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Utilization of preventive oral health care by Medicaid-enrolled senior adults during their transition from community-dwelling to nursing facility residence

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UTILIZATION OF PREVENTIVE ORAL HEALTH CARE BY MEDICAID-ENROLLED SENIOR ADULTS DURING THEIR TRANSITION FROM COMMUNITY-DWELLING TO NURSING FACILITY RESIDENCE

by

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CERTIFICATE OF APPROVAL

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MASTER'S THESIS

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This is to certify that the Master's thesis of

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"You're not healthy without good oral health."

Surgeon General C. Everett Koop

Oral Health in America: A Report of the Surgeon General

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Abstract

OBJECTIVE: To establish baseline data of dental utilization and determine the predictors of receipt of dental procedures by Medicaid-enrolled senior adults who reside in Iowa nursing facilities.

METHODS: This was a longitudinal retrospective analysis of Iowa Medicaid claims data for SFY 2007-2014 of senior adults who were 68 years or older upon entry to a nursing facility and continuously enrolled (eligible 58 out of 60 months) in Medicaid for three years prior to and at least two years after admission.

RESULTS: During the 5-year study 52.8% of the subjects never received a dental exam and 75.9% never received a hygiene procedure. Controlling for the subject and nursing facility level variables, the strongest predictor of dental utilization after entry was the receipt of a dental procedure before entry ($p<0.001$). Subjects residing in a facility located in an urban area ($p<0.002$) or in two regions of Iowa ($p=0.035$, $p=0.019$, respectively) also had increased odds of receiving a dental procedure.

CONCLUSION: Our results show that approximately 50% of the subjects never received a dental procedure in the 5-year study period. The strongest predictor of receipt of dental procedures in the 2 years after entry was the receipt of dental procedures in the 3 years before entry. It is important for Medicaid-enrolled senior adults to establish a dental home while community-dwelling.

Public Abstract

Although there is a consensus among authors that oral health among institutionalized elderly patients are worse when compared to their community-dwelling peers, there are no published data for utilization of dental services by senior adults during their transition from community-dwelling to nursing facilities.

Many oral health programs are focusing on increasing access to oral health care for senior adults, however there is a lack of baseline utilization data for analysis of these programs. An objective of this study is to determine predictors of oral health care and establish baseline data for Medicaid-enrolled senior adults.

The present study shows that over half of Iowa Medicaid-enrolled senior adults never received an oral exam or oral hygiene procedure in 5 years while transitioning from community-dwelling to nursing facility residence.

Table of Contents

List of Tables

List of Figures

Chapter I

Introduction

Healthy teeth are important for more than just smiling and socializing; they support chewing, swallowing, speech, and overall health. Consequently, taking care of one's teeth is important to the quality of life and is essential at all stages of life. However, as one ages the level of oral health care, including both self-care and professional care, tends to decline.

Senior adults (those aged 65 or older) make up an increasing proportion of Iowa's general population and are keeping their teeth longer than previous generations. [1] Many senior adults are accustomed to a healthy mouth, but as they age they are likely to face debilitating health issues that affect their oral health. Health issues can force them to rely on others for assistance with Activities of Daily Living (ADL) such as brushing their teeth and other basic actions that independently functioning persons perform. [2] If medical concerns are severe and there is a need for help with ADL, an elderly person may require Nursing Facility Level of Care (NFLOC). The NFLOC is a set of medical and non-medical services provided in a range of locations, from private residences to Nursing Facilities (NF). Specifically, Medicaid includes nursing homes, long-term care facilities, and skilled-nursing centers among NF institutions. [3,4]

Dental decay, periodontal disease and the social consequences of bad breath and a self-conscious smile are well-known oral health conditions that affect people of all ages. Additional issues that are of more concern to the elderly are oral cancer, tooth loss, and poor nutrition. Several studies have researched the connection between oral health and systemic health conditions. Whether residing in the community or in an institutional setting, senior adults experience similar oral health concerns associated with aging. Research suggests that a lack of daily dental plaque removal contributes to periodontal

disease, which can result in an increased risk for aspiration pneumonia, cardiovascular disease, diabetes and possibly dementia. [5-9]

Aspiration pneumonia is a common cause of death among the frail elderly in nursing facilities [5,10,11], but studies have demonstrated that the risk of death can be reduced, and systemic health conditions improved, with professionally performed dental care and assistance with daily oral hygiene. [10,12] Systemic health conditions and medications can influence dental concerns as well. For example, diabetes can contribute to gingival inflammation and bleeding; medications that are essential for the health of the elderly may contain sugar, and many can cause xerostomia (dry mouth), which can contribute to dental caries; other medications may have side effects, such as increased growth of gingival tissues that can lead to periodontal disease; and dementia can lead to care-resistant behavior including resistance to brushing and flossing.

Professional oral care and daily oral hygiene reduce health complications and improve an individual's well-being. [13,14] In the general population, dental utilization varies for many reasons. For instance, age, dental workforce availability, state policy issues, and payment methods can affect access to dental utilization. [15] When a patient resides in a NF, access to oral care and oral hygiene practices are even more severely affected. [16-18] For this reason, dental access for the senior population is the target of recent dental policies in NF in Iowa and various other states. Impediments specific to the elderly include difficulty recognizing the value of keeping their teeth and providing their own effective oral hygiene, inability to physically move around, and especially inaccessibility of dental procedures in their place of residence. [18-21]

The residents' health and mobility, lack of transportation, and the physical inaccessibility of a private dental practices can prevent the frail elderly from getting care in traditional dental setting. [21] At the same time, public health and general supervision of Registered Dental Hygienists (RDH) has helped facilitate preventive oral health services

in institutional settings in Iowa, though these programs are not widely utilized and problems still inhibit the delivery of care to senior adults. Most dentists and RDHs are employed in the private practice setting and therefore may feel ill-prepared, lack the proper equipment, or be otherwise unavailable to deliver care in nursing facilities. Thus, the physical immobility of elderly residents directly affects their access to dental services.

Even if residents are able to overcome the barriers to dental utilization caused by lack of mobility, there is still the issue of paying for the dental procedures received. Senior adults may lack payment methods for dental procedures. [22] Medicare does not cover dental treatment, and dental benefits for adults are an optional state-determined coverage under Medicaid. Numerous reports describe Medicaid dental coverage and usage for all ages, but none has specifically assessed dental utilization by the frail elderly in nursing facilities. [22-24] Senior adults' lack of private dental insurance and reduced discretionary income are also reasons for the lack of dental care received. [23,25]

It therefore seems reasonable to assume that when senior adults move into an institutional setting, their professional dental usage will change. While oral health issues are a major concern in nursing facilities, the amount of professionally delivered dental procedures residents received is unknown, nor is it clear how greatly it differs from the care they received prior to entering a NF. This thesis examined the predictors of annual utilization of dental procedures when a Medicaid-enrolled senior adult entered an Iowa NF. The annual utilization rate was evaluated using specific Medicaid-covered dental procedures codes, cross-referenced with the Medicaid code indicating that the frail elder resided in a NF. This thesis then compared the frequency of those same dental procedure codes prior to the Medicaid-enrolled senior residing in the institutional setting.

The frail elderly in nursing facilities who access professional oral care might receive earlier dental diagnoses and, subsequently, need less complicated treatment, incur lower treatment costs, and have fewer dental and medical complications than those who

have not previously accessed professional oral care. It seems likely that the annual utilization rate of preventive dental procedures will decline when a Medicaid-enrolled, frail elderly resides in a NF. The results of this study will help inform decision makers and future policy aimed at improving the health of Iowa's NF population.

Chapter II

Literature review

A wealth of research exists connecting oral health to systemic health for people of all ages including senior adults. This literature review covers the aging population, their health conditions associated with oral health and their access to dental care.

Definitions

Senior Adults and Frail Elderly

In the decade between 2000 and 2010, persons aged 65 or older were the fastest growing age group in the U.S. In 2014 Iowa, senior adults made up approximately 15.6% of the state's population and this percentage is predicted to rise to 19.8% by 2040. [26,27] For the same years, the U.S. senior adults made up approximately 14.2% of the population and it is predicted that these numbers will increase to 19.7%. [26] While most government reports use the age of 65 as a cut-off point when categorizing age groups, there is no consensus on terms to define this aging population. The U.S. Census and the Centers for Disease Control and Prevention (CDC) classify those 65 years or over as "older." [28] In the literature, those 65 or older identified with debilitating health concerns are defined as "functionally-dependent" [29] or "frail elderly." [30] Medicaid uses "senior adults" and "frail elderly" to categorize the 65 or older population who use health services at a Nursing Facility Level of Care (NFLOC). [3,31] NFLOC includes medical and non-medical services for the frail elderly who need assistance with Activities of Daily Living (ADL) over an extended period of time. [2] The U.S. Department of Health and Human Services defines ADL as the basic actions that independently functioning persons perform on a daily basis including bathing, dressing, transferring to and from a bed or a chair, eating, and caring for incontinence. [2] In this thesis, **"senior adult"** will refer to all people aged 65 or older. **"Frail elderly"** will refer to senior adults who are functionally-

dependent or at a NFLOC. Not every frail elderly person enters a Nursing Facility (NF). The literature commonly differentiates the frail elderly by and their place of residence as "community-dwelling" or "institutionalized."

Nursing Facilities

NF encompass several residential arrangements that provide health-related services and are categorized by the level of care available. NF need to ensure that the physical, mental and psychosocial requirements of each resident are maintained. [32] Multiple levels of care may be offered within the same facility. [33] Skilled nursing facilities deliver a higher level of rehabilitative and medical services than the long-term care facilities that provide health-related care due to mental or physical conditions. Rehabilitation care delivers services associated with injury, disability, or illness. Research literature uses a similar variety of terms for the living arrangements of frail elderly. In this thesis, the term "NF" will be comprehensive of all institutional living arrangements for the frail elderly.

Major Oral Diseases and Conditions

A considerable amount of research has examined major oral diseases and their consequences, specifically among NF residents. Dental caries and periodontal disease, not age itself, are primary risk factors for tooth loss. [34] Senior adults are keeping their natural teeth longer, and it is foreseeable that, as teeth are retained longer, there is a greater likelihood of dental disease. [25,35]

Periodontal Disease

Periodontal disease affects the supporting structures around teeth and can eventually lead to tooth loss. Periodontal disease affects 70.1% of community-dwelling people aged 65 or older. [36] There are different severities of periodontal disease ranging from gingivitis, a reversible condition characterized by swollen and bleeding gum tissues, to periodontitis, an irreversible condition characterized by bone loss around the tooth.

According to the 2009 National Health and Nutrition Examination Survey (NHANES), 64% of adults 65 years or older have either severe or moderate periodontitis. [37] Periodontal disease is also associated with systemic illnesses, adding further health complications. The potential systemic health consequences of periodontal disease in senior adults will be covered later in this chapter.

Caries

Caries is a common oral bacterial infection that can cause tooth problems at any age. In 2014 the U.S. Department of Health and Human Services Appropriations Committee recognized "that dental caries remain (*sic)* the most prevalent chronic disease in both children and adults, resulting in a significant economic and health burden to the American people." [38] Caries can be painful and can lead to dental abscesses and possible tooth loss. Coronal caries occurs on the portion of the tooth above the gum line, while root caries occurs on the portion of the tooth normally covered by the gum tissue. Root caries is an important dental concern and the primary reason for tooth loss in the senior adult population. [39,40] The 1999-2002 NHANES reported that root caries prevalence (including untreated and restored lesions) increases with age from 9.4% among persons aged 20-39 years to 31.6% among those aged ≥60. [41] According to the 2005–2008 NHANES, 20% of senior adults had untreated dental decay. [42] For senior adults living in poverty, the prevalence of untreated decay was three times greater (41%) than that of senior adults living above the poverty level. [42] Research also suggests the dental caries rate among frail elderly is greater in those living in institutions than those living in the community. [40,43] If caries is identified early in the disease process, dentists can restore the affected tooth; if it is left untreated more extensive dental procedures such as root canal therapy or tooth extraction may be necessary.

Oral Cancer

The risk of oral cancer increases with age. Oral cancer is typically diagnosed in people aged 62 or older. [44,45] Oral cancer occurs in tissues of the oral cavity or the oropharynx including the posterior one-third of the tongue, the soft palate, the side and back walls of the throat, and the tonsils. Those diagnosed with oral cancer may also have an additional area of cancer nearby and are at risk for developing other cancerous spots in the oral cavity or oropharynx. [44] In 2014 there were 42,440 new cases and 8,390 deaths from cancer of the oral cavity and pharynx in the U.S. [45] Approximately 42.4% of the new cases and 57.1% of the deaths are in those people 65 or older [45]. The 2000-2004 five-year survival rate was 63%. [45,46] This is a 10% improvement over survival rates in the 1990s, and this improvement has been attributed to early diagnosis and treatment. [44-46] These findings underscore the importance of oral cancer screenings or exams on a regular basis.

Preventive Oral Health

Ample research supports the need for professional dental care and proper daily oral hygiene to prevent cavities, gingivitis, and periodontal disease. The literature uses a variety of terms to describe oral care. The terms "dental hygiene," "oral hygiene," and "dental cleaning" are used in research from outside the U.S., many times without differentiating between professionally delivered care and routine daily oral hygiene. In this thesis, "**Professional Oral Care" (POC)** will refer to services performed by a dentist or Registered Dental Hygienist (RDH) and includes such procedures as dental examinations or screenings, dental prophylaxis, and fluoride treatments. The term **"oral hygiene"** will refer to self-care and care provided by someone other than a dentist or RDH and includes tooth brushing, mouth rinsing, and cleaning in-between tooth surfaces by flossing, or using an interdental brush. The term "dental" will pertain to teeth and

supporting structures, and "oral" will pertain to the mouth including the teeth and supporting structures.

Prophylaxis/Gross Debridement

When performed effectively, oral hygiene removes most plaque and food from the teeth, gingival tissues and mouth. However, even with the best oral hygiene, POC is needed to remove any remaining plaque, debris and stain, and provides an opportunity for an oral evaluation. A dental prophylaxis (prophy), or dental cleaning, removes plaque, stain, calculus (tartar) and debris on the tooth surface. POC is considered preventive, promotes tooth and gingival health, and is performed by a dentist or RDH. When the plaque and debris covering tooth surfaces are extreme and interfere with a comprehensive dental exam , a gross debridement may be performed. [47] Extensive research has examined the frail elderly's oral health in nursing facilities comparing POC to oral hygiene. [19,48-52]Later in this chapter, the review of systemic conditions associated with oral health will support the need for POC for NF residents.

Fluoride

Fluoride prevents caries in teeth at any age [53-55] by strengthening the enamel through remineralization. Fluoride is available in drinking water, in over-the-counter or prescription toothpaste, and in a professionally applied varnish, gel, or rinse. Community water fluoridation serves 74.6% of the U.S. and 92.0% of the Iowa population. [53] Fluoride in all forms has been effective in preventing and reversing early caries and root caries. [54,56] There has been an increase in promoting fluoride varnish programs for senior adults at risk for dental caries, [57-59] but few studies have been conducted on the frail elderly to test the effectiveness of fluoride application. [55] Recommendations for fluoride varnish programs that target senior adults are mostly based upon research with children or generalizations of the effectiveness of fluoride varnish. [55,57,60,61]

Oral Examination and Screening

A medical or dental professional can perform an oral evaluation of extra-oral and intra-oral soft and hard tissues. Oral evaluations can include screening for oral cancer and other oral mucosal lesions and conditions, recording of dental caries, periodontal conditions, existing restorations and dental prostheses. When a dentist performs the oral evaluation, it is considered an exam to diagnose dental conditions and is typically done prior to any oral health services being performed. When a RDH or other licensed health professional performs the oral evaluation, it is considered an assessment or a screening, primarily for data collection or referral to a dentist. A RDH or other licensed health professional may perform select dental services such as the application of a fluoride varnish after a dental assessment.

Health Issues Regarding Senior Adults Keeping Their Teeth Longer

Research indicates that in order to maintain healthy teeth, daily oral hygiene, regular dental visits, and a healthy diet are recommended. Research further connects oral health conditions to overall health, which is often compromised in the senior adult population. According to the 2010 National Health Interview Survey, 45.3% of senior adults had multiple chronic illnesses in 2009 compared to 37.2% of the senior adults in 2002. 62 Some of these health conditions interact with oral health. Tooth loss seems to be declining among aging seniors. The 2012 Iowa Behavioral Risk Factor Surveillance System (BRFSS) reported that of the senior adults who had had a dental visit in the previous year, 17.3% reported all their permanent teeth as extracted 24 which is a decrease from 23.9% reported in the 1999 BRFSS. 63 The fact that this population retains teeth longer leads to intensified needs for oral health care. Dementia, cardiovascular disease and diabetes are identified to be among the most prevalent chronic medical conditions suffered by the frail elderly in nursing facilities. 64,65 As more people are living with more chronic illnesses and are keeping teeth longer, the emphasis on access to

oral health care to meet the multiple health needs of senior adults will also grow in importance.

Tooth Loss and Nutrition

Though people are retaining their teeth longer, tooth loss does occur. Edentulism and partial edentulism are the conditions of having no natural teeth or only some natural teeth, respectively. The 2008 NHANES reported that nearly 23% of senior adults were without natural teeth, and among the poor 37% were affected by total tooth loss as compared to 16% of the non-poor senior adults. [42] Extensive dental caries and periodontal disease, the costs of their respective care, and treatment failures can contribute to tooth loss. Though teeth may be replaced with dentures and partial dentures or implants, tooth loss can adversely affect nutrition, social contacts, speech, and other quality of life issues. [35,66,67]

Food choices are impacted by tooth loss or mouth pain, and in turn, affect socialization in the frail elderly. The frail elderly may be embarrassed over the inability to finish a meal with others and choose a softer diet that may be easier to eat but less nutritious. [14,68,69] Poor food choices can lead to malnutrition, and malnutrition associated with tooth loss and oral diseases can worsen systemic illnesses and social issues in senior adults. The number of teeth present is important for proper nutrition and overall health. [68] In 2009 Savoca et al. evaluated 635 minority adults aged 60 or older as part of the Rural Nutrition and Oral Health Study. They reported that adults aged 60 or older with ten or fewer teeth had a lower adherence to the USDA 2005 Dietary Guidelines for Americans than those adults with more teeth, after adjusting for gender, ethnicity, age, poverty status, and dental insurance. [69] Even when teeth are replaced with dentures there can be concerns. To avoid the same issues as if teeth were not replaced, dentures need to be well-fitting and comfortable to wear to assist the elderly in nutritional intake. [68,70,71] Interdisciplinary approaches are needed between dental professionals and dieticians to

identify and treat nutritional deficiencies leading to oral health problems and conversely oral health problems causing nutritional concerns. [72]

Aspiration Pneumonia

Pneumonia is a lung infection that can be mild or severe and can affect people of all ages. A person's weakened immune system and other medical conditions make the very young and very old most susceptible. Aspiration pneumonia is a common institutionally-acquired infection and can lead to death of the frail elderly in NF. [6,73-75] Aspiration pneumonia occurs when oral bacteria or gastric secretions are inadvertently inhaled into the lungs and the medically-compromised patient is unable to naturally expel the irritants. [76] Oral plaque and periodontal disease have been identified as suppliers of the bacteria associated with aspiration pneumonia. [7,10,75-77]

Several studies researched the association between POC and the reduction in aspiration pneumonia. [6,10,73-79] Adachi et al.(2002) studied counts of *Staphylococcus aureus* and *Candida albicans,* microorganisms known to have an effect on aspiration pneumonia, before and after POC in two nursing facilities in Japan. [80] One hundred-forty-one subjects were randomly assigned to POC or control group. Both groups continued their usual daily oral hygiene regimens. The POC subjects were provided weekly hand scaling, brushing with an electric toothbrush, a swab and interdental brushes, and other appropriate treatments including denture cleaning by a RDH. The control group did not receive any RDH-provided services. Sixty-three subjects completed the entire 24 months of the study, with drop-outs occurring because of death and other unexplained reasons. Of the patients who died during the study (n=10), aspiration pneumonia was indicated as the cause in 5.0% of the POC and 16.7% of the control deaths (Fisher's exact test, $p < 0.05$). The Adachi et al. study demonstrated that NF subjects who received POC had fewer days with fever and fewer deaths due to aspiration pneumonia than the control group.

Yoneyama et al. researched 366 older adults from 11 nursing facilities in Japan. [7] The study began with 417 subjects who had been free from acute illnesses for at least three months prior to study, and had no chronic pulmonary disorder. Subjects were randomly assigned to the POC group (n=184) or to the control group (n=182). The POC group received a dental cleaning by a dentist or RDH once a week and NF staff-assisted in oral hygiene after each meal. The control group did not receive POC or specified project-related assistance with oral hygiene, though assistance was available as part of routine NF services. The dependent variables, (presence of fever, pneumonia and dying from pneumonia) were assessed at six, twelve, eighteen and twenty-four months. Fifty-one subjects were excluded from the results due to death from illnesses not related to pneumonia over the two-year study period. New pneumonia cases were diagnosed more often in the control group than in the group who received POC. Deaths from pneumonia (16%) in the control group were greater than in the oral care group (7%) ($p<0.01$). Febrile days (seven cumulative days with axillary temperature of 37.8° C) occurred more in the control group (29%) compared to those in the oral care group (15%) ($p <0.01$). The findings demonstrated that POC with caregiver oral hygiene assistance could improve medical outcomes for preventing fever, pneumonia and death.

These studies demonstrate that POC and assistance with daily oral care can help reduce prevalence of patients experiencing fevers and death from pneumonia in the frail elderly residing in nursing facilities. Additionally, the CDC Morbidity and Mortality Weekly Report 2004 Guidelines for Preventing Healthcare–Associated Pneumonia specifically recommended a comprehensive oral hygiene program to reduce aspiration pneumonia. [81]

A recent study by Juthani-Mehta did not support oral hygiene as a prevention method for pneumonia in nursing home residents. The oral hygiene activities consisted of twice per day tooth brushing and oral chlorhexidine rinse by trained nursing home

personnel. However, there were several limitations in this research such as the cohort had been at high risk for pneumonia, several participants had enrolled after the study began, and the control nursing facilities oral hygiene practices not observed. [82]

Diabetes

Diabetes is a metabolic disease in which the body cannot properly produce or process insulin, subsequently causing inconsistent blood glucose levels. Diabetes affects 29.1 million people in the U.S. (9.3% of the population) and of that number, 11 million are senior adults (25.9% of the senior adults). [83] The 2004 National Nursing Home Survey reported that 362,000 (24%) of NF residents have diabetes. [65] Diabetes, which is associated with many health concerns including kidney failure, blindness, stroke, heart disease, and premature death, is also associated with periodontal disease. [9,83-85] Medical and dental professionals have investigated diabetes and periodontal disease for many years with conflicting results regarding the causal or bidirectional relationships between the two conditions. [86]

Tsai et al. (2002) investigated the relationship between periodontal disease and glycemic control in 4343 U.S. adults aged 45- 90 years. Data were collected through the NHANES III. The researchers found that subjects with diabetes had a higher prevalence of periodontal disease than those without diabetes. The odds for periodontal disease increased with the increased number of teeth present with subgingival calculus. Also, subjects in the 65–74 age group had statistically significant higher odds of having severe periodontal disease as compared to the younger (45-64 and 55-64) and older (over 75 - 90).[87]

Engebretson et al. (2013) conducted a randomized controlled trial of 514 diabetic adults' ≥35 years with moderate to advanced periodontal disease defined by clinical attachment loss of 5mm and a probing depth of at least 5mm in 2 or more quadrants. [88] The treatment group received scaling and root planing at baseline and supportive

periodontal treatment at three and six months. Each subject in the treatment group also received oral hygiene instructions and chlorhexidine gluconate 0.12% oral rinse. The control group received oral hygiene instructions only at the baseline, three-month and six-month visits. The outcome measure was the HbA1C levels, a marker for glycemic control in diabetics. The researchers concluded that non-surgical periodontal therapy did not lower the HbA1C.

Southerland, et al. (2011) found that diabetes worsens periodontal disease, which then can increase the risk of other systemic illnesses. [89] Though diabetes' bidirectional association has not been proven, the fact that there is a relationship to periodontal disease makes it an important health concern and indicator for consistent oral hygiene and professional oral care. [90]

Alzheimer's Disease and Dementia

Alzheimer's disease is the most common and widely known cause of dementia. The National Institute on Aging reports that in 2013 over 5 million people in the U.S. had Alzheimer's disease [91]. Many times Alzheimer's disease and dementia are used synonymously since Alzheimer's disease accounts for 60% to 80% of diagnosed cases of dementia [92]. Though dementia diagnoses can occur earlier in one's life, the risk doubles at every 5-year interval after the age of 65. [93] In 2013 the CDC reported 48.5% of the nursing home population and 39.6% of residents in assisted living suffer from Alzheimer's disease. [94] As the population of elderly rises we can expect escalations in the demand for medical and long-term residential care for patients with dementia/Alzheimer's disease.

According to the National Institute on Aging, dementia is not a normal part of aging, though it is more common with advanced age. While many older adults live without dementia, as many as half of adults aged 85 years or older may develop some type of dementia. [91] Dementia affects cognitive functioning to a degree that adversely

interferes with a person's daily life. [91,95] The capability to think, remember, reason, and behave appropriately may be altered in persons suffering from dementia. Dementia can also include physical effects such as difficulty with fine motor skills and ADL. [95] Several studies indicate a negative association between oral health and dementia. [8,61,96-104]

Stein et al. (2007) and Gatz et al (2006) conducted longitudinal studies which found an association between a low number of teeth measured at baseline and dementia later in life. [98,99] In both studies, the research subjects were without dementia at baseline. Additional studies also concluded that periodontal pathogens and the inflammatory process are risk factor for developing Alzheimer's disease [8,85,96]. Though the association between periodontal disease and Alzheimer's disease has been established, the bidirectional relationship between the respective diseases' causations and treatments requires further study. [8,86,96,99,100,102]

The changes attributed to cognitive deterioration and poor oral health behaviors are supported by several studies. [61,101,103,105] Compared to those without Alzheimer's disease, the frail elderly who suffer from Alzheimer's can have difficulty with self-care, be care-resistant to any assistance and deny professional care. The care resistance to daily oral hygiene practices places them at an increased risk for caries and periodontal disease. Greater amounts of dental plaque were found in residents with dementia in nursing facilities compared to non-dementia residents. [103] The deterioration of fine motor skills, inability to remember how to perform tasks learned early in life, and simply not remembering can all affect regular tooth brushing. [91,95,101,105] People with Alzheimer's disease may not allow others to assist them with oral hygiene. [67,101,103] The physical impairments and related cognitive concerns of Alzheimer's can lead to increased dental disease and difficulty obtaining required daily oral hygiene and professional dental care.

Cardiovascular Diseases

According to the World Health Organization, Cardiovascular Diseases (CVD) are a group of conditions of the heart and blood vessels. CVD include coronary heart disease, cerebrovascular disease, deep vein thrombosis and pulmonary embolism. Heart attacks and strokes are caused by CVD [106]. Over 83 million American adults have one or more types of CVD and approximately half of those adults are ≥60 years of age. For the 60 - 70-year-old age group approximately 70% of men and women have CVD [107]. In that same age group 21% of men and 10% of women have experienced a heart attack and 6.2% of men and 6.9% of women have experienced a stroke [107].

Several studies have found an association between CVD and periodontal disease [86,89,108]. Periodontal disease and CVD have common risk factors such as smoking or diabetes [109]. Southard et al. (2012) conducted a large study (n>6000) in several U.S. sites to measure the relationship between CVD, diabetes, and periodontal disease. Their findings suggest that people with co-diagnoses of diabetes and periodontal disease might be at increased risk of heart disease compared to those people with diabetes alone [89].

Factors Affecting Access to Care

Nursing Facility Responsibility

NF, which provide services to Medicaid or Medicare enrollees, have state and federal requirements to meet. Included in these mandates is a Minimum Data Set (MDS) evaluation for each resident within 45 days of admission [110]. The MDS is a comprehensive and standardized clinical assessment of each resident's functional capabilities and is intended to identify health problems [110]. The MDS oral health component evaluates full and partial dentures, the lack of natural teeth or the existence of tooth fragments, abnormal mouth tissue, obvious cavities or broken natural teeth, swollen or bleeding gums, loose natural teeth, mouth or facial pain, and discomfort or difficulty with chewing [110]. A registered nurse from the NF screens the frail elderly and completes

the MDS. The findings of the MDS screening become part of the resident's care plan. The only finding mandated for "prompt referral" to a dentist is a missing or broken denture.

The Centers for Medicare and Medicaid Services (CMS) State Operations Manual [32]requires NF to assist residents with dental/denture care and be "directly responsible for the dental care needs of its residents. The facility must ensure that a dentist is available for residents" [110]. Additionally, the mandate requires a NF to make appointments; arrange for transportation to and from the dentist's office; and to promptly refer to a dentist when the resident has lost or damaged dentures [110]**.** The issue of transportation to oral health services continues to be a concern among Iowa NF administrators [18,24].

Workforce

Caregivers play an important role in the oral health of the frail elderly. When the frail elderly are in a NF, they may have the ability for self-care oral hygiene. However, if they suffer from dementia or physical disabilities, they may need to be reliant on others. Studies have assessed the frail elderly's oral health status with various combinations of oral hygiene providers, the resident's self-care and oral hygiene provided by the NF staff or dental professionals [19,48,49,111]. The research has also examined dental professionals as the educators or coaches for NF staff and providers of POC [19,61].

Nursing Facility Work Force

Several studies examining caregiver types have measured oral health indices as the outcome variable [12,19,48]. A study by Sloane et al. (2013) researched plaque, gingival, and denture plaque indices in 97 older adults in three North Carolina nursing facilities. Staff members specially trained in oral health care performed oral hygiene for the study subjects. All oral hygiene indices were measured at eight weeks and showed statistically significant improvement compared to the baseline scores (plaque index and gingival index p-values ≤ 0.0001; denture plaque index p-value≤ 0.04). Other studies reported

similar oral health improvements though several research studies reported that this improvement diminished if the caregivers did not receive periodic retraining [12,48,49]. Studies that found the most improved oral health indices used models with POC combined with NF staff care as compared to NF provided care only [12,48,73,76].

A combination of delivery systems, self-care or caregivers educated to provide daily oral hygiene with POC will have the most promising oral health outcomes [61,112]. Dentists and RDHs may be cost prohibitive to employ on site to provide oral hygiene on a regular basis. Additionally, NF staff report difficulties with providing oral hygiene care [20]. These difficulties can be attributed to care-resistant behavior, staff turnover, uncertainty in providing the oral hygiene care, inadequate supplies, or insufficient time each day [20,43,61,67,101].

Oral health data are usually self-reported by the community-dwelling population, while the data for institutionalized frail elderly are usually collected by dental health professionals. A vast amount of research supports the need for oral health services and proper oral hygiene in the NF population [6,21,30,50,51,73,111,113,114]. Senior adults are at risk for many physical health problems, especially those systemic conditions associated with poor oral health. Studies support that POC and daily oral hygiene can result in improved systemic and oral health [10,52,80]. Consequently, the frail elderly are in continued need of oral care after entry into a NF. In fact, due to health limitations common to residents of nursing facilities, the frail elderly most likely need more care than their community-dwelling counterparts [43]. Systemic conditions can be improved by receiving POC, self-care, and assisted-daily oral hygiene.

NF staff are the initial providers of oral health care services to the institutionalized frail elderly. A registered nurse performs the MDS screening and the Direct Care Worker (DCW) assists residents in the ADL which includes daily oral hygiene [110]. According to a 2007 survey of nursing staff, DCWs feel they do not have

enough time for providing personal care to their residents which then increases the likelihood of leaving their job. The same survey reported a 66% annual turnover rate of DCWs in nursing facilities [115].

Dental Work Force

According to the Commission on Dental Accreditation, dental and dental hygiene education must include experiences with the vulnerable elderly [116]. The University of Iowa College of Dentistry educates third and fourth year dental students with didactic and clinical geriatric dentistry courses and offers a graduate level certificate in Geriatric and Special Needs Dentistry. The University of Iowa's College of Dentistry's Geriatric Mobile Unit (GMU) gives dental students an opportunity to provide geriatric care at ten eastern Iowa nursing homes. The dental hygiene programs in Iowa also require didactic and clinical geriatric experiences and offer a variety of additional opportunities outside the school setting to treat senior adults.

Even if dental professionals are well educated, there are still obstacles in providing care to the frail elderly. After graduation and licensure, dentists and RDHs are primarily employed in private, solo or group dental practices [117,118]. Bedridden and frail elderly who require sedation (such as those with dementia) are not able to access a traditional private dental practice [30]. Other limitations such as the lack of wheelchair ramps, difficulty of transferring from wheelchair to dental chair, narrow doorways, transportation unavailability, as well as medical and health complications can impede the frail elderly's access to a private dental practice.

While the frail elderly have challenges to access care in a dental practice there are also obstacles for dental professionals to provide care in the NF, such as the lack of available dental equipment, the residents' medical conditions, the extent and severity of the dental condition, the dentist's preferred location for providing care, and the NF having accommodations dedicated to dental practice [18,30]. In a 2011 survey of Iowa

dentists and NF administrators it was found that a minimal amount of dental care is provided in the NF and that the dentists preferred to deliver care in their practices. The survey reported that 44.5% (49/110) of the directors of the nursing had some dental treatment provided at their NF and 92.7% (102/110) had care at dental offices. Over 36% (70/191) of the responding dentists reported providing some care at nursing facilities [18].

Even with the known limitations of delivering care to the frail elderly in the NF, a common model, such as the GMU, is the use of portable/mobile dental equipment which is brought into the NF to provide the care. Public and private programs employ dentists, RDHs and dental assistants to care for the frail elderly. Services are limited to procedures that can be safely provided in the NF setting as well as within the scope of practice of the dental personnel delivering the care.

Policy

Many states have practice acts that allow RDHs to work in nursing facilities. There can be additional educational requirements and certificates that RDHs have to meet prior to delivering care to the frail elderly outside the traditional dental practice [119]. In Iowa, "general supervision" enables the RDH to see a patient without a dentist present. General supervision would cover the RDH providing the full scope of practice with the exceptions of local anesthesia and nitrous oxide after a dentist has examined and authorized treatment, as well as screening and data collection for a dentist's definitive diagnosis prior to a dentist's examination. Another level of supervision in Iowa is "Public Health Supervision" (PHS). Under PHS, a RDH can enter into a collaborative agreement with a dentist, allowing the hygienist to provide authorized services to patients prior to those patients being examined by a dentist. Authorized services are similar to general supervision but are limited to the preventive services agreed upon by the supervising dentist and RDH [120] . The collaborating dentist has no requirement to see the patients

treated under PHS. The dental services provided by RDHs under PHS were considerably fewer in nursing facilities than in other public health sites [121].

Reimbursement Mechanisms and Locations for Care

Private or public insurance, self-pay, and other payment programs reimburse for POC provided at private dental practices, federal, state or local public dental programs, and nursing facilities. In general, a senior adult with private dental insurance usually will lose coverage upon retirement [22,66]. Though the data are lacking on residents of NF, there are data available for senior adults who are community-dwelling. Studies demonstrate that insurance coverage affects medical and dental utilization [22,23,25,122,123]. In short, the cost of dental treatment may be simply unaffordable for the senior adult [22,23]. The 2004 Medical Expenditure Panel Survey (MEPS), a series of surveys of individuals, health providers, employers, and insurers conducted through the Agency for Healthcare Research and Quality reported about 70% of U.S. senior adults had no dental insurance coverage, 24% had private insurance and 6% had public insurance [22]. Unfortunately, this survey covers only U.S. civilian community-dwelling population and not the NF population. The same MEPS reported that between 1996 and 2004 there were no significant changes in percentages of senior adults with public, private or no dental coverage.

Medicaid and Medicare

Medicaid and Medicare, two public health insurance programs, help cover healthcare costs. Iowa is one of about 25 states that provide comprehensive adult dental benefits through Medicaid [24,123]. Medicaid primarily relies on income for determining eligibility, while the eligibility for Medicare is age-based, beginning at 65 years old. In 2008, there were 9.2 million frail elderly in the U.S. and over 85,000 frail elderly in Iowa who were "dual-eligible," i.e. having Medicaid payment for long-term care services and Medicare payment for acute health care services and prescriptions [124,125]. Of those dual-

eligible frail elderly, 60% had multiple chronic health conditions and 19% resided in institutional settings [126].

CMS mandates nursing facilities follow a minimum set of health and safety standards to be considered Medicaid-qualified and to have the ability to be reimbursed for state Medicaid reimbursable services [32]. In 2011 Medicaid-qualified nursing facilities numbered 15,465 in the U.S. and 443 in Iowa [127]. In that same year, the funding sources for care provided in nursing facilities were Medicaid 63.5%, Medicare 14.5% and private-pay 22% in the U.S., and in Iowa 47% for Medicaid, 8% for Medicare and 44% for private-pay [127]. Though the frail elderly may qualify for institutionalized long-term care, statewide and nationally an increasing number of them are receiving NFLOC in the community setting [128]. U.S. Medicaid funds to long-term care facilities experienced a decline in 2007, while the total funding of NFLOC to community settings increased from 13% in 1990 to 43% in 2007 [129].

Specific financial and medical criteria must be met for the frail elderly to enter a NF and be Medicaid-eligible. The medical benchmark is that the resident's ADL cannot be met without assistance. [3] The financial measure is complex and evaluates personal and spousal income and assets. [124]

Medicare provides very limited dental coverage, and if the care qualifies, it must be deemed to be of a medically necessary origin. Medicaid has federally-mandated dental coverage for children and state-determined coverage for adults, but reimbursements are generally very low [66]. Senior adults commonly pay for their own dental care, and many senior adults lose their dental insurance when they retire, or they may never have had dental coverage. [23,66,124]

Other Payment Models

Another payment model, recent to Iowa, is a category of its own. Incurred Medical Expense is a federal program to pay health-related expenses not covered by Medicaid or another third party payer for NF residents who qualify for Medicaid and Social Security. [130] The Incurred Medical Expense program allows payment for incidental health related expenses such as vision, hearing and dental care. Some for-profit dental programs bring POC directly to the NF and use the residents' right to access their monthly benefits. These dental programs employ and reimburse the dentists and RDHs. If necessary dental treatment cannot be performed at the NF these programs refer to outside providers and the costs for that dental treatment may or may not be covered. [131]

Dental Utilization

While studies have found that POC improves senior adults' oral and systemic health, the frequency of dental care received by NF residents is unknown. Research addressing the oral care delivered in nursing facilities is primarily self-reported through surveys and questionnaires. Exact data are lacking on institutionalized senior adults' dental care utilization. According to the Health Policy Institute of the American Dental Association, over the past decade dental care use, especially among low-income adults, has declined. [132] MEPS compared the number of senior adults who had a dental visit to the 44% of the overall population who had a dental visit. According to the 2004 MEPS, about 46% of senior adults aged 65-74 and 39% of those 75 years or older had at least one dental visit. Senior adults with Medicaid were more likely to have a dental visit in 2004 than in 1996. Preventive or diagnostic services accounted for approximately 70% of dental procedures in 2004. Both a dentist and another non-dentist dental provider (i.e. RDH or dental technician) provided care for 36% of the 2004 dental visits. While the overall total number of dental procedures increased from 1996 to 2004, and the percentage of diagnostic procedures increased, restorative procedures decreased. [22]

Unfortunately, the MEPS and BRFSS data are for community-dwelling populations and not the NF population.

Specific to Iowa, the 2008 BRFSS reported that 78.7% of those aged 65 or older received a dental prophylaxis compared to 74.5% in the 1999 BRFSS. [133] The only data specific for Iowa Medicaid-enrolled senior adults was found in a personal communication between researcher MK and C. Coppes from Iowa Medicaid Enterprise (IME).[128] Of the Medicaid-enrolled frail elderly in nursing facilities only 14.7% (n= 2,633) received any dental service in 2011, and of the non-institutionalized Medicaid-enrolled senior adults 22.85% (n= 4,726) received any dental in the same year. [128] Utilization of dental care by the institutionalized frail elderly who have additional barriers outside of solely their age remains unknown. [86]

Summary

Senior adults are increasing in proportion in the U.S. and Iowa. Programs and policies need to address this aging population. Though numerous reports describe Medicaid dental usage for all ages, none specifically assesses dental utilization in institutional settings. Senior adults are at an increased risk for oral diseases and when there are severe enough health conditions they may enter institutional settings. Considering the association between oral diseases, systemic health issues, and the functional-dependence of a resident required to enter a NF, oral health care assistance often becomes more necessary than in community-dwelling senior adults [43]. Research reveals that POC can be associated with improvements in overall health outcomes. NF have the responsibility of assisting the residents with ADL, which includes daily oral hygiene, and obtaining services from a dentist. Promising programs can facilitate POC in a NF. However, there is a lack of national or state baseline data about dental care utilization in NF. This information can be critical to understanding where and in what situations Medicaid-enrolled senior adults are able to transition from community-

dwelling to the institutional setting while still receiving dental care. IME covers medical and dental procedures, which allow a unique opportunity to evaluate the utilization of both types of health services within the same subject.

This study examined how the annual receipt of dental procedures changed when a Medicaid-enrolled senior adult transitions from community-dwelling to an Iowa NF. The information from this research can assist in policy development and evaluating current or future programs.

Chapter III

Methods

This study employed a retrospective within-subject design using enrollment and claims data that Iowa Medicaid Enterprise (IME) provided to the University of Iowa Public Policy Center to address the research questions focused on the utilization of dental procedures among senior adults (68 and older). The annual utilization of dental procedures by senior adults continuously enrolled in Medicaid was analyzed, covering a five-year time period starting three years prior to their residency in an Iowa NF and continuing through two years of residency (Figure i). For this project, the three-year period prior to a subject's residency in a NF is defined as "before NF entry," and the two-year period when residing is defined as "after NF entry." The study period allowed sufficient time for the frail elderly's transition from community-dwelling to institutional setting.

University of Iowa Institutional Review Board approval was obtained on March 31, 2015. Permission to access the IME data specific to this project was received on April 10, 2015. An Iowa Public Policy Center researcher (EM) directly accessed IME data for Iowa's fiscal years 2007 through 2014. The study inclusion criterion was IME enrollees who were 68 years or older upon entry to an Iowa NF who had been continuously enrolled (eligible 58 out of 60 months) in Medicaid for three years prior and at least two years after admission. For this project, dental procedures were divided into three categories: Hygienist Probable Procedures, Exams, and Other Dental Procedures (Figure ii). Preventive Dental Procedures (PDP) are defined as oral examinations, dental prophylaxis, fluoride applications, periodontal maintenance, scaling/root planing, and gross debridement; all other dental procedures are categorized as Other Dental Procedure (ODP).

Null Hypothesis 1: Among senior adults continuously enrolled in Iowa Medicaid, there is no association between PDP before NF entry and after NF entry while controlling for a set of available variables.

Null Hypothesis 2: Among senior adults continuously enrolled in Iowa Medicaid, there is no association between ODP before NF entry and after NF entry while controlling for a set of available variables.

Three levels of variables were collected over the five-year period: geographic, subject, and dental procedure (Table 1). NF and chronic condition information were analyzed at year 4 (after NF entry). Chronic conditions at year 4 reflect the subjects' health conditions at the time of their transition from community-dwelling to an institutional setting. Prescriptions written were collected over the entire study period and served to reflect subjects' health changes. Dental procedures were collected each of the five years in the study to reflect the utilization of dental services during the transition between residences.

Nursing Facilities

The location of the NF for each subject was the basis for determining the geographic variables that may affect accessing PDP. Iowa's Area Agencies on Aging (AAA) regions were used to divide the state into meaningful categories for analyses (Figure iii). IDPH designations determined Dental Health Professional Shortage Area (DHPSA) category. Iowa Health Care Association data were used to categorize facilities by urbanicity (Table 2).

Subject Characteristics

The age of the subjects was defined as their age in years upon entry into a NF and then categorized into three levels (Table 3). Race was collected as listed in the IME database, but due to the low percentages of the subjects who identified as being a race other than white, race was categorized as white and other/not reported. The number of chronic conditions was categorized on an ordinal scale into five levels. Also in Table 3 for subjects who received ≥ 1 PDP before and after NF entry, it was determined whether the subject continued with same dentist after NF entry.

Health data were extracted from the IME claims database using International Classification of Diseases 9 (ICD-9), National Drug Codes, and American Dental Association Code of Dental Terminology (CDT) codes (Table 4). The initial list of chronic conditions was determined by using the Centers for Medicare and Medicaid Services (CMS) Chronic Condition tables for dual-eligible Medicare and Medicaid recipients. Medical conditions associated with oral health of the subjects were kept for the data analyses. Evidence of a chronic medical condition was identified by the subject presenting with one or more ICD-9 codes for that condition. Each subject was classified into one of five groups based on the chronic medical condition groups observed out of a total of 21 chronic condition variables based on CMS data tables (Table 3). The prescriptions written for each subject were collected by year, then categorized into three levels.

Dental Procedures

The IME claims database was used to extract all dental procedures received by the subjects in a single year. Several CDT codes have been updated recently which made it necessary to identify some of the PDP under multiple codes. PDP were categorized as Hygienist Probable Procedure (HPP) and Examinations (Exam), as shown in Figure ii. HPP are services within an Iowa Registered Dental Hygienist (RDH) scope of practice

and usually provided by RDHs, however there is not a way to track the exact provider therefore "hygienist probable procedure" (HPP) was used. Dental procedures other than HPP or Exams were considered ODP as described earlier. These procedures were classified as binary variables and measured by receipt of at least one dental procedure of that type in a single year.

The primary researcher (MK) accessed the de-identified data and used SAS Enterprise 5.1 for univariate and bivariate analyses. The analysis addressed predictors of the receipt of ≥ 1 PDP and ODP during the two years after entering a NF. After descriptive and univariate analyses were conducted to determine the most parsimonious model, multivariable logistic regression was used to estimate predictor effects. EM determined the type of statistical analysis to be used for multivariable analyses.

Chapter IV

Results

Nursing Facilities and Iowa Area Agencies on Aging Regions

Characteristics of the Nursing Facilities (NF) and Iowa Area Agencies on Aging (AAA) regions are shown in Table 5. The majority of NF in Northwest (NW), Northeast (NE), Southeast (SE), and Southwest (SW) regions were rural and Dental Health Professional Shortage Areas (DHPSA). SE region had 84.4% of the NF in rural areas and 100% in DHPSA. In contrast, most NF in Central and East Central regions were in urban, non-DHPSAs (75.4% and 65.9%, respectively). The majority of NF in each of the AAA regions had 51 or more bed, and every NF had approximately 50% Medicaid-funded residents.

The AAA regions that have primarily urban designations (Central and East Central) have the fewest counties and subjects (Figure iv). The percentage of NF in each of the AAA regions was generally distributed proportionately to the percentage of subjects and counties in each region.

Target Population

Among the 641,685 Medicaid enrollees, 34,928 were 65 or older; 5,472 enrollees resided in an Iowa NF for ≥ 24 months and were 68 years or older upon NF entry, and 874 met the established inclusion criterion of a required 58 out of 60 month's continuous enrollment [134] (Figure v). Of the subjects, 20.5% were in the 68 to 74-year-old level (the youngest group) while there were 39.7% of the subjects in the 85 or older level (the oldest group) (Table 6). The percentage of NF residents who identified their race as white was 71.7%. The percentage of subjects who resided in a NF located in a DHPSA was 63.3%.

Chronic Conditions

The percentages of chronic conditions experienced by subjects is shown in Table 7. The greatest percentage of subjects were diagnosed with hypertension (54.5%), followed by mental health conditions (51.4%), coronary artery disease (40.9%) and diabetes (35.0%). Subject percentages by the number of chronic conditions are shown in Table 8; the percentages of subjects diagnosed with multiple chronic conditions ranged from the low of 0.3% with 13 conditions to the high of 13.0% with 4 conditions. The highest percentage of subjects have 4 or more chronic conditions (Table 8) and were in the 4 or more chronic condition group level. Chronic condition groupings varied slightly between the conditions included in the CMS report and this study (Table 9).

Prescriptions Written Levels

Percentages of subjects by prescriptions level are shown in Table 10. The percentage of subjects who had at least 11 prescriptions written on their behalf during any single year more than doubled in years 4 and 5 compared to years 1 to 3.

Null Hypothesis 1: Preventive Dental Procedures

AAA Regions and Preventive Dental Procedures

The percentages of subjects who received ≥ 1 Preventive Dental Procedures (PDP) in year 4 by AAA regions are shown in Figure vi. The percent of subjects who received ≥ 1 PDP in year 4 ranged from 17.7% (SE region) to 33.3% (NE and Central regions).

Chronic Conditions and Preventive Dental Procedures

As shown in Table 7, less than one third of subjects diagnosed with the chronic conditions listed in (e.g. cardiovascular disease, diabetes and dementia) received ≥ 1 PDP; although 51.1% of subjects who had a diagnosis of PD/MS received ≥ 1 PDP. Among the subjects diagnosed with PD/MS, 51.1% received ≥ 1 PDP compared to 26.4% of subjects who did not have PD/MS diagnosis ($p<0.001$) (Table 11). Although, fewer

subjects diagnosed with hypertension (24.8%) received ≥ 1 PDP compared to the subjects without a hypertension diagnosis (31.2%) (p=0.036) (Table 11). There were no statistically significant associations between chronic condition groups and PDP as shown in Table 9.

Prescription Levels and Preventive Dental Procedures

Subjects' prescriptions levels and ≥ 1 PDP received are shown in Table 12. Generally, there was a positive correlation between number of prescriptions written and the percentage of subjects who received ≥ 1 PDP. The number of subjects who received ≥ 1 PDP were significantly associated ($p<0.008$) with the number of prescriptions written in years 1, 2 and 3; this significance was not observed in years 4 and 5.

Subject Characteristics and Preventive Dental Procedures

The bivariate analyses for the outcome variable (≥ 1 PDP) and explanatory variables are shown in Table 13. The percentage of subjects who received ≥ 1 PDP in the study period ranged from the lowest (17.5%) in year 2 to the greatest (27.7%) in year 4. Significant associations ($p<0.05$) were found between the percentage of subjects who received ≥ 1 PDP in the categories of race (years 1-3), urbanicity (years 4-5) and AAA regions (year 4). Among subjects who identified race as white about 20% received ≥ 1 PDP compared to 13% who identified race as other/unreported. The difference in years 1-3 within the race categories narrowed in years 4 and 5. During years 4 and 5, a greater percentage of subjects in the urban areas received ≥ 1 PDP than did subjects in the rural areas. In year 4, the NE and Central regions had the highest percentage (33.3%) of subjects who received ≥ 1 PDP and SE region had the lowest (17.7%). In year 5, four regions (NE, NW, Central and East Central) experienced a drop in the percentages of subjects who received ≥ 1 PDP. There were 253 (28.9%) subjects who received ≥ 1 PDP before NF entry.

Categories of Preventive Dental Procedures

To evaluate utilization within PDP categories, four mutually exclusive PDP categories were analyzed: “Exam & Hygienist Probable Procedures (HPP)”, “HPP only”, “Exam only”, and “No PDP.” The subject percentages within the PDP categories are shown in Table 14 . The clear majority of the subjects had no PDP. Among the subjects who received ≥ 1 PDP in years 1-3, the majority had “Exam and HPP” which was not the case in years 4 and 5 when most the subjects received “Exam only”. There were significantly ($p<0.001$) more subjects who received “Exam only” compared to “HPP only” each year. Across the study period the percentage of subjects who received “HPP only” remained ≤ 0.5% while the percentage of subjects who received “Exam only” more than doubled from year 1 (6.2%) to year 4 (13.8%).

To assess utilization of PDP during the transition from community-dwelling to NF, years 1-3 were grouped as “before NF entry” and years 4-5 were grouped as “after NF entry.” The percentage of subjects who received ≥ 1 PDP before or after NF entry are shown in Table 15. There were no statistically significant differences within the variable categories. The percentages of who received ≥ 1 PDP after NF entry are shown Table 16. There were no statistically significant differences between subjects who received ≥ 1 PDP after NF entry compared to the subjects who did not receive ≥ 1 PDP after NF entry.

To further evaluate utilization of PDP before and after NF entry each variable’s categories or levels were divided into four mutually exclusive groups: subjects who never received PDP over the study period (“no PDP”), subjects who received ≥ 1 PDP only before NF entry (“only before NF entry”), subjects who received ≥ 1 PDP only after NF entry (“only after NF entry”), and subjects who received PDP before and after NF entry (“before & after NF entry”). There were statistically significant differences in most of the categories for subjects who received ≥ 1 PDP “only before NF entry” or “only after NF entry” (Table 17). The percentage of female subjects who received ≥ 1 PDP “only

before NF entry" (11.4%) was significantly less ($p < 0.001$) than the percentage of female subjects "only after NF entry" (18.9%). In two age levels (68-74 and 85 or older) there were lower percentages of subjects who received ≥ 1 PDP "only before NF entry" (11.2% and 10.4%, respectively) versus "only after NF entry" (21.8% and 19.0%, respectively). In both race categories, there were lower percentages of subjects who received ≥ 1 PDP "only before NF entry" (11.6% for white and 10.1% for other/not reported) versus "only after NF entry" (17.9% and 19.8%, respectively).

The overall results of comparing the frequency of subjects who received ≥ 1 PDP within the Exam and HPP categories during the transition in residences are shown in Table 18. The greatest percentage of subjects never received Exam (52.8%) or HPP (75.9%) during the five study years. There was a statistically significant increase ($p<0.001$) between the percentage of subjects who received ≥ 1 Exam (11.3%) "only before NF entry" (years 1-3) versus (18.4%) "only after NF entry" (years 4 and 5). There were slightly fewer subjects ($p=0.472$) who received HPP, 6.6%, "only after NF entry" compared to 7.6% "only before NF entry." The percentage of subjects who received ≥ 1 Exam "before and after NF entry" was 17.5% compared to the percentage of subjects who received ≥ 1 HPP (9.8%).

Same Dental Provider and Preventive Dental Procedures

For subjects who received ≥ 1 PDP before and after NF entry, it was determined whether the subject continued with the same dentist (Figure vii). Among the 874 subjects 460 did not received PDP in the five-year study period, 98 had ≥ 1 PDP "only before NF entry" (years 1-3) and 161 had ≥ 1 PDP "only after NF entry" (years 4 and 5); finally, 155 subjects received ≥ 1 PDP "before and after NF entry" (≥ 1 PDP in years 1, 2 or 3 and ≥ 1 PDP in years 4 or 5). Among those who received ≥ 1 PDP, 98 of the subjects continued dental care with the same dentist after NF entry. The frequency of subjects who received ≥ 1 PDP before and after NF entry, and who continued care with the same

dentist by AAA regions are shown in Table 19. The percentage of subjects who received PDP by the same dentist ranged from 25.0% in the East Central region to 70.9% in the NE region; the overall mean of subjects who continued with their same dentist was 63.2%.

Logistic Regression and Preventive Dental Procedures

A logistic regression model was developed to evaluate predictors of receipt ≥ 1 PDP after NF entry Table 20. The significant variables related to receipt of ≥ 1 PDP after NF entry were receipt of ≥ 1 PDP before NF entry ($p<0.001$), and residing in a NF located in an urban area ($p<0.002$) or in the NW or NE regions ($p=0.035$, $p=0.019$, respectively). Controlling for covariates, the odds of receipt of ≥ 1 PDP after NF by subjects who received ≥ 1 PDP before NF entry were 4.71 (CI 95% 3.40-6.50) times the odds of those who did not receive PDP before entry. Subjects who resided in a NF located in an urban area had 2.00 (CI 95% 1.33-3.00) times the odds of receiving ≥ 1 PDP after NF compared to the subjects who resided in a NF located in a rural area controlling for other covariates. Subjects residing in a NF in a DHPSA was not associated ($p=0.555$) with receipt of ≥ 1 PDP after NF entry. Controlling for covariates subjects who resided in a NF located in the NE or NW regions had approximately 1.80 times the odds of receiving ≥ 1 PDP after NF entry compared to subjects who resided in a NF located in the SE region.

Null Hypothesis 2: Other Dental Procedures

AAA Regions and Other Dental Procedures

The percentages of subjects who received ≥ 1 Other Dental Procedures (ODP) in year 4 by AAA regions are shown in Figure viii. The percent of subjects who received ≥ 1 ODP in year 4 ranged from 18.9% (SE region) to 39.3% (East Central region).

Chronic Conditions and Other Dental Procedures

The percentages of chronic conditions experienced by subjects who received ODP are shown in Table 21. Overall, about 25% of subjects diagnosed with the chronic conditions described previously in this thesis (e.g. cardiovascular disease, diabetes and dementia) received ≥ 1 ODP; although 42.6% of subjects who had a diagnosis of PD/MS. Among the subjects who were diagnosed with PD/MS 42.6% received ≥ 1 ODP compared to 25.0% without the PD/MS diagnosis (p=0.008) (Table 11). Additionally, among the subjects who were diagnosed with CAD, 29.7% received ≥1 ODP compared to 23.4% of the subjects without CAD diagnosis (p=0.037) (Table 11). There were no statistically significant associations between chronic condition groups and PDP as shown in Table 9 and Table 22.

Prescriptions Written Levels and Other Dental Procedures

Percentages of subjects who received ≥ 1 ODP by prescriptions level are shown in Table 23. There was a positive correlation between number of prescriptions written and the percentage of subjects who received ≥ 1 ODP. The number of subjects who received ≥ 1 ODP were significantly associated ($p<0.001$) with the number of prescriptions written in years 1, 2 and 3; this significance was not observed in years 4 and 5.

Subject Characteristics and Other Dental Procedures

The bivariate analyses for ≥ 1 ODP and explanatory variables are shown in Table 24. The percentage of subjects who received ≥ 1 ODP in the study period ranged from the lowest (17.6%) in year 2 to the greatest (25.9%) in year 4. Significant associations ($p<0.05$) were found between the percentage of subjects who received ≥ 1 ODP in the categories of race (years 2 - 3), urbanicity (years 4-5) and AAA regions (year 4). Among subjects who identified their race as white about 20% received ≥ 1 ODP compared to 13% who identified their race as other/unreported. The difference in years 1-3 within the race categories narrowed in years 4 and 5. During years 4 and 5, a greater

percentage of subjects in the urban areas received ≥ 1 ODP than did subjects in the rural areas. In year 4, East Central region had the highest percentage (39.3%) of subjects who received ≥ 1 ODP, and SE region had the lowest (18.9%). In year 5, all regions experienced a drop in the percentages of subjects who received ≥ 1 ODP; moreover, East Central experienced a nearly 50% drop to 19.7%. There were 274 (31.4%) of the subjects who received ≥ 1 ODP before NF entry.

Exams and Other Dental Procedures

To evaluate ODP with Exams, four mutually exclusive dental procedure categories were analyzed: "Exam & ODP", "ODP only", "Exam only", and "No Exam or ODP" shown in Table 25. Among the subjects who received ≥ 1 ODP, ≥ 1 Exam was also provided; the highest percentage of "Exam & ODP" (21.2%) was in year 4. Year 1 was the only period that there were significantly ($p<0.001$) more subjects who received "ODP only" compared to "Exam only." Most the subjects did not receive an exam or ODP in any of the five study years.

To assess utilization of ODP during the transition from community-dwelling to NF, years 1-3 were grouped as "before NF entry" and years 4-5 were grouped as "after NF entry." The percentage of subjects who received ≥ 1 ODP before or after NF entry are shown in (Table 26). There were no statistically significant differences within the variable categories. The percentages of who received ≥ 1 ODP after NF entry are shown (Table 27). There were no statistically significant differences between subjects who received ≥ 1 PDP after NF entry compared to the subjects who did not receive≥ 1 ODP after NF entry.

To further evaluate utilization of ODP before and after NF entry each variable's categories or levels were divided into four mutually exclusive groups: subjects who never received ODP over the study period ("No ODP"), subjects who received ≥ 1 ODP only before NF entry ("only before"), subjects who received ≥ 1 ODP only after NF entry

("only after"), and subjects who received ODP before and after NF entry ("before & after"). There were statistically significant (p-value <0.05) differences in three of the categories for subjects who received ≥ 1 ODP "only before" or "only after" (Table 28). The percentage of female subjects who received ≥ 1 PDP "only before" (13.3%) was significantly fewer (p <0.001) than the percentage of female subjects "only after" (19.4%). In the youngest age level (68-74 years) there was a lower percentage of subjects who received ≥ 1 ODP "only before" (13.4%) versus "only after" (22.4%). The Other/Not Reported race category had a lower percentage of subjects who received ≥ 1 ODP "only before" (12.9%) versus "only after" (20.6%).

The overall results of comparing the frequency of subjects who received ≥ 1 ODP during the transition in residences are shown in Table 28. The greatest percentage of subjects (49.7%) never received ODP during the five study years. There was a statistically significant increase (p<0.001) between the percentage of subjects who received ≥ 1 ODP "only before" (13.8%) versus "only after" (18.9). The percentage of subjects who received ≥ 1 ODP "before and after" was 17.6%.

Other Dental Procedures by Same Dental Provider

For subjects who received ≥ 1 ODP before and after NF entry, it was determined whether the subject continued with the same dentist (Figure ix). Among the 874 subjects 434 did not received ODP, 120 had ≥ 1 ODP "only before" NF entry and 166 had ≥ 1 ODP "only after" entry; finally, 154 subjects received ≥ 1 ODP "before and after" NF entry. Among those who received ≥ 1 ODP 94 of the subjects continued dental care with the same dentist after NF entry. The frequency of subjects who received ≥ 1 ODP before and after NF entry, and who continued care with the same dentist by AAA regions are shown in (Table 30). The percentage of subjects who received ODP by the same dentist ranged from 37.5% in the East Central region to 72.7% in the SE region; the overall mean of subjects who continued with their same dentist was 61.0%.

Logistic Regression and Other Dental Procedures

A logistic regression model was developed to evaluate predictors of receipt ≥ 1 ODP after NF entry (Table 13). The significant variables related to receipt of ≥ 1ODP after NF entry were receipt of ≥ 1 ODP before NF entry ($p<0.001$), and residing in a NF located in an urban area ($p=0.002$) or in the NW region ($p=0.022$). Controlling for covariates, the odds of receipt of ≥ 1 ODP after NF by subjects who received ≥ 1 ODP before NF entry were 3.48 (CI 95% 2.55-4.74) times the odds of those who did not receive ODP before entry. Subjects who resided in a NF located in an urban area had 1.92 odds (CI 95% 1.28- 2.87) of receiving ≥ 1 ODP after NF compared to the subjects who resided in a NF located in a rural area controlling for covariates. Subjects residing in a NF in a DHPSA was not associated ($p=0.103$) with receipt of ≥ 1 ODP after NF entry. Controlling for covariates subjects who resided in a NF located in the NW region had 1.79 the odds of receiving ≥ 1 ODP after NF entry compared to subjects who resided in a NF located in the SE region.

Chapter V

Discussion

Introduction

This study examined the predictors of the receipt of dental procedures by senior adults who were continuously-enrolled in Iowa Medicaid after entry into an Iowa NF from a community-dwelling residence. The primary purpose of this research was to determine if receipt of dental care while a senior adult was community-dwelling was a predictor of receipt of dental care after that same senior adult resided in an Iowa NF. A secondary purpose was to evaluate other predictors of receipt of dental procedures before or after NF entry.

We found that most subjects did not receive any dental procedures before or after entering a NF, and more subjects received one or more dental procedure after entering a NF than before entering a NF. The strongest predictor of receipt of dental care while residing in a NF was receipt of dental care before NF entry. Other significant predictors included residing in a NF located in an urban area or specific Iowa AAA regions. There were few significant associations between receipt of ≥ 1 dental procedure and subject-level variables in the bivariate analyses and none in the multivariable analysis.

Target Population

Senior adults who are long-term Medicaid enrollees represent a very specific population (likely the poorest and very sick). Therefore, only a few generalizations between the target and general populations may be made.

The study subjects were primarily female and white, as are long-term care residents nationally and Iowa Medicaid enrollees aged 65 or older. [135-137] The study subjects primarily resided in rural areas in contrast to the Iowa's mainly urban population. Another significant difference is that nationally 62.9% of NF residents rely

on Medicaid as a payer source compared to 100% of this research's target population relying on Medicaid. [137]

Health Characteristics

There are several differences in health characteristics between senior adults in the study and nationally. This study used chronic health conditions from the CMS Chronic Condition Warehouse which allowed for comparisons reported in *Physical and Mental Health Condition Prevalence and Comorbidity among Fee-for-Service Medicare Medicaid Enrollees 2014.*[138] The percentages of the subjects' primary chronic conditions in this study population differed quite remarkably from their national counterparts also in NF. Diabetes was diagnosed 43.7% nationally compared to the study's 35.0%. Depression nationally was 43.9% compared to the study's 23.2%. [138] Dementia/Alzheimer's Disease was 48.5% nationally compared to 22.3% in our study. [94]. Although the study subjects were less sick than their national counterparts in NF it is still essential to address the oral health needs of this population.

CMS also reported that Iowa has a large percentage of enrollees who are white, 65 or older with multiple chronic conditions. [138] There were 83.1% of the study subjects who had multiple chronic conditions (Table 8). When categorized by chronic condition groups, there were 44.2% of the study subjects with 4 or more conditions compared to 50.0% nationally (Table 9). [138] The frequency of subjects with multiple chronic conditions confirms that the study subjects could be considered as the frail elderly.

Health Characteristics and Dental Procedures

The study used the subjects' chronic conditions upon entry into an Iowa NF, which matches the point in time used in national NF surveys. [65] This did not allow us to measure aspiration pneumonia since that is a condition that is usually acquired while residing in a NF. In the multivariable regression model, there were no correlations between chronic conditions and receipt of dental procedures after NF entry, and few

significant associations were found in the bivariate analysis (Table 8). Statistically significant associations between ≥1 dental procedure received and chronic conditions were found with Parkinson's Disease/Multiple Sclerosis (PD/MS), hypertension, and Coronary Artery Disease (CAD). Subjects diagnosed with PD/MS were more likely to receive ≥1 PDP or ≥1 ODP than subjects without PD/MS. Due to the apparent physical difficulties experienced by subjects with Parkinson's disease/Multiple Sclerosis family members or health professionals may recognize the oral hygiene complications therefore refer to dentists more often. Subjects who were diagnosed with CAD were more likely to receive ≥1 ODP compared to those without CAD diagnosis. However, subjects who were diagnosed with hypertension were less likely to have received ≥ 1 PDP compared to those without a hypertension diagnosis. Presently there is no required referral system between the subjects' medical and dental providers. Due to the association between periodontal disease and cardiovascular diseases such a referral system could be valuable to improve health.

Generally, there were only a few statistically significant associations between presence of a chronic condition and the receipt of a dental procedure, despite evidence that oral health is related to systemic health (Table 7). Medical providers may not recognize that chronic conditions may be impacted by oral health, or the subject may not have a dentist of record for referral. The overall percentage of study subjects receiving dental procedures is low. More concerning is the lack of ≥ 1 dental procedure for the subjects diagnosed with the chronic conditions associated with oral health. This was a missed opportunity for possible improvements in the subjects' overall health. The low percentage of subjects with chronic conditions receiving a dental procedure suggests a need for an interdisciplinary health referral system to emphasize the importance of oral health's impact on overall health.

Prescriptions written for each subject served as a measure of health for each of the five years (Table 10). PDP and ODP were significantly associated with the number of prescriptions written in years 1-3 (before NF entry) which may be indicative of health-seeking behavior (Tables 12 and 23). The number of subjects in the highest prescriptions written level category substantially increase after NF entry which would be expected of subject needing NF care (Table 10). The increased proportion of subjects in the highest level of prescriptions written likely contributed to the loss of significance between prescriptions written and a dental procedure received. The loss of significance between dental procedures received was not only in prescriptions written but for other variables as well.

Subject Categories by Receipt of ≥ 1 Dental Procedure

Year by year analysis gave an overview of the subject variables and receipt of dental procedures. There were few subject-level variables that had significant associations with receipt of ≥ 1 dental procedure. Furthermore, the subject variables that were associated with receipt of dental procedures in the bivariate analysis were not significant in the multivariable regression models.

The two significant associations between a subject-level variable and ≥ 1 dental procedure received in any individual year were in the prescription written (discussed earlier) and the race variables. Statistically significantly more white subjects received ≥ 1 PDP (years 1-3) and ≥ 1 ODP (years 2 & 3) than other/not reported subjects. After NF entry (years 4-5) the percentage of subjects who received ≥ 1 dental procedure in both race categories rose compared to years 1-3. However, the other/not reported category increased at a higher rate so that the significant difference between the races was lost. The loss of significance suggests that once residing in a NF there were no differences between the subject-level variables and utilization of dental procedures. Similar results were found in other comparisons of subjects before and after NF entry.

When comparing subjects by receipt of ≥ 1 dental procedure "only before NF entry" to "only after NF entry" there were statistically significant variables such as more females and subjects from the 68-74-year-old age group had ≥ 1 dental procedure "only after NF entry" compared to "only before NF entry." Females may have neglected their own needs while community-dwelling, because they were caring for others. Once in a NF the female subjects could have their oral health needs treated, because they are no longer preoccupied with providing care. Upon entry into a NF, a dental screening is performed as part of the Minimum Data Set (MDS) which could result in a dental referral and subsequent receipt of PDP and ODP. Finally, there were no significant associations between any subject-level variable when comparing subjects who did or did not receive ≥1 dental procedure after NF entry.

Receipt of ≥ 1 Dental Procedure

This research evaluated subjects' dental utilization of PDP and ODP in multiple ways. This allowed for analyzing variables by subject categories and timing of ≥ 1 dental procedures received. Although the percentages of PDP and ODP differed, in each table the percentages ranked by year the same. Therefore, the following discussion will consider the PDP and ODP collectively as "dental procedures" unless there were differences in dental procedure categories.

The year by year analysis gave an overview of the percentages of subjects who received ≥ 1 dental procedure each year. While community-dwelling (years 1-3), the percentage of subjects who received ≥ 1 dental procedure ranged between 17.5% and 20.1% which aligned with the national data 14% to 19% nationally of publicly insured senior adults had at least one dental visit in the past year between the years 2008-2013[139], but was a stark contrast to the Iowa BRFSS 2014 report that cited 70% aged 65 or older had dental visit in previous 12 months. [140] BRFSS relies self-reported data may be over-reported or there may be dental procedures delivered that are not accounted for by

Medicaid claims data. Another reason for the discrepancy may be that the study population is Medicaid-enrolled while the BRFSS data are sampled from the general population regardless of income level.

A greater number of subjects received ≥ 1 PDP in year 3 than years 1 or 2. This was unexpected due to the assumption that the frail elderly would have competing priorities (i.e. chronic conditions sufficient to transition residence to a NF, the transition itself from community to an institutional setting and possibly relocating to another geographic region, etc.) that would make a dental visit less likely. This may be explained by as the subject's health worsened the family members became more involved and subsequently sought out dental care in preparation of subject taking residence in a NF.

For both dental procedure categories, the greatest number of subjects received ≥ 1 dental procedure in year 4 followed by year 5. This was also an unexpected finding considering the abundant reports of the lack of access to dental care and the poor oral status of the frail elderly in the NF. Even though more subjects received dental procedures while residing in a NF (years 4 and 5) than while residing in the community, there is still a great need for professional dental care in NF since fewer than 28% of the subjects received ≥ 1 dental procedure while residing in a NF.

The year by year analysis included subjects who may have received a dental procedure in multiple years, thus we examined the subjects by variables across time to reveal a unique count of subjects and their overall pattern of dental utilization (Table 13). The multivariable regression analysis showed that the strongest predictor of PDP or ODP after NF entry was receipt of ≥ 1 dental procedure prior to NF entry. For that reason, establishing a dental home while the senior adult is still community-dwelling is important. Further, the Iowa Department on Aging stated in the *State Plan on Aging 2014- 2015* that there are focused efforts on senior adults remaining in the community

and their homes, [141] which adds credence to the importance of senior adults obtaining dental care in the community.

Dental Procedures by Category

Senior adults benefit greatly from retaining their teeth; they have a larger variety of food choices, enhanced social interactions, and good overall health. Accompanying tooth retention is the need for professional oral care. However, nearly 50% of the subjects went without any dental procedures during the five-year study period. Iowa BRFSS 2014 cited that 75% of Iowans 60 years or older reported having some or all of their permanent teeth. [140] Although this percentage was for only community-dwelling individuals, and thus not representative of our target population, we assume that a portion of our target population would have been dentate and benefited from dental procedures.

When the dental procedure categories were analyzed separately exams generally drove the PDP data. Very few subjects, 0.2% to 0.5%, received Hygienist Probable Procedures (HPP) without an exam; although subjects who received an exam without HPP ranged from approximately 5.0% to 14.0% (Table 14). 76% of the subjects never received HPP despite the proven connection between diabetes and periodontal (gum) health (Table 18). Senior adults are more likely to be diagnosed with oral cancer so even the edentulous would have benefited from an exam that included an oral cancer screening. Those subjects who received an Exam usually received HPP or ODP in the same year (Tables 13 & 24). Despite this, 52.8% of the subjects never received an Exam during the five-year study period.

It would be expected that a dental exam would occur before any other dental services. However, like HPP, there were subjects who received ODP without an exam (Table 25). This may be due to an exam and ODP were performed on separate days which happened to occur in different fiscal years. Therefore, there would appear that ODP was provided without an exam in the claims data. Data from year 1, when subjects

were still community-dwelling, is an example of when subjects received statistically significantly more ODP only than exams. These procedures may likely have occurred on separate days and subsequently may not have been counted in the same fiscal year (Table 25). Also, dentists may have inadvertently submitted claims only for the ODP, and not the exam.

Overall due to the difficulty of delivering dental procedures to the frail elderly and the frail elderly transportation burden, only urgent care to relieve pain may have been provided especially in the years 4 and 5. Urgent dental needs may explain the sharp increases of Exams and ODP provided after NF entry (years 4 & 5).

Geographic Variables and Receipt of Dental Procedures

The variables, urbanicity, Dental Health Professional Shortage Areas (DHPSA), and AAA regions, specific to NFs were considered in years 4 and 5. Overall most NF were in Iowa's rural areas (Table 5). The regression analysis revealed that subjects who resided in NF located in urban areas were more likely to obtain ≥1 dental procedure after NF entry (Tables 20 and 31). In year 4, the Central and East Central regions, primarily urban, had the greatest number of subjects who received PDP and ODP respectively (Tables 13 & 24). These two regions have the highest concentration of dentists in Iowa. Additionally, the University of Iowa's College of Dentistry's Geriatric and Special Needs Clinic and the Geriatric Mobile Unit (GMU) is in East Central. Access for study subjects in these areas would be easier due to the number of dentists in these urban areas.

Although the odds were greater for subjects in urban NF to receive dental procedures after NF entry compared to rural areas, subjects in two rural NF (NE and NW) areas had statistically significantly greater odds of receipt of dental procedures after NF entry (Table 20 and Table 31). The NE region had the majority (66%) of its NF in rural areas (Table 5), and subjects in this region had statistical significantly greater odds for receipt of ≥1 PDP after NF entry compared to subjects in the SE region NF (Table 20).

This significance was most likely due to the NE region being ranked highest for the percentage of subjects who received PDP in year 4 (Table 13). Although the NW region had 98% of NF in rural areas, there was statistical significance in the regression models for PDP and ODP. These findings demonstrate that regional differences other than urbanicity affect the receipt of dental procedures.

It seems reasonable to assume that more subjects had a dental procedure after they entered a NF compared to before because of requirements that the NF perform an MDS screening for each resident upon entry and quarterly thereafter. Additionally, NF are "directly responsible for the dental care needs of its residents. The facility must ensure that a dentist is available for residents" including arranging transportation [32]. Generally, the MDS requirement would explain why greater percentages of subjects receive ≥1 dental procedure in year 4 compared to year 5. While fewer subjects received ≥1 dental procedure in year 5 in each AAA region, East Central had a noticeable 20% drop in subjects. This was most likely because the GMU visits the NF every 15 months, meaning that the 12 subjects who received ≥ 1 dental procedure from the GMU in year 4 may not have receive dental services in year 5, because the 15-month period resulted in no visit to occur in year 5. Additionally, subjects in all regions may be frailer or have less family attention needs in year 5 compared to year 4. More subjects received dental procedures once residing in a NF compared to when community-dwelling although still nearly 70% of the subjects did not receive any dental procedures after NF entry (Table 14 and Table 25).

DHPSA designations were not significant in this research because most NF in DHPSA were in rural areas (Table 5) and the multivariable regression model showed that subjects in urban areas were more likely to receive dental procedures than subjects in rural areas (Table 20 and 31). Study subjects who did receive dental procedures may reside in one county considered DHPSA although there is a dentist in a closer proximity

to access [142,143] which could explain why there were no significant negative associations between DHPSA and dental procedures received.

The "place of service" (e.g. dental office, NF, other) was collected from Medicaid claims. In the East Central AAA region, the GMU delivered care to 12 subjects in the NF. However, all the claims indicated that care had been done in dental offices in the East Central region. These inconsistent findings indicated the place of service had likely been miscoded on the claims data, and thus we did not include "place of service" in these results.

Continuing Dental Procedures

This study evaluated continuing dental procedures by subject, and by the same dental provider and the AAA region. Among the subjects who received dental procedures before & after NF entry 17.7% received ≥1 PDP and 17.6% received ≥1 ODP (Tables 16 & 28). Although these are nearly identical percentages, the same subjects did not necessarily receive both PDP and ODP. As previously stated there were no significant associations between the subject-level variables and receipt of dental procedures after NF entry, controlling for all variables in the multivariable analysis.

Among the approximately 18% of the subjects who received dental procedures (PDP & ODP) before and after NF entry slightly over 60% continued with their same dentist (Figures 7 & 9). This could indicate that subjects remained in their same AAA region after NF entry, and therefore could have received dental care from the dentist who provided their dental care before NF entry. Additionally, it was possible that the same dentist in each AAA region continued dental care for more than one study subject before and after NF entry.

Three AAA regions were ranked in the same order for PDP and ODP in respect to procedures by the same dentist. The highest percentages, slightly over 70%, of subjects who received care by their same dentist resided in NF located in the Central (PDP) and

SE (ODP) regions. The East Central region had the lowest percentage of subjects who continued with the same dentist after NF entry. This may be attributed to the University of Iowa's College of Dentistry's Geriatric and Special Needs Clinic and the GMU located in the region. Although the College of Dentistry is opened to patients statewide, subjects who reside in NF in proximity to the clinic may select to have care perform at the College. Understandably, the subjects who reside in one of the ten NF served by the GMU would utilize the service which eliminates many access barriers such as transportation and dentists' experience of providing dental care to the frail elderly.

Receiving dental care in the NW and NE, primarily rural regions, had statistically significant odds ratios which is contrary to the finding that subjects in NF located in urban areas are more likely to receive dental procedures. The higher odds for receipt of dental care may be attributed to NF characteristics (dental transportation system or consistent staffing) or the characteristics of dentists (such as specialized training in geriatric care or a close relationship between dentist and subject attributed to the friendships found in smaller communities) in that region.

Limitations

This research did not access the subject's location while community-dwelling (prior to NF entry). The claims data accessed for this research listed many mailing addresses outside of Iowa which suggests that these addresses were of guardians and not the subjects' previous residences. Considering the significant predictors of ≥1 dental procedure after NF entry being the geographic variables (urban, NE, NW) it would have been interesting to know if the subject resided in a region with similar geographic characteristics to the NF region while community-dwelling.

This study did not consider the dentate or oral health status of the subjects which could have revealed the subjects' dental needs. For instance, an edentulous subject would not need HPP, but may need dentures and denture adjustments. Additionally, the dental

procedures were counted as binary (yes or no to specific dental category in one year) and did not consider the number and type of dental procedures that the individual subject received.

The target population may have received dental procedures from dental providers who did not submit Medicaid claims, therefore dental procedures were not counted. For instance, students at dental hygiene programs in Iowa provide HPP to NF residents and would not submit Medicaid claims [144], and Iowa dentists have reported providing free services to Medicaid recipients rather than submitting claims. [145] Additionally, dental providers who utilize Incurred Medical Expense have chosen an alternate method of reimbursement and therefore would not submit a fee-for -service Medicaid claim.[130] Lastly, dental hygienists who provide HPP under Public Health Supervision are not recognized Medicaid providers therefore cannot submit Medicaid claims; HPP may be accounted for in Medicaid data only if the dental hygienist submitted a claim through a dentist.

Strengths

Strengths of this research were the use of reliable administrative data, the large number of subjects (n=874) and the longitudinal analysis to demonstrate patterns of dental utilization. Medicaid administrative claims data are robust with medical, dental and demographic information. The Medicaid data allowed the analysis of the entire population of Medicaid-eligible enrollees who met the study criteria, and subsequently had several variables to be considered in the regression models. The longitudinal analysis studied patterns of dental utilization by senior adults while community-dwelling and in an institutional setting. Additionally, the subjects served as their own comparison group; this within subject design controlled for the individual subject differences.

Future Studies

This novel research may serve as a foundation for many future studies. Additional research may include Medicaid enrollees who remained community-dwelling for the five-year study period as a comparison group to the nursing facility enrollees, allowing for comparisons to show whether similar geographic predictors or oral health care utilization patterns existed over the five-year period.

Further research is warranted regarding dentists who provided dental procedures after NF entry and NFs where subjects received dental care. Information such as whether the dentist received advanced geriatric training, had handicap-accessible office, provided the dental services in the NF, or was ready to retire and no longer desired a full-time practice could be gathered. This information would help to identify dental providers who are more likely to deliver care to NF residents. NF information such as how transportation is arranged for dental visits, if the dentist has a contract with the NF, or how dental referrals are made (findings from Minimum Data Set screening, resident request, Direct Care Worker concern) would help in designing future oral health programs for the frail elderly and determining specific barriers to care.

Policy Implications

This research suggests that dental insurance coverage alone did not assure that subjects would receive dental care. Fewer than half of the study subjects received any dental procedure in the five years despite having public insurance this entire period. Iowa dentists report that reimbursements levels are too low to provide overall dental care.[146] The frail elderly may require specialized care which may involve sedation, care in a NF or in a hospital which may worsen the financial burden to the dentist. Additionally, the Medicaid elder enrollees may be unaware of Iowa's dental coverage. [123]
Medicaid has an opportunity to connect specific ICD codes to prompt a dental referral from a medical provider to possibly save healthcare costs and improve health outcomes.

This research found that subject-level (e.g. prescriptions written, race) variables are statistically significant when the senior adult is residing in the community, and thus should be addressed in planning health programs that target senior adults. Programs could include training for geriatricians to perform oral health screenings or expanding I Smile ™ Silver beyond the SE region. (The Iowa Department of Public Health implemented I Smile ™ Silver as a pilot project in the SE AAA region that is intended to help older Iowans access oral health care. [147]

Currently dental codes can only be used by dentists or Title V Maternal Child Health agencies when providing dental care to children and expectant mothers through Iowa's I Smile™ program. [148] Opening the Medicaid dental codes to NF also would allow for dental hygienists to provide only HPP similar to the current I Smile ™ model as previously described. In addition to NF, allowing other community sites that focus on senior adult services (e.g. congregate meals, adult daycare) to be reimbursed for HPP would also enhance access oral health care for Medicaid-enrolled senior adults. At least 18 states currently allow dental hygienists to be Medicaid providers. [119] Direct reimbursement to dental hygienists by Medicaid for HPP provided in NF would strengthen the current Public Health Supervision program and most likely dramatically increase the number of subjects who receive "HPP only" in NF from its current 0.5% high during the study period (Table 14).

Conclusion

The strongest predictor of receipt of dental procedures in the two years after NF entry was the receipt of dental procedures in the three years before NF entry. This underscores the importance of establishing a source of dental care before NF entry. There are many efforts in Iowa to keep the frail elderly out of institutional settings which will place more importance on making dental services available in the community.

Table 1. Data Collected from Iowa Medicaid Enterprise by Year

		Before NF Entry			After NF Entry	
Level	Original Data	Year 1	Year 2	Year 3	Year 4	Year 5
Nursing Facility	AAA region				x	
	Urbanicity				x	
	DHPSA				x	
Subject	Chronic Conditions				x	
	Prescriptions	x	x	x	x	x
Procedure	Procedure Code	x	x	x	x	x
	Provider	x	x	x	x	x

Table 2. Data Source for Nursing Facility Variables in Iowa

Domain	Data source	Variable Type	Level
Geographic location	IDPH	Nominal	AAA Regions
Urbanicity	Iowa Health Care Association	Binary	Rural Urban
DHPSA	IDPH	Binary	Yes No

Table 3. Subject Variables from Iowa Medicaid Enterprise (IME) Database

Domain	Data source	Variable Type	Level
Age in years [a]	IME	Ordinal	65-74 75-84 ≥85
Sex [a]	IME	Binary	Male Female
Race [a]	IME	Nominal	White Other/Not Reported
Chronic Conditions Groups [a]	IME	Ordinal	0 1 2 3 ≥ 4
Same Dental Provider [b]	IME	Binary	Yes No

[a] At time of subject's entry into Nursing Facility
[b] If subject had dental procedures before and after entry into nursing facility

Table 4. Health Related Variables from Iowa Medicaid Claims Database

Domain	Data source
Dental Procedure Codes	American Dental Association (Code of Dental Therapeutics 2014)
Medical diagnosis [a]	**IME Claims Data (ICD-9 Codes)**
Hypertension	401, 405.99, 362.11, or 437.2
Mental Health	290, 290.99, 293, 302.99, 306 or 316.99
Coronary Artery Disease	390, 400.99, 402, or 429.99
Diabetes	249, 250.99, 357.2, 357.29, 362.0, 362.09, 366.41, 648.0, or 648.09
Cataracts	366.01, 366.9, 379.26, 379.31, 379.39 or V43.1
Rheumatoid Arthritis	714.0 or 715.98, 721.00 or 721.91
Depression	296.2, 296.89, 298.0, 300.4, 309.1, 311 or 311.99
Dementia	290, 290.99, 294, 294.8, 331.0, 331.07 or 797
Heart Failure	398.91, 402.01, 402.91, 404.01, 404.93, 428.0 or 428.9
Hyperlipidemia	272.2, 272.29, 272.4, 272.49, 272.0 or 272.09
Chronic Obstructive Pulmonary Disease	490, 492.99, 496, 496.99, 494 or 494.1
Ischemic Heart Disease	410.00 or 414.9
Anemia	280.0 or 285.9
Cerebrovascular Disease	430, 436.99, or 997.02
Anxiety	300 or 300.99
Hypothyroidism	244 or 244.99
Arterial Fibrillation	427.31
Osteoporosis	733.00 or 733.09
Renal/Kidney Disease	016.00, 016.06, 095.4, 249.40, 249.41, 250.40, 250.43, 271.4, 274.10, 283.11, 403.01, 403.11, 403.91, 404.02, 404.03, 404.12, 404.13, 404.92, 404.93, 440.1, 442.1, 572.4, 580.0, 584, 586.99, 588.9, 591, 753.12, 753.29 or 794.4
Parkinson's /Multiple Sclerosis	332, 332.99, 340 or 341.99
Schizophrenia	295 or 295.99
Prescription Medications [b]	IME Claims Data (National Drug Codes)

[a] At time of subject's entry into Nursing Facility

[b] Based on number of prescriptions written then categorized into ordinal groups (0, 1 - 10, ≥11)

Table 5. Percentage of Nursing Facilities by Characteristics and AAA Regions

Characteristics of Nursing Facilities by AAA Regions							
	Total NF	NW	NE	Central	East Central	SE	SW
	n=433 (100%)	103 (23.8)	85 (19.6)	69 (15.9)	41 (9.5)	64 (14.8)	71 (16.4)
Rural DHPSA	206 (47.6)	57 (55.3)	51 (60.0)	4 (5.7)	0 (0.0)	54 (84.4)	40 (56.3)
Rural Non- DHPSA	73 (16.9)	44 (42.7)	5 (5.8)	13 (18.9)	8 (19.5)	0 (0.0)	3 (4.2)
Urban DHPSA	48(11.1)	2 (2.0)	21 (24.7)	0 (0.0)	6 (14.6)	10 (15.6)	9 (12.7)
Urban Non- DHPSA	106 (24.5)	0 (0.0)	8 (9.4)	52 (75.4)	27(65.9)	0 (0.0)	19 (26.8)
# of Beds by Facility [1]							
≤50	140 (32.3)	43 (41.7)	25 (29.4)	17(24.6)	8 (19.5)	18 (28.1)	29 (40.8)
≥51	293 (67.6)	60 (58.3)	60 (70.5)	52 (75.4)	33 (80.5)	46 (71.9)	42 (59.2)

[1] Iowa Health Care Association Data, 2014

Table 6. Characteristics of Target Population

Subjects 68 Years or Older, Continuously- Enrolled* in Medicaid Residing in an Iowa Nursing Facility for ≥ 24 Months	
	n=874 (15.9)
Sex	
Female	675 (77.2)
Male	199 (22.8)
Age (Years)	
68-74	179 (20.5)
75-84	348 (39.8)
85 or older	347 (39.7)
Race	
White	627 (71.7)
Not Reported	247 (28.3)
Black	14 (1.6)
American Indian	3 (0.3)
Asian	2 (0.2)
Hispanic	1 (0.1)
Pacific Islander	0 (0.0)
Multiple-Hispanic	1 (0.1)
Urbanicity [1]	
Rural	556 (63.6)
Urban	318 (36.4)
Dental Health Professional Shortage Area (DHPSA)[2]	
Yes	553 (63.3)
No	321 (36.7)
Area Agencies on Aging (AAA Regions)	
NW	196 (22.4)
NE	171 (19.6)
Central	132 (15.1)
East Central	61 (6.9)
SE	164 (18.8)
SW	150 (17.2)

Rural, DHPSA and AAA Regions as determined by nursing facility locations.

[1] Rural as listed in the 2010 US Census Bureau List of Rural Counties And Designated Eligible Census Tracts in Metropolitan Counties

[2] DHPSA as listed by Iowa Department of Public Health, 2014

*Continuously Enrolled means enrolled in Medicaid for ≥ 58 out of 60 months

Table 7. Percentage of Subjects with Chronic Conditions who received ≥ 1 PDP Year 4 (After NF Entry)

Variable	Frequency (%)[a]	Subjects with Chronic Condition Who Received ≥ 1 PDP Year 4
Total	874 (100%)	242 (27.7)
Hypertension	476 (54.5)	118 (24.8)
Mental Health	449 (51.4)	127 (28.3)
Coronary Artery Disease	357 (40.9)	101 (28.3)
Diabetes	306 (35.0)	79 (25.8)
Cataracts	298 (34.1)	92 (30.9)
Rheumatoid Arthritis	269 (30.8)	76 (28.3)
Depression	203 (23.2)	59 (29.1)
Dementia	195 (22.3)	50 (25.6)
Heart Failure	194 (22.2)	55 (28.4)
Hyperlipidemia	170 (19.5)	48 (28.2)
Chronic Obstructive Pulmonary Disease	167 (19.1)	40 (23.9)
Ischemic Heart Disease	166 (18.9)	40 (24.1)
Anemia	118 (13.4)	37 (31.4)
Cerebrovascular Disease	117 (13.4)	28 (23.9)
Anxiety	110 (12.6)	31 (28.2)
Hypothyroidism	108 (12.4)	32 (29.6)
Arterial Fibrillation	100 (11.4)	31 (31.0)
Osteoporosis	85 (9.7)	30 (35.29)
Renal/Kidney Disease	80 (9.2)	21 (26.3)
Parkinson's /Multiple Sclerosis	47 (5.4)	24 (51.1)
Schizophrenia	38 (4.4)	14 (36.8)

[a] ≥1 ICD code in diagnosis domain is counted as 1

Table 8. Frequency of Subjects and Number of Chronic Conditions Year 4 (After NF Entry)

Number of Chronic Conditions Year 4	Subjects Frequency (%)
	n=874 (100%)
0	59 (6.8)
1	88 (10.1)
2	99 (11.3)
3	83 (9.5)
4	114 (13.0)
5	93 (10.6)
6	107 (12.2)
7	83 (9.5)
8	53 (5.9)
9	41 (4.7)
10	29 (3.3)
11	16 (1.8)
12	7 (0.8)
13	3 (0.3)

Table 9. Percentage of Subjects Who Received ≥1 PDP by Chronic Conditions Group

Chronic Condition Group by Subjects and ≥ 1 PDP Year 4		
Chronic Conditions Groups*	All Subjects n=874 (100%)	Subjects Who Received ≥ 1 PDP
		Yes n=242
0	59 (6.8)	14 (23.7)
1	110 (12.6)	28 (25.5)
2	145 (16.6)	37 (25.5)
3	178 (20.4)	54 (30.3)
4 or more	382 (44.2)	109 (28.5)

*Based on Centers for Medicare and Medicaid Services data table for senior adults
Chi Square test p-value not significant

Table 10. Percentage of Subjects by Prescriptions Written Levels and Year

		Year 1	Year 2	Year 3	Year 4	Year 5
		Study n=874 (100%)				
Prescriptions Written Levels	0	506 (57.9)	501 (57.3)	410 (46.9)	87 (10.0)	112 (12.8)
	1 – 10	158 (18.1)	132 (15.1)	224 (25.6)	203 (23.2)	182 (20.8)
	11 or more	210 (24.0)	241 (27.6)	240 (27.5)	584 (66.8)	580 (66.4)

Table 11. Chronic Conditions Correlated to ≥ 1 Dental Procedures Received

Chronic Condition	Frequency (n)	≥ 1 PDP Received n (%)	p-value	≥ 1 ODP Received n (%)	p-value
Parkinson's Disease/ Multiple Sclerosis					
Yes	47	24 (51.1)	<0.001	20 (42.6)	0.008
No	827	218 (26.4)		207 (25.0)	
Coronary Artery Disease					
Yes	357			106 (29.6)	0.037
No	517			121 (23.4)	
Hypertension					
Yes	476	118 (24.8)	0.036		
No	398	124 (31.2)			

Table 12. Frequency of Subjects Who Received ≥ 1 PDP and Prescription Level

		Year 1		Year 2		Year 3		Year 4		Year 5	
		Study n=874 874	PDP n=162 (18.5)	Study n=874 874	PDP n=153 (17.5)	Study n=874 874	PDP n=167 (19.1)	Study n=874 874	PDP n=242 (27.7)	Study n=874 874	PDP n= 214 (24.5)
Prescription Written Level	0	506	67 (13.2)	501	63 (12.6)	410	52 (12.7)	87	19 (21.8)	112	28 (25.0)
	1 - 10	158	37 (23.4)	132	33 (25.0)	224	49 (21.4)	203	54 (26.6)	182	36 (19.8)
	11 or more	210	58 (27.6)	241	57 (23.7)	240	67 (27.9)	584	169 (28.9)	580	150 (25.8)
*p-value			**<0.001**		**<0.001**		**<0.001**		0.160		0.412

* Cochran–Mantel–Haenszel Row Mean Scores Differ

Table 13. Percentage of Subjects Who Received ≥ 1 PDP, by Year

		PDP Year 1		PDP Year 2		PDP Year 3		PDP Year 4		PDP Year 5	
PDP Total (%)	Subjects n = 874	n=162 (18.5)	p-value	n=153 (17.5)	p-value	n=167 (19.1)	p-value	n=242 (27.7)	p-value	n= 214 (24.5)	p-value
Sex											
Female	675	124 (18.4)	0.817	121 (17.9)	0.547	125 (18.5)	0.415	188 (27.9)	0.843	173 (25.6)	0.147
Male	199	38 (19.1)		32 (16.1)		42 (21.1)		54 (27.1)		41 (20.6)	
Age (Years)											
68-74	179	33 (18.4)		40 (22.4)		40 (22.4)		60 (33.5)		47 (26.3)	
75-84	348	65 (18.7)	0.996	60 (17.2)	0.128	66 (18.9)	0.418	86 (24.7)	0.101	81 (23.3)	0.742
85 or older	347	64 (18.4)		53 (15.3)		61 (17.6)		96 (27.7)		86 (24.8)	
Race											
White	627	129 (20.6)	**0.014**	122 (19.5)	**0.015**	131 (20.9)	**0.032**	180 (28.7)	0.283	161 (25.7)	0.191
Other/Not Reported	247	33 (13.4)		31 (12.6)		36 (14.6)		62 (25.1)		53 (21.5)	
Urbanicity											
Rural	556							127 (22.8)	**<0.001**	122 (21.9)	**0.021**
Urban	318							115 (36.1)		92 (28.9)	
DHPSA											
Yes	553							142 (25.7)	0.081	132 (23.9)	0.579
No	321							100 (31.2)		82 (25.6)	
AAA Regions											
NW	196							54 (27.6)		43 (21.9)	
NE	171							57 (33.3)		50 (29.2)	
Central	132							44 (33.3)	**0.022**	39 (29.6)	0.093
East Central	61							18 (29.5)		13 (21.3)	
SE	164							29 (17.7)		29 (17.7)	
SW	150							40 (26.7)		40 (26.7)	

*Chi Square Significant p-value <0.05

Table 14. Subject Percentage Within Preventive Dental Procedure Categories, by Year

	Before NF Entry			After NF Entry	
	Year 1	Year 2	Year 3	Year 4	Year 5
No PDP[1]	712 (81.5)	721 (82.5)	707 (80.1)	632 (72.3)	660 (75.5)
HPP only[2]	2 (0.2)	4 (0.5)	2 (0.2)	4 (0.5)	3 (0.3)
Exam only	54 (6.2)	46 (5.3)	62 (7.1)	121 (13.8)	115 (13.2)
Exam & HPP	106 (12.1)	103 (11.8)	103 (11.8)	117 (13.4)	96 (10.9)
p-value*	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**

*p-value <0.05 calculated with McNemar's Test.
For ease of reading cells represent discordant values are highlighted.
[1] PDP= Exams and Hygiene Probable Procedures
[2] HPP= Hygiene Probable Procedures

Table 15. Percentage of Subjects Who Received ≥ 1 PDP by Before and After Nursing Facility Entry

		PDP Before NF Entry		PDP After NF Entry	
PDP Total (%)	Subjects n = 874	n=253 (28.9)	p-value	n=316 (36.2)	p-value
Sex					
Female	675	198 (29.3)	0.643	249 (36.9)	0.406
Male	199	55 (27.6)		67 (33.7)	
Age (Years)					
68-74	179	56 (31.3)		75 (41.9)	
75-84	348	103 (29.6)	0.569	117 (33.6)	0.169
85 or older	347	94 (27.1)		124 (35.7)	
Race					
White	627	193 (30.8)	0.057	232 (37.0)	0.407
Other/Not Reported	247	60 (24.3)		84 (34.0)	
PDP Before					
Yes	N/A			155 (61.3)	< 0.001
No				161 (25.9)	

Table 16. Percentages of Subjects by ≥1 PDP After NF Entry

		Did Not Receive ≥1 PDP After NF Entry	Received ≥1PDP After NF Entry	
PDP Total (%)	Subjects n = 874	n=558 (63.8)	n=316 (36.2)	p-value
Sex				
Female	675	426 (63.1)	249 (36.9)	0.406
Male	199	132 (66.3)	67 (33.7)	
Age (Years)				
68-74	179	104 (58.1)	75 (41.9)	
75-84	348	231 (66.4)	117 (33.6)	0.169
85 or older	347	223 (64.3)	124 (35.7)	
Race				
White	627	395 (63.0)	232 (37.0)	0.407
Other/Not Reported	247	163 (65.9)	84 (34.0)	

Table 17. Changes in Subject Frequency by Subject Category and ≥ 1 PDP Before & After NF Entry

PDP Received	Total Subjects n=874	PDP Received Neither Before nor After NF Entry	≥ 1 PDP Before NF Entry Only	≥ 1 PDP After NF Entry Only	≥ 1 PDP Before and After NF Entry	p-value*
Sex						
Female	675	349 (51.7)	77 (11.4)	128 (18.9)	121 (17.9)	**<0.001**
Male	199	111 (55.8)	21 (10.6)	33 (16.6)	34 (17.1)	0.103
Age (Years)						
68-74	179	84 (46.9)	20 (11.2)	39 (21.8)	36 (20.1)	**0.013**
75-84	348	189 (54.3)	42 (12.1)	56 (16.1)	61 (17.5)	0.157
85 or older	347	187 (53.9)	36 (10.4)	66 (19.0)	58 (16.7)	**0.003**
Race						
White	627	322 (51.4)	73 (11.6)	112 (17.9)	120 (19.1)	**0.004**
Other/Not Reported	247	138 (55.9)	25 (10.1)	49 (19.8)	35 (14.2)	**0.005**

*p-value <0.05 calculated with McNemar's Test.
For ease of reading cells represent discordant values are highlighted.

Table 18. Frequency of Subjects by Timing of ≥ 1 Exam or HPP Received

Total Subjects n=874 (100%)	Neither Before nor After NF Entry	Only Before NF Entry	Only After NF Entry	Before and After NF Entry	p-value
Exam	461 (52.8)	99 (11.3)	161 (18.4)	153 (17.5)	**<0.001**
HPP	664 (75.9)	66 (7.6)	58 (6.6)	86 (9.8)	**<0. 472**

*McNemar's Statistic p-value significance 0.05
Discordant cells are highlighted.

Table 19. Subjects by AAA Region Who Received ≥ 1 PDP Before & After NF Entry from Same Dentist

	Total	NW	NE	Central	East Central	SE	SW
Subjects Who received ≥ 1 PDP Before & After NF Entry	155	35	31	28	12	22	26
PDP by Same Dentist	98	24	22	20	3	15	14
Percentage of Subjects with Same Dentist	63.2%	66.7%	70.9%	71.4%	25.0%	68.2%	53.9%

Table 20. Logistic Regression for Predictors of ≥ 1 PDP After NF Entry

Variable	Level	Beta	Standard Error	Odds Ratio	95% Wald Confidence Limits	p-value
	≥ 1 PDP Before	1.55	0.17	**4.71**	3.40 - 6.50	**<0.001**
	No PDP Before (Reference)	0.00	-	1.00	-	-
Sex	Female	0.19	0.19	1.21	0.84 - 1.75	0.292
	Male (Reference)	0.00	-	1.00	-	-
Age (Years)	68-74	0.29	0.19	1.35	0.93 - 1.95	0.116
	75 or older (Reference)	0.00	-	1.00	-	-
Race	White	0.11	0.17	1.12	0.80 - 1.57	0.525
	Other/Not Reported (Reference)	0.00	-	1.00	-	-
Urbanicity	Urban	0.69	0.21	**2.00**	1.33 - 3.00	**<0.001**
	Rural (Reference)	0.00	-	1.00	-	-
DHPSA	Yes	0.13	0.22	1.14	0.74 - 1.76	0.555
	No (Reference)	0.00	-	1.00	-	-
AAA Regions	NW	0.56	0.27	**1.75**	1.04 - 2.96	**0.036**
	NE	0.60	0.26	**1.83**	1.11 - 3.01	**0.019**
	Central	0.45	0.36	1.56	0.77 - 3.17	0.215
	East Central	0.02	0.41	1.03	0.46 - 2.28	0.951
	SE (Reference)	0.00	-	1.00	-	-
	SW	0.31	0.28	1.36	0.79 - 2.35	0.273
Chronic Condition Group	0-1 (Reference)	0.00	-	1.00	-	-
	2-3	0.20	0.25	1.22	0.75 - 2.00	0.424
	4-5	-0.02	0.25	0.98	0.60 - 1.58	0.925
	6 or more	0.18	0.23	1.19	0.75 - 1.85	0.432
Prescription Level	0 -10 in every years 1 -3	0.22	0.17	1.24	0.89 - 1.72	0.192
	11 or more in any year 1-3 (Reference)	0.00	-	1.00	-	-

Table 21. Percentage of Subjects by Chronic Conditions Frequency and ODP, Year 4

Variable	Frequency (%)[a]	Subjects with Chronic Condition Who Received ≥ 1 ODP Year 4
Total	875 (100%)	227 (25.9%)
Hypertension	476 (54.5)	116 (24.4)
Mental Health	449 (51.4)	114 (25.4)
Coronary Artery Disease	357(40.9)	106 (29.7)
Diabetes	306 (35.0)	74 (24.2)
Cataracts	298 (34.1)	85 (28.5)
Rheumatoid Arthritis	269 (30.8)	78 (29.0)
Depression	203 (23.2)	53 (26.1)
Dementia	195 (22.3)	45 (23.1)
Heart Failure	194 (22.2)	31 (26.5)
Hyperlipidemia	170 (19.5)	43 (25.3)
Chronic Obstructive Pulmonary Disease	167 (19.1)	42 (25.2)
Ischemic Heart Disease	166 (18.9)	37 (22.3)
Anemia	118 (13.4)	36 (30.5)
Cerebrovascular Disease	117 (13.4)	31 (26.5)
Anxiety	110 (12.6)	30 (27.3)
Hypothyroidism	108 (12.4)	34 (31.5)
Arterial Fibrillation	100 (11.4)	31 (31.0)
Osteoporosis	85 (9.7)	22 (25.9)
Renal/Kidney Disease	80 (9.2)	25 (31.3)
Parkinson's /Multiple Sclerosis	47 (5.4)	20 (42.6)
Schizophrenia	38 (4.4)	12 (31.6)

[a] ≥1 ICD code in diagnosis domain is counted as 1

Table 22. Percentage of Subjects Who Received ≥1 ODP by Chronic Conditions Level

Chronic Condition Group by Subjects and ≥ 1 ODP Year 4		
Chronic Condition Group*	All Subjects n=874 (100%)	Subjects Who Received ≥ 1 ODP
		Yes n=227
0	59 (6.8)	12 (20.3)
1	110 (12.6)	28 (25.5)
2	145 (16.6)	33 (22.8)
3	178 (20.4)	49 (27.5)
4 or more	382 (44.2)	105 (27.5)

*Based on Centers for Medicare and Medicaid Services data table for the senior adults
Chi Square test p-value not significant

Table 23. Frequency of Subjects Who Received ≥ 1 ODP and Prescription Level

		Year 1		Year 2		Year 3		Year 4		Year 5	
		Study n=874	ODP n=175 (20.1)	Study n=874	ODP n=154 (17.6)	Study n=874	ODP n=163 (18.7)	Study n=874	ODP n= 227 (25.9)	Study n=874	ODP n=199 (22.7)
Prescriptions Written Level	0	506	76 (15.0)	501	66 (13.2)	410	50 (12.2)	87	18 (20.7)	112	19 (16.9)
	1 - 10	158	40 (25.3)	132	29 (21.9)	224	48 (21.4)	203	44 (21.7)	182	182 (20.8)
	11 or more	210	60 (28.6)	241	59 (24.5)	240	65 (27.1)	584	165 (28.3)	580	143 (24.7)
*p-value			**<0.001**		**<0.001**		**< 0.001**		0.091		0.139

*CMH Row Mean scores Differ

Table 24. Percentages of Subjects Who Received ODP, by Year

	Study Subjects	ODP Year 1		ODP Year 2		ODP Year 3		ODP Year 4		ODP Year 5	
ODP Total (%)	874	n=176 (20.1)	p-value	n=154 (17.6)	p-value	n=163 (18.7)	p-value	n=227 (25.9)	p-value	n=199 (22.8)	p-value
Sex											
Female	675	135 (20.0)	0.852	117 (7.3)	0.681	124 (18.4)	0.696	173 (25.6)	0.670	160 (23.7)	0.225
Male	199	41 (20.6)		37 (18.6)		39 (19.6)		54 (27.1)		39 (19.6)	
Age (Years)											
68-74	179	0 (22.4)		39 (21.8)		35 (19.6)		59 (32.9)		41 (22.9)	
75-84	348	7 (19.3)	0.696	59 (16.9)	0.249	66 (18.9)	0.879	83 (23.9)	0.056	81 (23.3)	0.942
85 or older	347	69 (19.9)		56 (16.1)		62 (17.9)		85 (24.5)		77 (22.2)	
Race											
White	627	134 (21.4)	0.147	124 (19.8)	**0.007**	130 (20.7)	**0.012**	168 (26.8)	0.377	139 (22.2)	0.501
Other/Not Reported	247	42 (17.0)		30 (12.2)		33 (13.4)		59 (23.9)		60 (24.3)	
Urbanicity											
Rural	556							121 (21.8)	**<0.001**	114 (20.5)	**0.035**
Urban	318							106 (33.3)		85 (26.7)	
DHPSA											
Yes	553							139 (25.1)	<0.459	122 (22.1)	0.513
No	321							88 (27.4)		77 (23.9)	
AAA Region											
1 NW	196							48 (24.5)		47 (23.9)	
2 NE	171							49 (28.7)		40 (23.4)	
3 Central	132							38 (28.8)	**0.043**	35 (26.5)	0.626
4 East Central	61							24 (39.3)		12 (19.7)	
5 SE	164							31 (18.9)		30 (18.3)	
6 SW	150							37 (24.7)		35 (23.3)	

Table 25. Subject Percentage by Exam and Other Dental Procedures (ODP), by Year

	Before NF Entry			After NF Entry	
	Year 1	Year 2	Year 3	Year 4	Year 5
No Exam or ODP	685 (78.4)	698 (79.9)	683 (78.2)	593 (67.9)	624 (71.4)
ODP	29 (3.3)	27 (3.1)	26 (2.9)	43 (4.9)	39 (4.5)
Exam	13 (1.5)	22 (2.5)	28 (3.2)	54 (6.2)	51 (5.8)
Exam & ODP	147 (16.8)	127 (14.5)	137 (15.7)	184 (21.1)	160 (18.3)
p-value*	**0.014**	0.475	0.786	0.264	0.206

*p-value <0.05 calculated with McNemar's Test.
For ease of reading cells represent discordant values are highlighted.

Table 26. Percentage of Subjects Who Received ≥1 ODP by Before or After Nursing Facility Entry

		ODP Before NF Entry		ODP After NF Entry	
ODP Total (%)	Subjects n=874	n=274 (31.4)	p-value	n=320 (36.6)	p-value
Sex					
Female	675	213 (31.6)	0.809	254 (29.1)	0.251
Male	199	61 (30.7)		66 (33.2)	
Age (Years)					
68-74	179	61 (34.1)		77 (43.0)	
75-84	348	110 (31.6)	0.583	121 (34.8)	0.136
85 or older	347	103 (29.7)		122 (35.2)	
Race					
White	627	205 (32.7)	0.172	232 (37.0)	0.704
Other/Not Reported	247	69 (27.9)		88 (35.6)	
ODP Before					
Yes				154 (56.2)	<0.001
No				166 (27.7)	

Table 27. Percentages of Subjects by ≥1 ODP After NF Entry

		Did Not Receive ≥1 ODP After NF Entry	Received ≥1 ODP After NF Entry	
ODP Total (%)	Subjects n=874	n=554 (63.4)	n=320 (36.6)	p-value
Sex				
Female	675	421 (62.4)	254 (29.1)	0.251
Male	199	133 (66.8)	66 (33.2)	
Age (Years)				
68-74	179	102 (56.9)	77 (43.0)	
75-84	348	227 (65.2)	121 (34.8)	0.136
85 or older	347	225 (64.8)	122 (35.2)	
Race				
White	627	395 (63.0)	232 (37.0)	0.704
Other/Not Reported	247	159 (64.4)	88 (35.6)	

Table 28. Changes in Subject Frequency by Subject Category and ≥ 1 ODP Before & After NF Entry

	Total n=874	ODP Neither Before nor After NF Entry	ODP Before NF Entry Only	ODP After NF Entry Only	ODP Before and After NF Entry	p-value*
Sex						
Female	675	331 (49.0)	90 (13.3)	131 (19.4)	123 (18.2)	**0.005**
Male	199	103 (51.2)	30 (15.1)	35 (17.6)	31 (15.6)	0.535
Age (Years)						
68-74	179	78 (43.6)	24 (13.4)	40 (22.4)	37 (20.1)	**0.045**
75-84	348	174 (50.0)	53 (15.3)	64 (18.4)	57 (16.4)	0.390
85 or older	347	182 (52.4)	43 (12.4)	62 (17.8)	60 (17.3)	0.064
Race						
White	627	307 (48.9)	88 (14.0)	115 (18.3)	117 (18.7)	0.058
Other/Not Reported	247	127 (51.4)	32 (12.9)	51 (20.6)	37 (14.9)	**0.037**
Timing of ODP	874	434 (49.7)	120 (13.8)	166 (18.9)	154 (17.6)	**<0.001**

*p-value <0.05 calculated with McNemar's Test.
For ease of reading cells represent discordant values are highlighted.

Table 29 . Subjects by AAA Region Who Received ≥ 1 ODP Before & After NF Entry from Same Dentist

	Total	NW	NE	Central	East Central	SE	SW
Subjects Who received ≥ 1 ODP Before & After NF Entry	154	36	32	24	16	22	24
ODP by Same Dentist	94	13	21	15	6	16	13
Percentage of Subjects with Same Dentist for ODP	61.0%	63.9%	65.6%	65.2%	37.5%	72.7%	54.2%

Table 30. Logistic Regression for Predictors of ≥ 1 ODP After NF Entry

Variable	Level	Beta	Standard Error	Odds Ratio	95% Wald Confidence Limits	p-value
	ODP Before	1.25	0.16	**3.48**	2.55 - 4.74	**<0.001**
	No ODP Before	0.00	-	1.00	-	-
Sex	Female	0.28	0.18	1.32	0.92 - 1.89	0.131
	Male (Reference)	0.00		1.00		
Age (Years)	68-74	0.33	0.18	1.38	0.96 - 1.99	0.075
	75 or older (Reference)	0.00	-	1.00	-	-
Race	White	0.05	0.17	1.05	0.75 - 1.46	0.786
	Other/Not Reported (Reference)	0.00		1.00		
Urbanicity	Urban	0.65	0.21	**1.92**	1.28 - 2.87	**0.002**
	Rural (Reference)	0.00	-	1.00	-	-
DHPSA	Yes	0.35	0.22	1.43	0.93 - 2.19	0.103
	No (Reference)	0.00	-	1.00	-	-
AAA Regions	NW	0.59	0.26	**1.79**	1.09 - 2.97	**0.022**
	NE	0.29	0.25	1.34	0.82 - 2.17	0.242
	Central	0.22	0.35	1.25	0.62 - 2.50	0.530
	East Central	0.53	0.39	1.69	0.79 - 3.66	0.178
	SE (Reference)	0.00	-	1.00	-	-
	SW	0.14	0.27	1.16	0.68 - 1.96	0.593
Chronic Condition Group	0-1(Reference)	0.00	-	1.00	-	-
	2-3	0.05	0.25	1.05	0.65 - 1.71	0.831
	4-5	-0.09	0.24	0.91	0.57 - 1.45	0.681
	6 or more	0.15	0.22	1.17	0.76 - 1.79	0.486
Prescription Level	0 -10 in every year 1 -3	0.23	0.16	1.26	0.91 - 1.73	0.162
	11 or more in any year 1-3 (Reference)	0.00	-	1.00	-	-

Figure i. Study Timeline

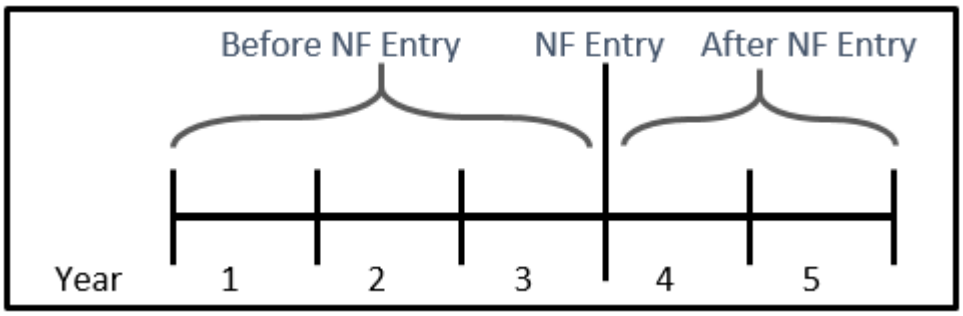
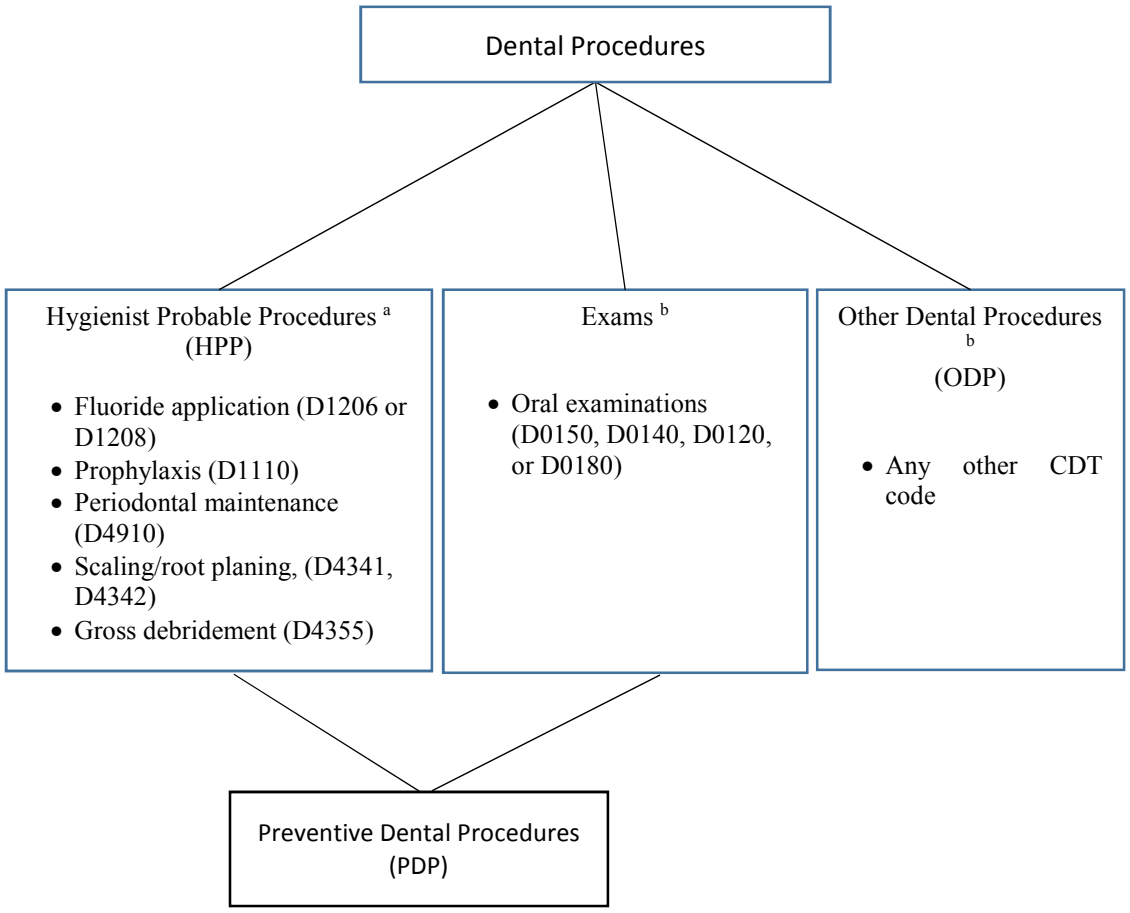


Figure ii. Dental Procedure Categories



a Provided by a dentist or a dental hygienist

b Provided by a dentist

Figure iii. Percent of Subjects by Iowa Area Agencies on Aging Regions

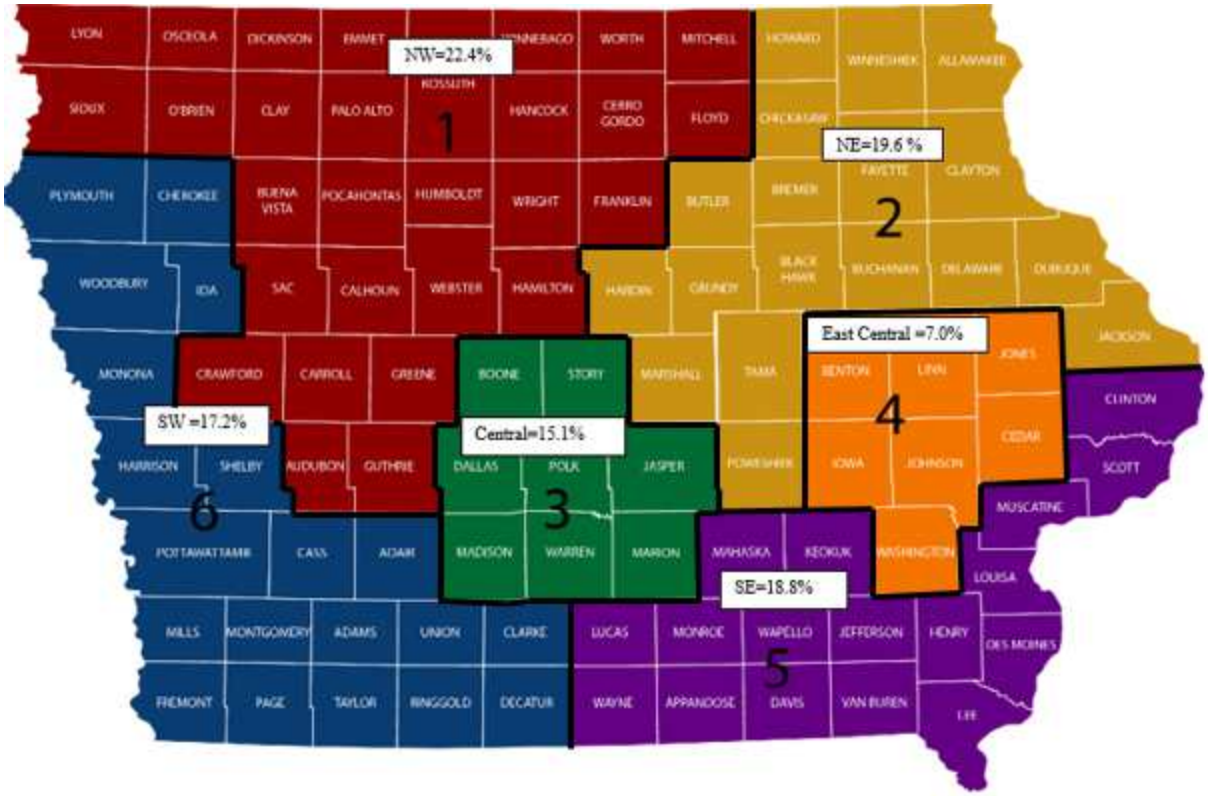


Figure iv. Percentages of Subjects, Nursing Facilities and Counties by AAA Regions

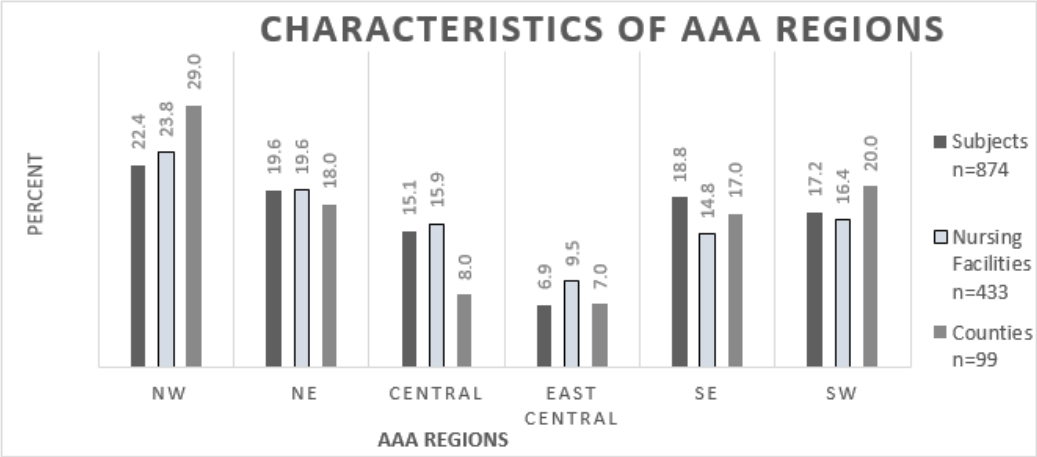


Figure v. Target Population

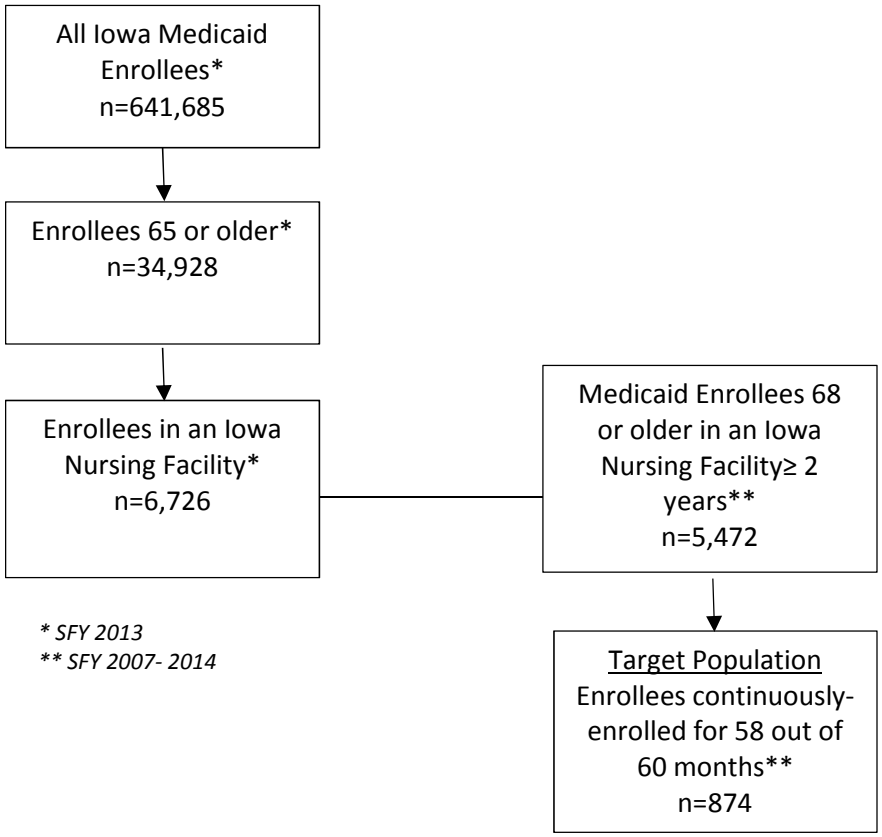


Figure vi. Percentage of Subjects Who Received ≥ 1 PDP in Year 4 by Iowa Area Agencies on Aging

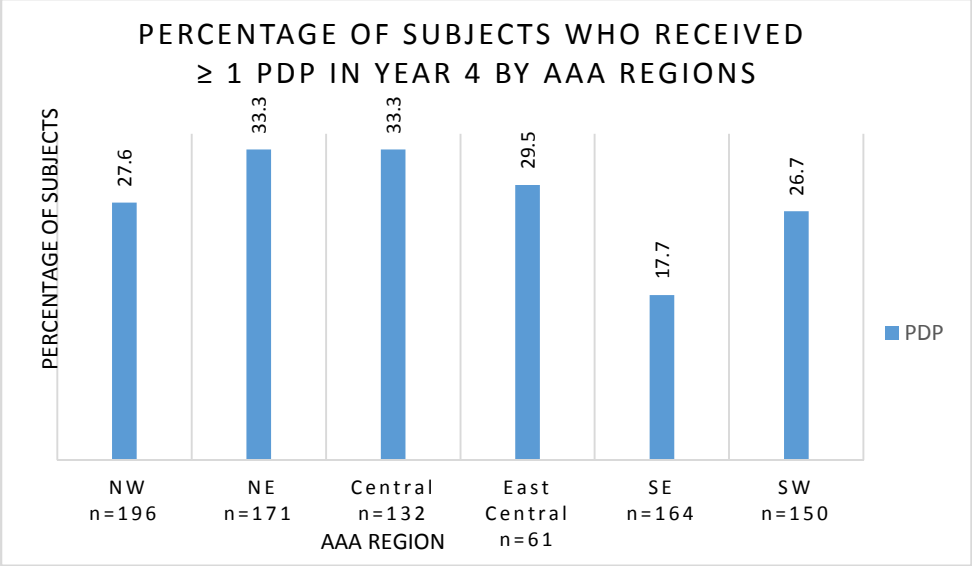


Figure vii. Subjects Who Continued Care with Same Dentist for ≥ 1 Preventive Dental Procedure After NF Entry

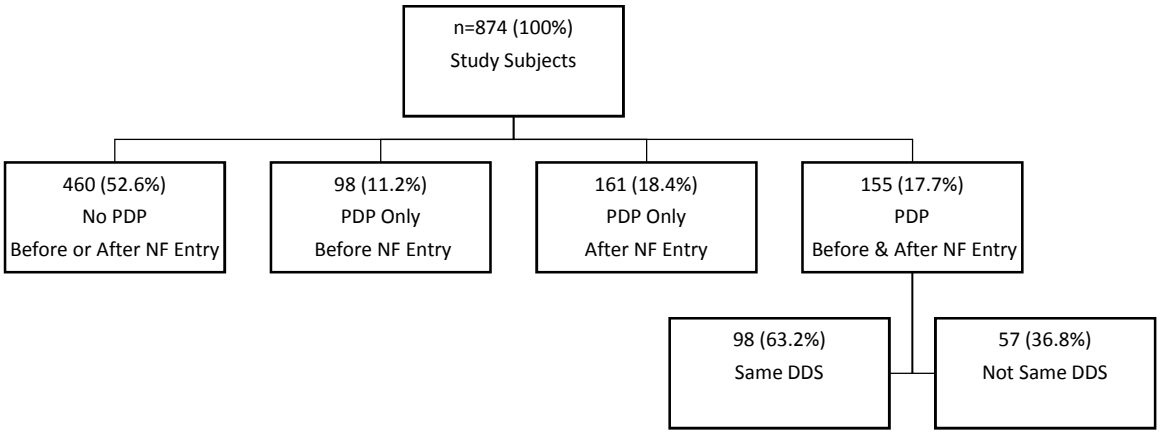


Figure viii. Percentage of Subjects Who Received ≥ 1 ODP in Year 4
by Iowa Area Agencies on Aging Regions

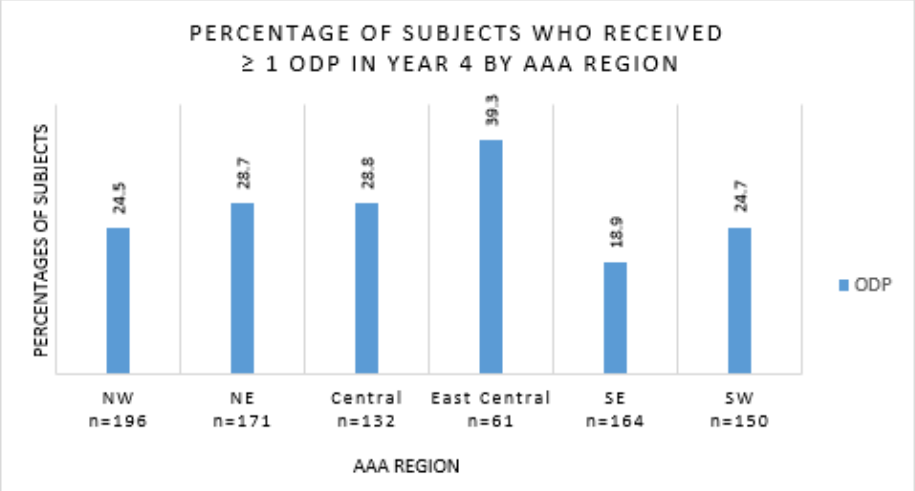
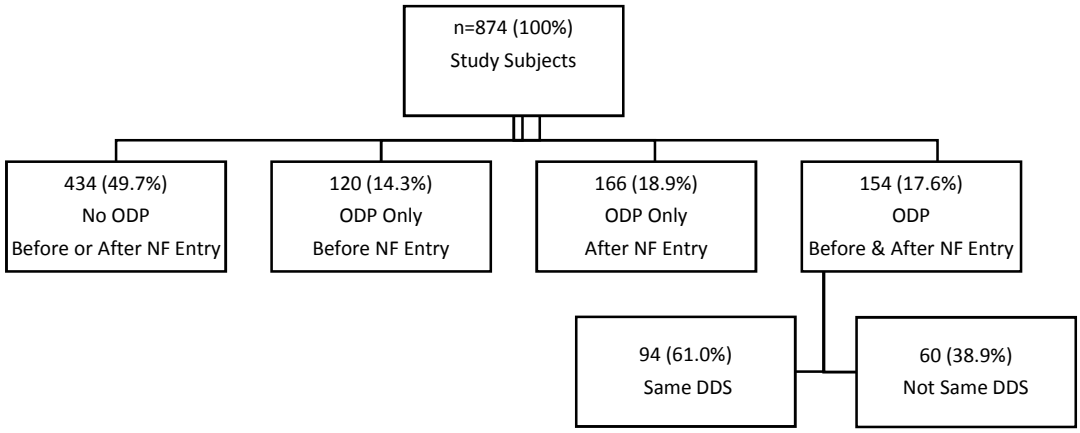


Figure ix. Subjects Who Continued Care with Same Dentist for ≥ 1 ODP



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