents with physical or neurological conditions limiting the ability to open wide, cognitive impairment or responsive behaviors, the procedures for obtaining new dentures can be challenging and may not be an appropriate choice for treatment, especially if compliance for long-term use and continued maintenance is questionable.[18] Consequently, some of the disagreement in regards to denture wearing between the RAI-MDS and dentist's assessments may be attributed to discontinued use of dentures, or potential fabrication of new dentures.

Suggested future research

Content of RAI-MDS Items

The individual RAI-MDS items specific to oral health may require reconsideration and modification in order to capture more accurate data about oral health status. Hoben et al[25] speculated that a lack of validity in the RAI-MDS oral health items may be attributed to vague and poorly defined constructs. The results of the present study suggest a similar concern; even with the difficulty in directly comparing the RAI-MDS items to specific oral assessment items recorded by the dentist due to the terminology differences and vague content of the RAI-MDS items.

Another potential weakness of the RAI-MDS oral health content is that multiple distinct conditions are contained under a single item. More accurate and specific information may be obtained if each aspect of oral assessment was identified and recorded separately. Research has noted that multi-faceted items included in questionnaires do not always result in appropriate time and attention being spent on each individually listed condition.[121] This possible arrangement of the information on the RAI-MDS may be a contributing factor to the disagreement between the documented RAI-MDS

responses and the oral health information recorded by the dentist, which was separately recorded for each condition.

Ensuring that each staff member completing the RAI-MDS has a clear understanding of the items and how to document their findings is critical to the overall management of the resident's care. Interviews with LTC staff were not part of the present study, but it is thought that if interviews with staff were completed, they may reveal how the RAI-MDS terms were interpreted and used. Staff input would be important for future revisions of the RAI-MDS and could guide improvements in the assessment and documentation process in long term care. For example, the item that recorded debris in mouth was recorded infrequently compared to the recorded prevalence of poor oral hygiene and moderate to severe plaque deposits by the dentist. The definition of debris may be a source of this discrepancy in documentation, so clearly defined terminology with effective training for LTC staff who are performing this assessment may improve accuracy in the resulting documentation. Further research is required to determine whether the items require content revision or if other improvements in the assessment process will result in the RAI-MDS achieving improved validity and agreement with dentists' findings.

In addition to lacking validity, the oral health items on the RAI-MDS also lack detail.[25] Many aspects of oral health information are missing on the RAI-MDS in comparison to the validated OHAT. The OHAT[52] provides further information, including specific descriptive terms of health or disease separately for each of the lips, tongue and gums; assessment of salivary flow; documentation of the presence or absence of natural teeth and severity of tooth problems; details on the use and condition of dentures; specific terminology for oral hygiene problems - food particles/tartar/plaque with categories of severity; and descriptions of oral pain signs and behaviours. A lack of detail on the RAI-MDS inhibits comprehensive care planning for oral health; however, requiring more comprehensive oral assessment in long term care must be balanced with time, resources and skills available for the assessment. Future research could continue to build on the findings from the OHAT validity and reliability analysis,[52] with an emphasis on producing an assessment tool that results in accurate documentation of oral health conditions when cognitive impairment is present.

Content revision of the RAI-MDS items may not be the most feasible approach to improving oral assessments in a timely manner. Updates to content in the InterRAI instruments are infrequently completed. Over a decade passed from the release of RAI-MDS 2.0 to the next version, RAI-LTCF. Due to the widespread use of the InterRAI tools internationally, efforts to improve the oral health assessment on the RAI-MDS have the potential to impact a large number of people. One approach toward improved oral health assessment is the implementation of an alternate oral health assessment tool.

Other Oral Health Assessment Tools for LTC residents

One option for conducting a more comprehensive oral health assessment in long term care may be to use an additional validated assessment tool in combination with the mandatory overall health assessment with the RAI-MDS. Most residents in LTC have dementia or other cognitive impairments, so it will be important that any selected or developed assessment tool be specifically tested for use in this population. To date, the OHAT is the only tool that has undergone validity testing for use by non-dental personnel in a population with dementia, however the sections on pain, salivary flow and oral cleanliness still require improvements.[52] Furthermore, consideration must be given to the feasibility of introducing any further assessment and documentation processes in a setting where workload stress is a documented concern.[122] Lastly, without ensuring the staff are adequately trained to assess and complete a more detailed oral health assessment, it does not seem feasible to add further assessment tools.

All sections of the Canadian RAI-MDS process must be completed as part of the Alberta's Continuing Care Health Service standards. These sections also contribute to provincial and national databases used for research, quality assurance and policy making. Adding another assessment tool will require additional time, effort and understanding on the part of the LTC staff, and may not improve the accuracy of the RAI-MDS documentation for oral health. Development of a new assessment tool that directly connects and correlates to the RAI-MDS has been suggested.[41] Although this still adds an extra step to the assessment process, it has potential to add detail to the assessment to improve resident care, as well as improve the accuracy of the RAI-MDS.

Educational Interventions

Staff in LTC may have limited educational training about oral health.[27,48] Results of educational interventions with staff in long-term care have shown short term improvements for increasing the accuracy of documentation of oral health on the RAI-MDS.[21,47] One-time seminar sessions intended to educate current staff in a facility are limited by staff turnover and more research on the long-term effectiveness of nursing continuing education, particularly in long-term care is needed.[49,50] Frequently, educational sessions are delivered in a lecture format with minimal to no demonstrations or hands-on activities to help reinforce the concepts being taught. This format may decrease learning uptake. Learner-centered, participatory workshops may be more effective than didactic lectures.[50] Other approaches to knowledge translation in LTC require further research.[123]

Communication between LTC staff

Accurate documentation of oral health items on the RAI-MDS depends in part on communication between the healthcare aids providing or supervising daily oral care and the nurses and other staff members who are completing the RAI-MDS. Barriers to communication between staff members, such as limited time, contribute to reduced quality of resident care.[112] For example, a staff member completing the RAI-MDS may not document that a denture has been temporarily misplaced by either the staff or the resident. This type of issue would be less likely to occur in a scenario where the daily oral care provider who is aware of the true status of the resident's denture use has strong communication with the nurse or other staff member who is completing the RAI-MDS. The health care providers who complete the RAI-MDS are generally not the ones responsible for daily direct oral care of a resident and they may complete the RAI-MDS oral/dental section with little consultation with health-care aide(s) who know important details about the resident's oral health condition. Ongoing experience with the resident may also improve the assessment of other items such as pain and soft tissue/mucosal problems. Bleeding gingiva, a sign of gingivitis, would be commonly observed by an attending staff member during daily tooth brushing but may not be obvious while conducting a brief assessment unless there was manipulation of the soft tissues. More research is needed on how to advance the

collaboration, communication and accountability for each staff member's role in the provision of daily oral hygiene care and oral health assessment.

Daily Oral Care

Alberta's most recent continuing care service standards[19] have included detail on daily oral care requirements for residents. However, without valid and sensitive assessment of oral health needs and documentation of oral care, ability to address compliance of LTC facilities to these minimal standards of oral care is difficult.[111] The oral assessment completed by a dentist in the present study identified poor oral hygiene as a prevalent concern but the RAI-MDS records did not capture the same oral hygiene concerns. Research is needed to ensure compliance of facilities for providing adequate daily oral hygiene care.

Role of dental hygienists in long-term care

Expanding the role of dental hygienists as integrated team members could contribute to achieving accurate, frequent and comprehensive oral health assessments of all residents. Dental hygienists have the scope of practice that may benefit the LTC population beyond assessment, including care planning and treatment of specific oral health conditions to improve oral health and associated systemic health outcomes. Research is needed to further explore cost-benefit analysis of including dental hygienists in this role in long-term care settings.

The regulation of registered dental hygienists in Alberta allows for independent practice in a LTC setting. Many of the College of Registered Dental Hygienists of Alberta Practice Standards correspond directly with gaps in oral health assessment in LTC. Dental hygiene scope of practice in Alberta includes recording and interpreting oral assessment findings, and determining if further assessment and/or oral health referrals are required. Dental hygienists are also able to identify residents' oral care abilities, and care plan for appropriate oral hygiene interventions. Education of dental hygiene students with older adult populations and in hospital and long-term care settings with older adults is preparing future dental hygienists to work in settings with complex, older adult populations.[124]

Chapter 6: Conclusion

Multiple groups, including the World Health Organization, have designated oral health of older adults a priority.[54-56] The results of the present study add to existing literature on the poor oral health condition of older adults in LTC and suggests a need for action regarding the oral health assessment process.

The dentist's oral assessment records used in this study reveal problematic oral conditions. Discrepancies between the oral condition shown in this sample and in other literature may be caused by inconsistent definitions and interpretations of the terms, assessment methods used, and subject characteristics such as level of cognitive impairment. The RAI-MDS 2.0 records described a low prevalence of oral problems, similar to existing research using RAI-MDS 2.0 assessments completed by LTC staff. Direct comparisons between the RAI-MDS 2.0 oral health items and the oral health assessments recorded by a dentist revealed low rates of agreement and prompts questioning about the suitability of the RAI-MDS 2.0 oral health assessment process in meeting the oral health needs of LTC residents.

Prevalence of dementia and demand for LTC services is predicted to rise as Canada's population ages. The present study describes the oral health condition of cognitively impaired individuals, a population frequently excluded in research samples. Accurate assessment of oral health through a standardized assessment tool such as the RAI-MDS 2.0 for older adults with all levels cognitive performance has potential to improve health and quality of life for residents in LTC facilities. Future research is required to establish effective knowledge translation interventions to improve oral hygiene care and accuracy of oral health assessments in LTC, particularly for individuals with cognitive impairment.

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Appendix A

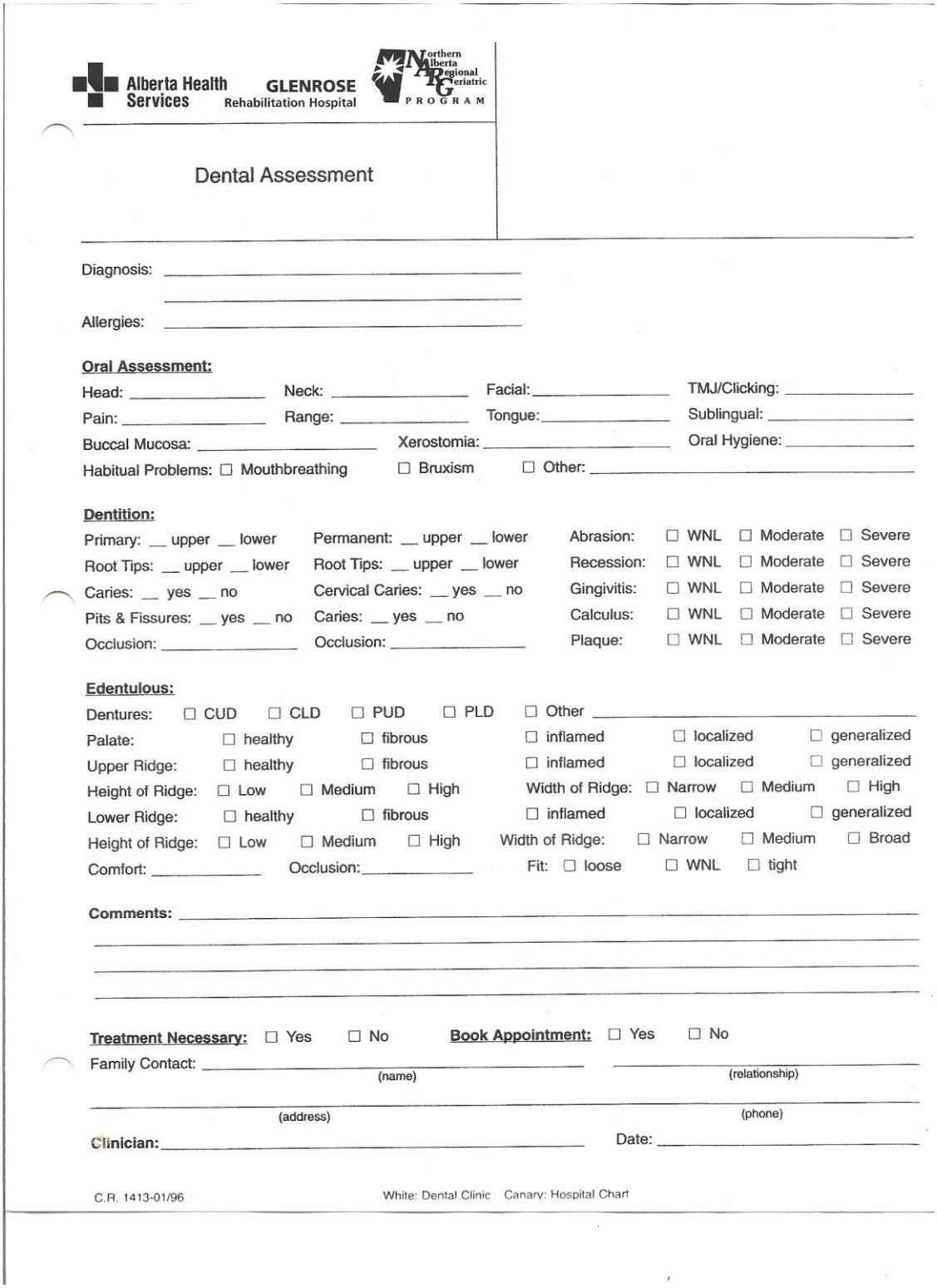
Verification Changes (25% of sample randomly selected for verification using Stata 13 software)

ID	Variable	Original	Changed to
17	RAI-MDS chewing	Yes	No*
17	RAI-MDS debris	No	Yes*
115	DA Treatment needed	No	Yes*
183	RAI-MDS date	2/22/2011	5/22/2011*
190	RAI-MDS date	3/6/2012	6/3/2012*
242	DA Lower ridge	---	Inflamed*
269	RAI-MDS dentures	No	Yes*

7 changes out of (103 subjects x 33 variables) =99.8% accuracy

Appendix B

Oral Health Assessment Form Completed by Dentist



Alberta Health Services GLENROSE Rehabilitation Hospital

Northern Alberta Regional Geriatric Program

Dental Assessment

Diagnosis: _____

_____

Allergies: _____

Oral Assessment:

Head: _____ Neck: _____ Facial: _____ TMJ/Clicking: _____

Pain: _____ Range: _____ Tongue: _____ Sublingual: _____

Buccal Mucosa: _____ Xerostomia: _____ Oral Hygiene: _____

Habitual Problems: ☐ Mouthbreathing ☐ Bruxism ☐ Other: _____

Dentition:

Primary: __ upper __ lower Permanent: __ upper __ lower Abrasion: ☐ WNL ☐ Moderate ☐ Severe

Root Tips: __ upper __ lower Root Tips: __ upper __ lower Recession: ☐ WNL ☐ Moderate ☐ Severe

Caries: __ yes __ no Cervical Caries: __ yes __ no Gingivitis: ☐ WNL ☐ Moderate ☐ Severe

Pits & Fissures: __ yes __ no Caries: __ yes __ no Calculus: ☐ WNL ☐ Moderate ☐ Severe

Occlusion: _____ Occlusion: _____ Plaque: ☐ WNL ☐ Moderate ☐ Severe

Edentulous:

Dentures: ☐ CUD ☐ CLD ☐ PUD ☐ PLD ☐ Other _____

Palate: ☐ healthy ☐ fibrous ☐ inflamed ☐ localized ☐ generalized

Upper Ridge: ☐ healthy ☐ fibrous ☐ inflamed ☐ localized ☐ generalized

Height of Ridge: ☐ Low ☐ Medium ☐ High Width of Ridge: ☐ Narrow ☐ Medium ☐ High

Lower Ridge: ☐ healthy ☐ fibrous ☐ inflamed ☐ localized ☐ generalized

Height of Ridge: ☐ Low ☐ Medium ☐ High Width of Ridge: ☐ Narrow ☐ Medium ☐ Broad

Comfort: _____ Occlusion: _____ Fit: ☐ loose ☐ WNL ☐ tight

Comments: _____

_____

_____

_____

Treatment Necessary: ☐ Yes ☐ No **Book Appointment:** ☐ Yes ☐ No

Family Contact: _____ _____

(name) (relationship)

_____ _____

(address) (phone)

Clinician: _____ Date: _____

C.R. 1413-01/96 White: Dental Clinic Canary: Hospital Chart

Appendix C

Agreement between first and second oral assessment findings recorded by a dentist (n=40)

Oral Condition	Agreement between assessments
Natural Teeth	95%
Removable dentures (partial or complete)	80%
Inflamed edentulous ridge or palate (edentulous only n=20)	70%
Poor Oral Hygiene	82%
Xerostomia	97%
Pain	80%
Treatment Needed	70%
Caries *	72%
Plaque (Moderate/Severe) *	100%
Gingivitis (Moderate/Severe) *	78%
Calculus (Moderate/Severe) *	76%

*Natural teeth only (n=18)

The presence of natural teeth remained similar over the time period, with only 2 residents becoming edentulous between the first and second assessments. All findings had at least 70% agreement with plaque being the only variable to be in 100% agreement between the first and second assessment. Seventy percent of the residents had the same treatment need status documented on both of the dentist's assessments with only one new case requiring treatment at the time of the second assessment. The remaining 27.5% needed treatment at the time of the first assessment, and no longer required treatment at the time of the second assessment. Explanations for the change in treatment need status were not always recorded, but information that could be extracted from the charts included loss of ill-fitting dentures that had originally been treatment planned for repair or replacement, dental treatment had been completed after the initial assessment, or that the resident still had oral problems but the dentist did not recommend treatment at the time of the second assessment.