THE EFFECTS OF ORAL HEALTH INSTRUCTION, AND THE USE OF A

BATTERY-OPERATED TOOTHBRUSH ON ORAL HEALTH OF PERSONS WITH

SERIOUS MENTAL ILLNESS

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ABSTRACT

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Introduction: The study aims to determine if a battery-operated toothbrush will result in a greater improvement in oral health as compared to a manual toothbrush and if the provision of oral home care instructions will lead to an improvement in oral health Background: Populations with a diagnosis of serious mental illness (SMI) have a greater incidence of poorer oral health as compared the general population.

Participants and Methods: A total of 87 participants from outpatient mental wellness center in N.J. completed the study. Pre-test and post-test gingival and plaque indices were collected on all participants. Two groups received a battery toothbrush and two groups received a manual toothbrush. One of each of these received oral home care instructions. Additional data collected included smoking and a survey to assess level of negative symptoms.

Results: The study found that the battery operated toothbrush resulted in a significant improvement in the mean change in gingival index: $F(1,86) = 4.52$, $p < .05$, $\eta^2 = .05$. The study also found that oral home care instructions, smoking and level of negative symptoms did not have an effect on the mean change in plaque or gingival indices.

Discussion: Collaboration between the oral health care provider and the mental health care provider is important in improving the oral health of the patient with a diagnosis of SMI. The implementation of a simple, cost effective measure such as a battery operated toothbrush can result in an improvement in oral health in this population.

CHAPTER I

INTRODUCTION AND BACKGROUND

It is estimated that 14% of the "global burden of disease has been attributed to mental illness, mostly due to the persistently disabling nature of common mental disorders such as depression, substance abuse disorders and psychoses" (Edward et al., 2012, p.423). For humans, oral health is linked to overall health and is a window to one's general state of well-being. Recent research has demonstrated that many systemic disorders initially present with oral manifestations and signify that poor oral health may be a sign of an underlying disease. Some diseases that may initially manifest in the oral cavity are Gardener's syndrome, pernicious anemia, and Kaposi's Sarcoma. Oral health has a significant impact on one's social life, social interactions, the ability to pronounce words, and the ability to eat. Additionally, poor oral health can negatively affect a person's cosmetic appearance and decrease his or her overall self-confidence. Deteriorating or poor oral health may also impact an individual's career (Almomani, Brown and Williams, 2006). Poor oral health that leads to the loss of the dentition affects the ability to speak properly; this in turn may negatively impact the ability to do well in an interview for potential employment.

Certain populations, such as those with serious mental disorders (SMI), suffer from a higher incidence of oral health issues as compared to the general population. Populations with SMI have a higher incidence of general healthcare issues.

Schizophrenia is an SMI that affects one (1) in one hundred (100) people (Pack, 2009). Although the specific cause of schizophrenia is unknown, it is believed that abnormalities in brain development may be one cause of this disorder (Friedlander and Marder, 2002). "The word has a Greek origin split (schizo) and mind (phrenia), a mind split from reality" (Clark, 2008). Predisposing factors include a genetic predisposition as well as environmental factors such as abuse and trauma (Pack, 2009). Men and women are affected equally; those who suffer from this disorder also suffer from a variety of other health issues such as heart disease, hypertension, cerebrovascular accidents, respiratory problems, and cancer (Pack, 2009). Additionally, this population suffers from "the inability to function effectively in self-care, family relationships, school, employment and social life in general" (when acutely ill) (Clark, 2008).

People with SMI have a shorter life span; this may be due to many factors including a sedentary lifestyle and poor diet, diabetes, obesity, isolation from others, as well as the symptoms that are related to the disease (Pack, 2009). Coronary artery disease (CAD) is the primary cause of higher mortality rates in this group (Clark, 2008). The high rate of CAD in those who suffer from schizophrenia is linked to smoking, elevated cholesterol, obesity, diabetes, and hypertension (Clark, 2008).

Nearly 70% of schizophrenic patients smoke as compared to approximately 25% of the general population (Clark, 2008). This has led to an increase in "emphysema, lung cancer, cardiac disease and oral cancer" in this population (Friedlander and Marder,

2002, p. 604). In a literature review conducted in 2012 by Edward, Felstead and Mahoney, it was concluded that poor oral health has also been shown to lead to an increase in mortality from pneumonia. In high-risk groups such as those with psychiatric disorders, the death rate from pneumonia was three times higher in those who did not receive oral care as compared to those who did. Additionally, Edward et al. (2012) found that individuals who brush only once per day are at a significantly higher risk for developing heart disease compared to those who brush twice per day.

Besides the above-discussed health- related issues, patients with schizophrenia also suffer from greater oral health problems, when compared to the general population. Several factors are believed to contribute to the poor oral health that is common in this population. These include a lack of motivation and/or skills necessary for oral hygiene care caused by the negative symptoms of schizophrenia as well as side effects of medications used to manage the disorder. Other factors include lack of finances, poor health literacy and the stigma associated with the disorder that may lead to discrimination when seeking dental treatment. The lack of access to dental practitioners with the practical background to manage patients with SMI also has a negative impact on the oral health of this population.

Primary studies that evaluate the benefits of preventive dental services and oral home care in those suffering from SMI are limited in the existing body of literature. The proposed study will evaluate whether or not the preventive care that such as the type of toothbrush and the provision of oral home care instructions improve the oral health of the patient suffering from SMI.

Negative and Positive Symptoms of Schizophrenia in Relation to Dental Care

The negative symptoms schizophrenia based on a Positive and Negative Symptoms Scale (PANSS) include those of flat affect, social and emotional withdrawal and apathy. These symptoms lead to "lack of desire and ability to perform oral health care procedures" (Almomani et al., 2006). The positive symptoms of schizophrenia, characterized by their presence, are an "exaggeration or distortion of normal function" (Friedlander & Marder, 2002, p. 603). The most common positive symptoms are hallucinations and delusions. As a result, patients who suffer more from the negative symptoms of schizophrenia are at greater risk of poor general and oral health as compared to the patient than those who suffer more from the positive symptoms of schizophrenia (Almomani et al., 2006). The increase in negative symptoms in patients diagnosed with SMI results in an increase in decayed and missing teeth as compared to an increase in positive symptoms in those diagnosed with SMI (Arnaiz et al., 2011). Presumably adherence to an antipsychotic medication regimen and an improvement in the negative symptoms of schizophrenia will lead to improvements in patients' self-care (Almomani et al., 2006).

The 1st-generation antipsychotic agents are able to manage just the positive symptoms of schizophrenia, whereas the 2nd-generation antipsychotic agents are better able to manage both the positive and negative symptoms of schizophrenia with a significant reduction in the extrapyramidal side effects. The overall effect is more desirable; however, the 2nd-generation antipsychotic medications lead to an increase in metabolic syndrome and excess visceral fat as well as an alteration in lipid and glucose metabolism. In the patient suffering from schizophrenia, these changes result in an

increase in coronary artery disease (CAD) and an increase in Type II diabetes (Clark, 2008). The 2nd- generation antipsychotic agents produce other oral side effects such as stomatitis, xerostomia, dysphagia, dysgeusia, and hypersalivation (Clozapine only).

Access to Care

Many people in general experience dental anxiety. However, dental anxiety and the lack of financial resources commonly experienced the SMI population may compound poor oral health problems (Almomani et al., 2006). Unfortunately, many dental professionals are not aware of how to manage patients with psychiatric disorders, resulting in a lack of availability of providers who are able to appropriately treat the dental concerns of patients with psychiatric disorders (Kilbourne, Horvitz-Lennon, Post, McCarthy, Cruz, Welsh and Blow, 2007). Many dental practitioners are not trained to manage patients with a diagnosis of serious mental illness. As a result, dental practitioners do not perform complete oral health assessments on patients with psychiatric disorders. Thus, necessary dental or periodontal needs may not be identified.

Patients suffering from an SMI also experience a higher rate of missing teeth; in many cases, teeth are extracted and not restored. The above may be due to lack of training during dental school education. Many patients with SMI feel that they do not receive appropriate treatment by the dental practitioner because of their mental disorders. As a result, the perceived stigma and dissatisfaction associated with dental care by those who suffer from psychiatric disorders may lead to the avoidance of dental visits by the psychiatric patient (Edward et al., 2012).

Cognitive Impact

Schizophrenia affects the cognitive skills of the patient suffering from the symptoms of this disorder (Bowie, McGurk, Mausbach, Patterson & Harvey, 2012). Cognitive improvement is seen in patients suffering from SMI with pharmacological and psychosocial interventions (Lee, Redoblado-Hodge, Naismith, Hermens, Porter, Hickie, 2013). Early intervention cognitive remediation particularly seems to be beneficial in improving psychosocial functioning of the patient (Lee at al., 2013). In particular, verbal learning and memory improved most significantly with early intervention cognitive learning (Lee et al., 2013). Cognitive impairment also affects memory, recall, the ability to learn new skills and the ability perform oral home care. Cognitive remediation may improve the ability to retain oral home care skills and may result in improved oral health.

Health Literacy

An additional challenge in managing the patient who has been diagnosed with SMI is overall lower health literacy. Health literacy is defined as "the degree to which individuals have the capacity to obtain, process and understand basic health information. Health literacy is so content specific it can differ substantially from general literacy. Even an individual who functions competently at home or work may have inadequate literacy in a healthcare setting." (Galletly, Neaves, Burton, Liu, Denson, & 2012). Poor health literacy may lead to negligence in oral home care in the population with a diagnosis of SMI.

In 2013, the Surgeon General's report confirmed that oral health is a significant part of overall health (Bress, 2013). Education and improvement of health literacy are important components that are related to overall health and well-being. According to

Bress (2013), poor oral health literacy affects overall health negatively in a more significant manner than "age, income, education level, employment status and racial or ethnic group." Terminology and educational instructions must be presented to the individual in terms that can be understood easily. In medicine, studies have shown that communication between physician and patient leads to an improvement in compliance (Bress, 2013), and the same methods can be applied to oral health. The dental hygienist plays an important role in the education of the patient. Studies demonstrate that oral hygiene educational programs conducted on non-disordered populations result in improved oral hygiene and improved home care (cite). One such study was conducted by D'Cruz and Aradhya (2013) in Bangalore, India.

It is important for the patient with SMI to remain in close contact with healthcare providers and acquire health literacy skills (Galletly et al., 2012). Schizophrenia does have a negative effect on memory and concentration; it is expected that those with schizophrenia would also have difficulty understanding health-related information (Galletly et al., 2012). According to this group of researchers, there are no studies that evaluate the impact of poor health literacy on people suffering from SMI. Health literacy data published in Australia did find that in the general population, "2.6% had inadequate health literacy and 4.2% had marginal health literacy, but that 8.9% of those with rheumatoid arthritis had inadequate of marginal literacy" (Galletly et al., 2012). Additionally, studies conducted on people with medical illnesses have found that poor adherence to instructions is correlated with a lower literacy rate. Galletly et al. (2012) studied whether or not those with SMI may have a lower health literacy rate as compared to the general population of Australia. Furthermore, Almomani et al. (2006) discussed the

successful implementation of education regarding oral health for this population with modifications to ensure that patients comply with home care. Based on the information gained during the literature review, it is hypothesized that the provision of home care instruction and education to patients whose SMI has been stabilized should lead to an improvement in oral health status. The dental practitioner should seriously consider a powered toothbrush, as this instrument may result in greater compliance and an improvement in oral care. A powered toothbrush will allow for ease of manipulation while performing oral home care, especially in patients who suffer from tardive dyskinesias.

In addition to health illiteracy, other problems, like an individual's financial problems may be a barrier to the ability to access a powered toothbrush. Powered toothbrushes vary significantly in quality, price and features offered. Prices can range from well under ten (10) dollars to over one-hundred (100) dollars. The dental practitioner can suggest a low cost battery operated toothbrush, which is available at most pharmacies and department stores to the patient who suffers from SMI in order to allow for ease of manipulation during oral home care. The cost of a powered toothbrush and preventive care is significantly less than the cost of a dental office visit; investing in a powered toothbrush may reduce costs long term.

Patients who are non-compliant may be the most challenging for the dental professional and may need more frequent dental visits for maintenance. Thus, family members may also need to be involved in the daily home oral care of the non-motivated patient (Clark, 2008). The education of the patient and family members should include nutrition and dietary counseling to promote the reduction of sugary substances and high

carbohydrate meals. Furthermore, all involved should also receive education on the use of artificial saliva to improve moisture to the oral cavity (Clark, 2008). The dental professional should be familiar with the use of toothpastes containing chlorhexidine and fluoride, as they reduce the risk of gingival inflammation and caries (Clark, 2008). Additionally, it is important for the dental professional to be aware of the many barriers that face this population with regard to access to dental care (Almomani et al., 2006, Kilbourne et al., 2007).

The ability of the dental practitioner to appropriately treat the patient with a psychiatric disorder will result in the reduction of dental problems and an increase in self-esteem as well as an improvement in overall health. Appropriate care is also less costly as preventive measures will aid in the reduction of extensive restorative procedures. Collaboration between dental professionals and psychiatrists may also benefit the psychiatric patient (Nielsen et al., 2010; Friedlander and Marder, 2002). Educating the young dental and medical students regarding the importance of collaborating with other healthcare providers and each other is important. The education process will allow the new practitioner to reach out to other professionals for a more holistic treatment of the patient. Additionally, the family members of the patient suffering from SMI and/or a proxy and/or a case manager can coordinate communication between the dental practitioner and the psychiatrist.

Oral Hygiene Instruction and the Patient with Serious Mental Illness

Will oral hygiene instruction and education improve the oral health of patients with SMI? The literature searches that were conducted for the proposed study demonstrate that studies that provide evidence of the benefits of oral health education are relatively rare. It

is predicted that the proposed study will demonstrate the benefits of oral hygiene education for people with SMI. Furthermore, the use of an automatic toothbrush may be beneficial when compared to a manual toothbrush (Almomani et al., 2006). The study will test whether or not an automatic toothbrush is more beneficial for the patient with psychiatric disorders as opposed to a manual toothbrush. This study will also demonstrate whether or not any improvements in oral hygiene are clinically and/or statistically significant. Additionally, the proposed study will assess whether or not education is important by the implementation of two groups that receive a toothbrush (either automatic or manual) but no oral hygiene education.

The theoretical framework of this study is informed by two overarching psychological theories: behaviorism and the cognitive theory of learning. The behaviorist theory dominated during the earlier part of the 20th century and supports the idea that people merely respond to environmental stimuli and that all learning is accomplished through conditioning. Behavioral techniques are utilized widely today to help patients, including those with SMI, learn new therapeutic such as oral home care (Psychology Theories, n.d.). Cognitivism replaced behaviorism in the 1960s. According to Cognitivism, people are rational beings who require active participation in order to learn (Cognitivism - Learning Theories, n.d.). Vygotsky's theory of learning and Bandura's social learning theory may also be beneficial if implemented in primary healthcare situations (Hopewood, 2015). This core of Vygotsky's theory is the concept that the focus should shift from the problem to the solution (Hopewood, 2015). Specifically, the patient and the support system should play a central role in bringing forth a resolution to the problem. Tools should be provided to the patient in order to mediate the issue.

Mediation is long lasting and provides the tool to resolve the problem (Hopewood, 2015). Bandura's theory is based on the belief that people learn from each other through observation and modeling (McLeod, 2016). This theory incorporates motivation and memory and it bridges the gap between the behaviorist and cognitive learning theories (Mceod, 2016). The discussed learning theories will be integrated into the theoretical framework learning with the use of visual, auditory learning and tactile/kinesthetic learning styles.

In summary, patients with SMI have more co-morbidities such as diabetes and heart disease as compared to the general population. One such phenomenon is poor oral hygiene in this group which contributes to yet more co-morbidities, including coronary artery disease, pneumonia as well as diminished self-esteem with the loss of the dentition due to lack of oral care. However, many of these comorbidities are reversible if the health care provider appropriately addresses the overall and oral health care concerns. It is believed that poor oral hygiene in this population is linked to the negative impact of schizophrenia on cognitive abilities. Educational interventions, which adhere to the behaviorist theory, have been shown to improve skills in those with SMI. It can be hypothesized that educational interventions which adhere to the behaviorist theory and cognitive learning style combined with other resources such as an automatic toothbrush will achieve better oral health, and overall enhanced health status; perhaps decreasing the financial impact on our health care system.

Based on the information from this literature review, a detailed consideration of Behaviorism and Cognitivism will provide us with an understanding of how participants who are exposed to visual and auditory learning can learn to improve their at-home oral

care routines. The integration of these theories, which include auditory and tactile learning techniques, will inform how people learn to comply to health care regimens, thus allowing for long-term retention of oral self-care skills.

In summary, it is important to address the oral health concerns of the patient diagnosed with a serious mental illness. Improving the oral health of this population will increase the retention of the natural dentition and will result in improved social interactions, speech and the ability to eat a variety of foods and improved diet. The dental practitioner should take into account the xerostomic effects of the medications used to manage SMI as well as the dyskinesias that may result from the medications. Both the xerostomia and the difficulty in performing oral home care caused by the dyskinesias can lead to a rapid deterioration in oral health. The oral health care provider should also take into account that patients with a diagnosis of SMI may also suffer from diminished cognitive skills; as a result, the practitioner may need to spend more time educating the patient and the care giver on the importance of diet and oral home care. Demonstrating oral home care techniques with visual and audio aids such as videos as well as reinforcing instructions at each recare visit is important for retention of this activity of daily living. Furthermore, health literacy is important and education of the patient regarding oral home care may result in better oral health. Additionally, more frequent recare visits may be needed to maintain the oral health of the patient. Patients with negative symptoms of schizophrenia are more likely to suffer from poorer oral health than those with a diagnosis of positive symptoms of schizophrenia. The dental practitioner must be prudent in involving the patient and the caregiver in the performance of oral home care. Educating the dental student in the management of patients suffering

from SMI is important. The future practitioner will be better able to diagnose and manage the patient with a diagnosis of SMI resulting in better oral health. Financial constraints are a problem faced by this population that may result in lack of a dental care. Educating the patient regarding affordable dental care options is important. These choices include dental providers that accept Medicaid for patients who have Medicaid. Federally Qualified Health Centers (FQHC) accept Medicaid for dental services and also offer sliding scale fees based on income. Dental schools where dental students are the providers are also a viable option for patients with a diagnosis of SMI. For all patients with a diagnosis of SMI the dental health care provider should work closely with the treating physician so the patient receives holistic care. When necessary other providers such as a dietician should be involved in the healthcare process as well.

CHAPTER II

REVIEW OF THE LITERATURE

Throughout the world, persons with serious mental illness suffer from oral health care issues more than the general population (Almomani et al., 2006). As stated by Almomani et al., (2006), 63% of patients in psychiatric hospitals in South Wales were edentulous and those with a remaining dentition had fewer teeth than the general population. A similar study conducted by Kenkre (2000) in India found that nearly 90% of hospitalized psychiatric patients were in need of basic dental care such as oral hygiene care and simple periodontal therapy and that 16% of patients were in need of complex periodontal treatment. A study in Nigeria regarding the perspective of nurses on "character cause and prevalence of oral disease among psychiatric patients" was conducted by Azodo, Ezeja, Omoaregba, & James (2012). This cross-sectional, questionnaire surveyed one hundred thirty-six (136) nurses. Approximately sixty-seven percent (67%) of the nurses stated that psychiatric patients have higher oral and dental problems as compared to the general population. A variety of reasons such as long

sedation periods, lack of family care, symptoms of the disorders, lack of access to dental providers and lack of oral hygiene advice cause this poor oral health. Common patient complaints are toothaches, gingival pain and inability to open the oral cavity. Although over ninety-four (94%) of the nurses are involved in the oral care of the patients, nevertheless they face many barriers such as lack of materials and lack of patient cooperation (Azodo et al., 2012). The nurses recommended that having a dentist trained in the management of patients with psychiatric disorders present at the facility will aid in the reduction of dental issues faced by this population. Similar results were found in the United States; as stated by Almomani et al., (2006), only 55% of psychiatric patients performed regular oral hygiene procedures; 91.5% of hospitalized psychiatric patients would benefit from oral hygiene education and that 77.3% of patients would benefit from oral prophylactic procedures.

Additionally, McGurk, Twamley, Sitzer, McHugo, and Mueser (2007) conducted a meta-analysis of 26 randomized controlled trials of cognitive remediation that included 1,151 patients diagnosed with schizophrenia. It was found that cognitive remediation was linked to a significant improvement in function. Cognitive performance improved with a medium effect size, psychosocial performance improved with a medium effect size, and symptoms improved with a small effect size. This group of researchers found that cognitive remediation "produces moderate improvements in cognitive performance, and when combined with psychiatric rehabilitation, also improves functional outcomes." This meta-analysis is important to the proposed question as it demonstrates that cognitive remediation that utilizes practice and strategies for adaptation in order to improve memory and the ability to solve problems can aid in the improvement of oral home care.

A literature review conducted by Morrison (2009) demonstrates that cognitive behavioral theory (CBT) has been implemented for many years to aid in the management of the symptoms of schizophrenia. Drury, Birchwood, Cochrane and MacMillan (1996) found that CBT significantly reduced the positive symptoms of schizophrenia during the first twelve (12) weeks of hospitalization. However, there was no observed decrease in the negative symptoms of schizophrenia during this time period. This group of researchers found that early implementation of CBT in "acutely psychotic inpatients, female gender, shorter duration of illness, and shorter duration of untreated illness" predicted a better outcome of CBT success. CBT is not as successful in patients who have severe negative symptoms or who have comorbid conditions such as substance abuse and addiction (Tai & Turkington, 2009). Schuster, Cather, Pachas, Zhang and four others (2017) conducted a study which included 153 participants with a diagnosis of schizophrenia or bipolar disorder. The participants received twelve (12) weeks of smoking cessation therapy which included varenicline and CBT. The study also considered independent predictors of smoking abstinence such as diminution of withdrawal symptoms, fewer cigarettes smoked per day at baseline, improved baseline attention, refrainment from alcohol use and decreased expectation of peer support to help in quitting smoking. Schuster et al., (2017) found that varenicline and CBT are beneficial in successful smoking cessation in patients with a diagnosis of SMI. However, in participants that report no significant reduction in nicotine cravings or are heavy smokers or who have unrealistic expectations of support from others in order to quit smoking, additional and more aggressive intervention may be necessary Schuster et al., (2017).

A search for primary studies was completed using the Cochrane Library. The selection criteria for this search was based on the inclusion of patients who suffer from schizophrenia; studies were excluded if they were not available in English or were not related to dental care or oral healthcare or did not include human subjects. Search terms included schizophrenia and oral health, schizophrenia, oral health and improvement, psychiatric disorders and oral health, mental disorders, oral hygiene and improvement, psychiatric disorders, oral health and education for both primary studies and literature reviews. Intervention search terms included oral health education, preventive treatment and formal teaching sessions. Observational studies included cohort studies, case-control studies, cross-sectional studies, before-and-after studies and case-series studies; a second search for literature reviews using Medline and CINAHL was also conducted; studies were excluded if they were not available in English, did not include a dental component or did not include human participants.

A limited number of primary studies were located because there is little original research on the study of oral health issues among patients with SMI, particularly schizophrenia. Those that specifically study the impact of oral health care education on the patient with schizophrenia are particularly limited. Literature reviews conducted by other researchers that focus on the oral impact of schizophrenia have also been included in this paper. Two literature reviews and 11 primary studies were found to be relevant and utilized after the implementation of all inclusion and exclusion criteria.

Hayes, Mann, Morgan, Fitcher, Kelly and Weightman (2011) completed a formal review of the published literature ~~search~~ to determine: (1) if collaboration between government and health agencies can have a positive impact on general and oral health

issues, (2) the extent of collaboration between health agencies and (3) the best methods

for collaboration. Hayes et al., (2011) found no such evidence based on the search that

was conducted that government intervention leads to an improvement in overall health.

This group believes that the lack of benefits in multi-agency collaboration may be due to

the difficulties involved in initiating and carrying out a joint effort among larger public

entities; to overcome this problem. Additionally, Hayes et al., (2011) suggest that long-

term planning may be needed to ensure success with a collaborative effort. Additionally,

resources should be adequate and disbursed appropriately as the lack of resources

(monetary and manpower) can result in the failure of the effort.

Khokhar, Clifton and Jones conducted a literature review to determine the

effectiveness of oral health education in "reducing morbidity and mortality and in

preserving the quality of life in people with serious mental illness (p. 1)." This group

found that oral health is not viewed as a priority among those who with a serious mental

illness and that the implementation of oral health care educational programs could

improve the dental care this population. Interventions should include verbal and visual

education and advice, specific to each patient, in a non-judgmental manner, which is

provided by the dental professional to the patient suffering from a psychiatric disorder.

Additionally, it is important to address the oral side effects of medications used to

treat mental disorders. Patients and families should play a role in helping to promote to

the oral health of patients with SMI. Furthermore, studies conducted in the U.S.

demonstrate that a low health literacy rate leads to a lower participation rate in preventive

measures such as cancer screenings. As a result, a lower literacy rate results in diagnosis

at later stages. Patients with lower literacy rates are less likely to understand and follow

instructions provided by their healthcare givers. Thus, the education of patients suffering from schizophrenia may need to be approached in a multifaceted manner. This includes educating the patient diagnosed with SMI. Patients should be educated regarding diet and healthy food options that minimize dental decay and promote dental health. Additionally, patients should be educated regarding dental treatment options other than extractions. Patients should also be taught the importance of prevention and oral home care. The patient that is knowledgeable will be better able to make decisions regarding food choices and dental treatment.

Medication as a Contributing Factor to Poor Oral Health

Medications used to manage schizophrenia have a negative impact on the oral cavity because they cause xerostomia and oral dyskinesias. Management of SMI usually requires multiple medications, thus resulting in an additive xerostomic effect. Both of these side effects lead to a rapid to deterioration in oral health (Arnaiz, Zumárraga, Díez-Altuna, Uriarte, Moro & Pérez-Ansorena, 2011). These side effects are more common with the 1st generation of antipsychotic agents (such as haloperidol or chlorpromazine) and less common with the newer, 2nd generation of antipsychotic agents (such as clozapine or risperidone) used to treat schizophrenia.

Oral dyskinesias are involuntary and uncontrollable movements of the tongue, lips and jaws that vary in severity and result in difficulty in performing oral care, as patients are unable to maneuver a toothbrush. These movements may lead to abnormal patterns of wear in the existing dentition and atypical facial tics (Clark, 2008). As a result, existing dental prosthesis may lose retention and become difficult to wear and use. Females are more prone to oral dyskinesias than males (cite this claim). To minimize or

prevent the occurrence of dyskinesias, psychiatrists may prescribe an anticholinergic medication such as benztropine mesylate or trihexyphenidyl hydrochloride. These additional anticholinergic medications result in an additive xerostomic effect of the antipsychotic medications. Xerostomia or dry mouth is problematic because it reduces the ability of the oral cavity to wash away food particles and may also result in ulcerations of the oral cavity, dysphagia, burning mouth syndrome, candida overgrowth and difficulty in verbalization (Clark, 2009). Furthermore, patients who suffer from xerostomia frequently tend to use sugar-laden candies and drinks to counteract the effects of a dry oral cavity. The reduction in salivary flow with the addition of high carbohydrate substances leads to a rapid progression of dental caries. Additionally, tardive dyskinesia is a neurological disorder, which is exhibited by involuntary movements of the face and jaw. This disorder may be caused by some psychiatric medications. The involuntary movements make it difficult to perform oral self-care.

Tardive dyskinesia makes oral hygiene difficult to complete by the dental practitioner as well. The dental practitioner (i.e., the dentist, dental hygienist or dental assistant) many not be trained well in evaluating patients for possible SMI and the side effects of the medications which the patient may be taking to manage the disorder. The oral side effects include xerostomia and dysgeusia. Furthermore, the dental practitioner should refer the patient immediately to the treating physician upon noticing tardive dyskinesia type movements in a patient who may be taking first generation antipsychotic medications. If the medications are terminated early in treatment, the involuntary movements may cease. However, if the medication treatment continues, the movements become permanent, even if the medications are terminated at a later point in time.

There are many challenges that the dental practitioner faces when treating a person with an SMI. The prescribed medications may cause patients with psychiatric disorders to suffer from disordered cognitive functions such as memory, attention, and problem solving skills (Almomani et al., 2006). This decrease in cognitive function is believed to affect basic skills as well as the ability to gain skills. The effect of these medications on cognitive function and the impact on oral self-care is discussed in detail below. The negative impact on the cognitive functions may make it challenging for the patient to provide an accurate medical history to the practitioner as well as for the dental practitioner to obtain a medical and dental history from the patient in order to complete an assessment and develop a comprehensive treatment plan. Additionally, the impact of diminished cognitive function may make teaching skills such as oral home care to the patient with an SMI may be more difficult. As a result, this population may not be able to follow the home care treatment plan, which may lead to further deterioration in oral health. These intolerable side effects of both 1st- and 2nd-generation antipsychotic agents may lead to a lack of compliance with medications in approximately 40% of patients, resulting in a relapse of the symptoms of the psychiatric disorder (Friedlander and Marder, 2002). Besides xerostomia and tardive dyskinesias, other side effects of 1st-generation antipsychotic agents are orthostatic hypotension, vision changes, skin pigmentation and malignant neuroleptic syndrome. The anticholinergic medications used to treat schizophrenia as well as the additional anticholinergic medications prescribed to counteract the tardive dyskinesias can also result in constipation (Friedlander & Marder, 2002).

In addition to the previously discussed side effects of the 2nd-generation antipsychotics, these medications may also cause minor sedation, hypotension, sexual dysfunction and malignant neuroleptic syndrome. Non-compliance of medications, resulting in a relapse of the positive and negative symptoms of the schizophrenic disorder, may lead to a greater decrease in the frequency of regularly scheduled visits with dental professionals in this particular population. As a result, this group is more likely to visit the dental office only when dental problems become more severe. The end result is, in many cases, extraction of the problematic tooth and a greater number of missing teeth in this population as compared to the general population (Persson et al., 2009).

Primary Studies that Evaluate the Reason for Poor Oral Health in those with SMI

As studies that demonstrate the benefits of educational intervention for this population are rare, most of the primary studies that are included in this section focus on the factors that contribute to the poor oral health of those people with SMI. These studies help to inform healthcare practitioners, as well as government agencies, with regard to focusing of resources in order to improve oral health of those who suffer from psychiatric disorders.

According to Janardhanan, Cohen, Kim and Rizvi (2011), older adults are the most rapidly growing population suffering from schizophrenia. This research group conducted a study to determine dental care and associated factors in this particular population. The sample for this study included a large multiracial group of participants from a community setting. Included in the study were one hundred 198 community members from New York City, 55 years and older, with schizophrenia. Patients with

schizophrenia were randomly selected from outpatient centers and day programs as well as from residences. The comparison group was from a similar area in New York City and consisted of 113 Caucasians, African American, Hispanics and people from other cultural backgrounds who were randomly selected members of the community. Between the two groups, there was not much difference in those who reported having either one or two dental visits per year; however, there was a significant difference between the groups among those who reported problems. In the schizophrenia group, 41% stated that they had experienced dental problems as opposed to 23% of the comparison group. Furthermore, 46% of the schizophrenia group had dentures as opposed to the control group in which 38% percent had dentures.

The study conducted by Janardhanan et al.,2011, also evaluated all patients suffering from schizophrenia for 18 possible demographic, clinical, and health predictors related to annual dental visits. Of these predictors, eight were significantly related to at least one visit annually to the dental office: living in a supported residence, financial well-being, PANSS positive syndrome score, PANSS negative syndrome score, perceived dental problems, Abnormal Involuntary Movement Scale (AIMS) oral subsection, number of sustenance network linkages or number of people who provide money, food, or medical assistance, initiation perseveration subscale of dementia rating that assesses executive cognitive function such as writing a grocery list or alternating hand movement (Janardhanan et al., 2011). Upon completion of a logistic regression of the eight significant predictor variables, only four of the variables remained significant: financial well-being, perceived dental problems, AIMS oral subsection, and initiation/perseveration subscale.

This study conducted by Janardhanan et al., (2011) and the conclusions formed by the researchers based on this study are relevant, as they add vital information to the research question. Of all the factors considered, only a few were significantly related to poor oral health; addressing of the significantly related factors would most benefit this population. Addressing the four significant factors associated with poor oral health as found in this study would result in the greatest improvement of oral health for those who suffer from psychiatric disorders. This group of researchers found that there are many possible reasons for poor oral healthcare in the psychiatric patient as compared to the general population. Dental management of the psychiatric patient requires a multifaceted approach to address all the relevant causes of poor oral health

Similarly, Nielsen, Munk-Jorgensen, Skadhede, and Correll (2010) conducted a retrospective cohort study. The Danish Data Protection Agency and National Board of Health and Statistics in Denmark, which maintain data on all adult dental visits, approved this study. This group of researchers, like (Janardhanan et al., 2011), also demonstrated that there are several determinants of poor dental care in the schizophrenic patient.

Nielsen et al., (2010) selected the year 2006 to analyze the rate of patients visiting the dentist within one year. The years 2004-2006 were utilized to identify patients visiting the dentist for a consecutive three-year period (Nielsen et al., 2010). The study subjects were identified based on the International Classification of Diseases, Tenth Revision (ICD-10) F20.0-F20.9 schizophrenia in the Danish Central Research Register. ICD-10 F20-F20.9 includes schizophrenia and all of its subtypes. (Nielsen et al., 2010). Legal status and substance abuse was identified from other identifying register codes. For the year 2006, 8,780 females and 12,637 males (total of 21,417) subjects were included in

this study. For the 2004-2006-time span, 7,722 females and 11,170 males (total 18,892) were included in this historical prospective study. Clozapine was considered a variable due to its exclusive use for patients who have been resistant to other methods of treatment (Nielsen et al., 2010).

Nielsen et al., (2010) found that only 31% of patients complied with annual dental visits from the years 2004-2006. Substance abuse, involuntary legal status, living in an institution, admission to a psychiatric facility for at least 30 days and being male were the major risk factors. Conversely, clozapine treatment, atypical antipsychotic use, minimum of once per month outpatient visits and age greater than 50 years were associated with a lower risk for inadequate dental care (Nielsen et al., 2010). It was found those with greater financial stability were more likely to schedule and present for dental visits (Nielsen et al., 2010). Outpatient contact, clozapine use and receiving atypical antipsychotic medication as a component of a comprehensive treatment plan for those with SMI, demonstrated a positive relationship to the number of dental visits and decreased the likelihood of inappropriate dental care for participants in the 2006 study as well as the participants in the 2004-2006 study. Additionally, age of onset of schizophrenia greater than 50 years also demonstrated an inverse relationship to the number of dental visits.

The study conducted by Nielsen et al., (2010), is similar to the one conducted by Janardhanan et al. (2011), is relevant to the research question, as it too provides data regarding determining factors for poor oral health in the patient with SMI. The results of both of the above-discussed studies provide a direction to all healthcare practitioners involved in treating a patient with SMI: the factors that most significantly contribute to

the poor oral health of this disadvantaged group should be addressed for the greatest

improvement in oral health. Additionally, patients with SMI visit the dentist less

frequently than the general population and are also less aware of having dental problems.

The authors conclude that mental healthcare providers should be more aware of the oral

health of their patients and that they should encourage their patients to visit the dentist.

Furthermore, a collaborative effort should exist between the mental healthcare provider

and the dental healthcare provider.

A cross-sectional study was conducted by Kilbourne, Horvitz-Lennon, Post,

McCarthy, Cruz, Welsh and Blow (2007) in which this group attempted to determine the

"patient factors and medication factors associated with self-reported oral health status" in

patients of veterans' affairs (VA) who had been diagnosed with mental illness. This study

is similar to those previously discussed, as it studied the oral health of patients diagnosed

with serious mental illness (SMI) in a routine care setting (Kilbourne et al., 2007).

Patients from the year 1999 and a part of the VA National Psychosis registry (NPR) were

included in the study. The patients "completed a Large Health Survey of Veterans

Enrollees (LHSV) subsection on health and nutrition behaviors" (Kilbourne et al., 2007).

The LHSV survey includes a random sample of veterans who completed a survey

regarding exercise behavior, nutrition and demographics. For the final study subjects, the

NPR date from 1999 was merged with data from the LHSV survey for nutrition and

health patterns (Kilbourne et al., 2007). Patients from the NPR data included those who

had been diagnosed with bipolar disorder or schizophrenia. The LHSV questionnaire

asked each patient to describe the overall health of teeth and gingival tissues as one of the

following: excellent, very good, good, fair or poor (Kilbourne et al., 2007) and whether

or not they had difficulty eating due to problems with the dentition (Kilbourne et al., 2007). NPR and LHSV responses were utilized for covariates, which would influence oral health. These include being considered part of a "vulnerable group" and enabling factors such as the oral health status of a patient: current employment, financial strain, rural living status, having access to a VA and access to transportation (Kilbourne et al., 20.07). "Treatment factors" were also included as covariates for this study: use of medications that may reduce salivary flow and a minimum of 6 months of use of an antipsychotic agent, mood stabilizer or an antidepressant (Kilbourne et al., 2007).

Kilbourne et al., (2007) found that of the 3,981 patients with "complete data on overall health and medication treatment factors, 61% reported poor overall health." Of the 4,023 patients with complete data on eating difficulties and medication treatment factors, 34% reported dental problems that made eating difficult (Kilbourne et al., 2007). Data from the VA for patients who were not diagnosed with serious medical disorders and who completed the same LHSV survey demonstrated that 42% reported poor or fair oral health and 27% reported dental-related problems. "Hispanic/Latinos (when compared to Caucasians) and those with less education were more likely to report poor or fair oral health" (Kilbourne et al., 2007). Factors that affect access to dental care such as unemployment, financial strain and current smoking were associated with poor oral health and tooth problems (Kilbourne et al., 2007). Their impact was identified and controlled for in this design (Kilbourne et al., 2007). Medications such as tricyclic antidepressants and selective serotonin reuptake inhibitors were associated with poor oral health and dental problems. A major strength of the study conducted by Kilbourne at al. (2007) is that it uses a large sample across the nation that includes a diagnosis of SMI and

information regarding use of medications. Some limitations of this study are that it did not include objective measures of oral health since the information regarding dental problems was self-reported by VA members who completed the survey and that substance abuse was not included on the survey. Additionally, some VA members may not have completed the survey due to being homeless or severely ill. Since VA members completed the response, the majority of respondents were men. As a result, this study may be difficult to generalize to the general population which would include women (Kilbourne et al., 2007).

The study conducted by Kilbourne et al. (2007) is relevant to the research question as this group was able to demonstrate that support services must be made available which can address the factors that lead to poor oral health in those with serious medical disorders; these findings are similar to those of previous studies discussed. Nutritional counseling and smoking cessation methods are important parts of the necessary support services for this group of patients. Furthermore, expansion of routine dental treatment services such as comprehensive intraoral and extraoral exams, dental hygiene appointments, and dental radiographs may help to minimize serious problems within the oral cavity. Patients taking antidepressants should also receive education regarding the oral side effects of the medications. Family members and caregivers should also be educated, as in many cases it is the caregiver who will be managing dental appointments and assisting with oral home care. Dental practitioners should receive education regarding management of patients taking medications to treat psychiatric disorder in order to be able to appropriately treat those with severe mental disorders (Kilbourne et al., 2007).

Arnaiz, Zumárraga, Díez-Altuna, Uriarte, Moro, Pérez-Ansorena (2011) conducted a study at five outpatient centers in Vizcaya, Spain to examine whether patients with psychiatric disorders are more likely to suffer from oral health problems than the general population. The study consisted of a total of 66 male and female participants over the age of 20, who were receiving treatment in an outpatient setting. All participants had been diagnosed with schizophrenia for the past two years and were taking antipsychotic medications for at least two years. The control group was a volunteer group that consisted of 38 men and 28 women. All participants in the control group were university students or health professionals with an average age of 39.5 years (Arnaiz et al., 2011). The clinical history was obtained and assessed with the use of the PANSS scale for positive (P) and negative (N) symptoms of schizophrenia. A standard dental mirror and a periodontal probe were utilized to obtain a DMFT Index by evaluating the number of decayed (D), missing (M) and filled (F) teeth and a CPITN or Community Periodontal Index Treatment Needs. The influence of age and current smoking was considered a covariate; gender and the diagnostic group were treated as between subject factors. This study found that those with psychiatric disorders such as schizophrenia have significantly higher scores for D, M, F, DMF-T and CPITN when compared to the control group (Arnaiz et al., 2011). This was particularly true for the mean of missing teeth in those with psychiatric disorders when compared to the control group.

Additionally, Arnaiz et al., (2011) compared the correlations between positive (P) and negative (N) symptoms of schizophrenia to D, M, F, DMF-T and CPITN. It was found that those with higher PANSS-N scores had a greater number of decayed and missing teeth when compared to the number of decayed teeth and missing teeth with a

higher PANSS-P score. Furthermore, the higher the PANSS-N scores, the lower the number of filled teeth when compared to those with higher PANSS-P scores. The data demonstrates that those who suffer from the positive symptoms of schizophrenia are less likely to have missing teeth and that those suffering from the negative symptoms of schizophrenia also suffer from self-care neglect related to the oral cavity as well as general health. Thirty-nine percent of the participants in the control group were smokers who smoked an average 18 cigarettes per day as opposed to 71% of the patient group who smoked an average of 27 cigarettes per day with a standard deviation of 10. Age and smoking resulted in a significantly worse DMF-T and CPITN in both groups, thus increasing the need for dental work and periodontal treatment. The researchers found that both smoking and age increased the number of missing teeth. The values for D and M were higher for smokers when compared to non-smokers.

The study conducted by Arnaiz et al. (2011) provides important information regarding the oral health of patients with schizophrenia: there exists a positive correlation between PANSS-N and poor oral health. This may be due to the decreased energy and motivation associated with the negative symptoms of schizophrenia. Furthermore, many practitioners tend to treat psychiatric patients by extracting teeth rather than completing extensive restorative procedures. Loss of the dentition further negatively impacts the patient by affecting the ability to eat foods that require more chewing. As a result, the patient tends to eat softer starchier foods. The consumption of a more carbohydrate rich diet may lead to weight gain and cardiovascular disease; the loss of the dentition also impacts the social life of the patient suffering from SMI. This study is important ~~to the question at hand~~, as information gained from this research demonstrates that patients

diagnosed with an SMI experience a greater rate of decayed and missing teeth as compared to the general population. Furthermore, a diagnosis of negative symptoms of schizophrenia results in even greater decayed and missing teeth as compared to those with a diagnosis of positive symptoms of schizophrenia. The results of the study can assist the healthcare provider in treating the patient with the psychiatric disorder. Both the treating physician and the dental provider can educate the patient about the importance of oral home care and the importance of retaining the natural dentition. The dental provider can also gain knowledge from this study by realizing that it is important to restore and retain the natural dentition in this population rather than extracting the teeth.

The findings of the study conducted by Arnaiz et al. (2011) support the study conducted by Thomas, Lavrentzous, Karouzos, and Kontis in 1996. This group studied the factors that influence the oral condition of schizophrenic patients; also included as part of this study was the effect of psychotropic medications on oral health. The study, conducted in Greece, included 249 patients who had been diagnosed with schizophrenia. Duration of illness and years of hospitalization were recorded along with medication dosages; dosages were converted to an equivalent dose of chlorpromazine (EDC). The severity of the psychiatric disorder was assessed, positive symptoms were identified and negative symptoms were measured. The patients were then divided into three (3) groups. Group I had been hospitalized for greater than ten (10) years, Group II had been hospitalized for up to ten (10) years, and Group III included those who were receiving treatment in an outpatient setting. Two dentists examined the patients, and a DMF-T index was calculated for each patient after completion of the examination. A Simplified Oral Hygiene Index, OHI-S(15), was utilized to assess the oral hygiene status of each

patient. Group I had a significantly higher score for missing (M) teeth than groups II and III, resulting in a higher DMFT score. Additionally, Group I had a significantly higher BPRSNEGS score than Groups II and III. Additionally, the researchers found a strong and significant correlation between DMFT and BPRS, BPRSNEGS, EDC, and LSH with the strongest correlations between DMFT with BPRSNEGS and LSH. Additionally, a significant correlation between OHI and BPRS as well as OHI and BPRSNEGS was found.

The study conducted by Thomas et al. (1996) provides important information that is relevant to the study question propose: the longer the hospitalization period, the more severe the oral problems experienced by the patient; and outpatients experienced better oral health when compared to those who were hospitalized. Additionally, as found in other studies discussed.in the paper, negative symptoms had a greater impact on the deterioration of oral health; the more severe the negative symptoms, the poorer the oral conditions.

Not only is there a greater need for oral health educational programs for this population, but there is also a need for dental professionals who are able to manage patients with psychiatric disorders appropriately. A survey found that over 73% of hygienists felt that training and education did not prepare them adequately enough to be able to treat patients with psychiatric disorders, and that 82% of hygienists believed that advanced training and education were necessary in order to be able to treat this group appropriately (Almomani et al. 2006).

Many researchers believe that one reason for the lack of practitioners who are able to appropriately treat patients with psychiatric disorders may be due to the failure of

questions that are specific to these disorders on the medical history questionnaire; this may be a result of the sensitive nature of such information (Giglio and Laskin, 2010). Giglio and Laskin (2010) conducted a study in which 442 charts were randomly selected from 825 patients who had presented for initial screenings at the Virginia Commonwealth University School of Dentistry. The purpose of this study was to determine the prevalence of psychiatric disorders in patients presenting for routine dental care. The medical history form that must be completed by all patients contains a section about psychiatric disorders as well as a section regarding medications. Of the patients in the study 21% were positive for psychiatric disorders; more than two-thirds of men and women reported suffering from depression; half the women and nearly two-thirds of men reported suffering from anxiety disorders; and a smaller number of participants reported suffering from bipolar disorder (Giglio and Laskin, 2010). The participants also self-reported use of medications such as Selective serotonin reuptake inhibitors (SSRI), benzodiazepines, lithium and tricyclic antidepressants, anticonvulsants, atypical and typical antipsychotics, dopamine reuptake inhibitors, lithium and stimulants, all of which can result in adverse oral effects. More than half the subjects reported more than one disorder, and 20 patients reported taking more than one medication to manage the disorder(s). Of the general population, it is believed that 26% of dental patients suffer from mental illness; this difference may be attributed to the fact that those with severe mental illnesses generally do not present for dental care (Giglio and Laskin, 2010). A thorough medical history is important; however, a verbal review of the medical history with the patient is critical. Patients may not reveal a positive medical history in writing, but a discussion of what may not have been included on the form can identify that a

history of psychiatric disorders is present. A thorough exam may also identify psychiatric

disorders in patients who may be reluctant to disclose this area of the medical history.

The study conducted by Giglio and Laskin, (2010) provides important and

relevant information for this project as it demonstrates that patients who present for

dental treatment may be suffering from a psychiatric disorder, yet may remain

unidentified by the dental practitioner for a variety of reasons. Identification of the patient

with a psychiatric disorder is important not only for the formulation of an appropriate and

tailored treatment plan, but also from a medical management aspect in the dental office.

Many medications that are administered in the dental office may interact with prescribed

psychotropic medications. For example, the prescribing of a non-steroidal anti-

inflammatory (NSAID) medication may result in the decreased excretion of lithium,

resulting in lithium toxicity (Giglio and Laskin, 2010). SSRIs may inhibit the metabolism

of benzodiazepines, resulting in over sedation of the patient (Giglio and Laskin, 2010).

Since many antipsychotic medications may cause sedation, sedatives administered in the

dental office must be used with caution, as they may have an additive sedative effect.

Furthermore, medications such as SSRIs can result in increased bleeding during dental

treatment (Giglio and Laskin, 2010). Additionally, patients with psychiatric disorders,

particularly those who suffer from the negative symptoms of schizophrenia, may suffer

from a lack of motivation for self-care and as a result may benefit from more frequent

oral hygiene visits. Identification of these patients would allow more frequent scheduling

of maintenance visits. This population may need a dental treatment plan modification that

would include more simplified treatment options such as removable prosthetic dental

appliances as opposed to extensive crown and bridgework, which may be more difficult to maintain by the patient.

Primary Studies that Include Oral Health Care Education

Several primary studies included in this section will discuss the significance of educational programs that may benefit that psychiatric patient; one educational-based study was conducted on a non-disordered population in order to determine the effectiveness of oral hygiene education. One study evaluates oral health literacy in people with SMI and its impact on oral health and two studies evaluate the impact of education and remediation on cognitive skills of this population. The educational-based studies were conducted by different groups of researchers who approached this concept in distinct manners.

D'Cruz and Aradhya (2013) and Jain (2013) both conducted studies on non-disordered populations in India to determine the effects of oral health education. D'Cruz and Aradhya's (2013) study was conducted on school children in India ages 13 to 15 years old. Overall oral health in India is not satisfactory, particularly in this population. Much of this sub-par care for oral hygiene is attributable to the lack of knowledge regarding oral health care and lack of educational programs (D'Cruz and Aradhya, 2013). The study was a 9-month long, double blind, interventional study that included random selection. Three schools were randomly selected and then randomly assigned to one of three (3) groups. All participants underwent an oral exam by two qualified dentists. A modified Quigley-Hein plaque index and Loe-Silness gingival index were collected. Two groups received oral health education by the researchers in the form of a PowerPoint presentation. One of these two groups also received a demonstration of how to use a

toothbrush on a typodont (dental model). Oral health education was reinforced at three and six months for both experimental groups. The effectiveness of the intervention was evaluated by "assessing improvements in oral hygiene knowledge and practices (correct answers) and also changes in plaque index scores and gingival index scores in the intervention group in comparison with the control group" (D'Cruz and Aradhya, 2013). The intergroup comparisons of oral hygiene knowledge and practice scores changed significantly at three, six and nine months as compared to the baseline. Intergroup scores also changed significantly at the end of nine months when compared to the baseline. There were significant differences at three months between the experimental group that received the demonstration and the control group. Significant differences between the group that saw only the PowerPoint presentation on oral care and the control group were seen at six (6) months. Based on these results, the authors concluded, "oral health education can improve knowledge, practice and gingival health and decrease plaque levels" (D'Cruz and Aradhya, 2013). The study conducted by D'Cruz and Aradhya (2013) demonstrated that education could benefit the non-disordered population of children. Yet this research did not include adults or those with SMI. A study is needed to determine whether the administration of oral health education to adult patients with SMI may also result in improved oral health.

Besides education, many oral health care practitioners believe that an automatic toothbrush may aid in the improvement of oral hygiene, particularly in patients who may suffer from either physical or mental disabilities. In order to evaluate the potential beneficial effects of the automatic toothbrush on this particular population, the proposed

study can first examine the effects of the automatic toothbrush on the non-disordered population in a study conducted by Jain (2013).

Jain (2013) hypothesized that the automatic toothbrush is beneficial in improving oral hygiene in the non-disordered population. This randomized controlled trial included 60 dental students, both male and female, ranging from age 18 to 28 years, in Haryana, India. The study included two groups of 30 after stratification. One group used a manual toothbrush and one group used an automatic toothbrush. Each participant's plaque, gingival and oral hygiene index was obtained on the 7th, 14th and 45th day. A significant reduction in the gingival, plaque and oral hygiene index of both groups at one week, two weeks and six weeks was found. A significant reduction in the plaque index scores between the manual toothbrush and the automatic toothbrush was found at both two weeks and six weeks. The difference in gingival index and oral hygiene index scores between groups was not statistically significant. This study demonstrated that an electronic toothbrush could improve oral health by significantly reducing plaque, regardless of manual dexterity or education.

Based on the study by Jain (2013), it is hypothesized that the implementation of a treatment plan that includes an automatic toothbrush will result in a greater improvement in oral hygiene by plaque reduction when compared to the implementation of a manual toothbrush in the person with schizophrenia.

Two studies that align education with participants suffering from schizophrenia were conducted by different groups of researchers with distinct approaches to oral health education. Almonani et al. (2006) and Bell, Lasater, Sawyer and Ramirez (1973) conducted studies that were similar in that they utilized verbal and visual education of

oral hygiene home care. However, the study conducted by Almomani et al. (2006) utilized a positive approach towards oral health education of the patient diagnosed with schizophrenia, whereas the study conducted by Bell et al. (1973) utilized a negative approach and one that aroused fear as it focused on the negative impact of poor oral hygiene. Both studies were double- blind randomized controlled trials. Almomani et al. (2006) included 50 participants, both male and female, between the ages of 19 and 61 years of age, who were voluntarily recruited from a community support program; the participants were divided into 2 groups; all participants had been diagnosed with an SMI. Bell et al. (1973) included "39 patients from the psychiatric treatment ward of a local state hospital, who were randomly divided into three (3) groups. Both groups of researchers obtained initial plaque indices on the participants of their respective studies. Almomani et al. (2006) utilized the Quigley-Hein plaque index, whereas Bell et al. (1973) used the Patient Hygiene Performance (PHP) Index.

In the study conducted by Almomani et al. (2006), one group received verbal and visual education regarding home care from a senior dental hygiene student as well as a Crest Spin Brush Pro automatic toothbrush and reminders via a post-it note system. The second group received only the Crest Spin Brush Pro powered toothbrush. Plaque indices were recorded once more for participants in both groups as a baseline measure and after four weeks. Upon completion of the four weeks of the study, the group that received the visual instruction and the post-it reminders improved significantly more than the group that received only the toothbrush. At the end of the study, 95% of the participants stated that they learned new ways to improve oral hygiene. This study demonstrates that education is a critical component in the improvement of home care. However,

improvement in oral health may be limited, as those with psychiatric disorders may need extensive periodontal and restorative treatment to fully restore oral health

In the study conducted by Bell et al. (1973), the first group or high-fear group was presented with a demonstration that was intended to result in a high-fear response and provided with a home oral health kit. The second group or low-fear group was also shown pictures of oral problems that may occur due to neglect; these were monochromatic drawings as opposed to color photographs. This group was also provided with a home oral health kit. The third group or recommendations group was not shown any pictures and was only provided verbally with recommendations for oral healthcare and provided with a home oral hygiene care kit. The researchers collected data via a questionnaire for all three groups at five intervals: pre-test, immediate post-test, one-day post-test, one week post-test and one month post-test. In addition to the PHP Index, means for reporting frequency of intent to brush in the future, means on frequency of brushing and means on emotions experienced while brushing was also collected for each group for all five intervals. Anxiety or how the participants felt while brushing their teeth was not affected except for the high-fear group during the one-week post-period; this increase was statistically significant. The high- fear group demonstrated significantly higher anxiety regarding how they felt when brushing their teeth one-week post-test as compared to the low-fear group and the recommendations group. Furthermore, the mean for the anxiety felt during the demonstration and after the demonstration significantly increased in the low-fear group as compared to the mean for the high-fear group during the demonstration, after the demonstration and recommendations group during the demonstration and after the demonstration.

The study conducted by Bell et al. (1973) did not provide improvement in PHP scores. However, this study did demonstrate that in order to improve oral self-care in the patient with an SMI, a positive educational environment is beneficial. Anxiety increased in the high-fear group. The patient with a psychiatric disorder usually tends to attempt to escape from situations that may produce anxiety. Thus, something perceived as a threat causes an increase in anxiety, resulting in an attempt to avoid the threat (Bell et al., 1973). Since the dental office is often considered to be a medical setting that evokes feelings anxiety from patients, the researchers believed that behavior and response to a threat could be tested. Bell et al. (1973) hypothesized that a low level of fear should be more effective in the patient with a psychiatric disorder as compared to a high level of fear, which would cause the patient to withdraw from the situation. A similar study with the same hypothesis was previously conducted on a population that was not diagnosed with a psychiatric disorder; it was found that all three types of videos and information presented were effective at altering oral care habits. However, this study demonstrates that among those with psychiatric disorders, material perceived as a threat results in emotional dulling. Almomani et al., (2006) studies demonstrated that education, particularly presented in a positive manner, is an important component of improving the oral health of the psychiatric patient. Bell et al., (1973) found that oral home care education presented in a negative manner to the patient diagnosed with SMI results in fear that resulted in lack of oral care. Thus, it would appear that a positive approach to oral care might result in an improvement in hygiene habits for those with psychiatric disorders compared to a more negatively balanced approach (Bell at al., 1973).

Bell et al. (1973) and Almomani et al (2006) studied the impact of education on the improvement of oral health. However, health literacy may also play a role. This was found by D'Cruz and Aradhya (2013) and was discussed briefly earlier in this chapter. The study conducted by Galletly et al. (2012) evaluates the importance of health literacy as well. This investigation included 30 participants that had been recruited from a local community clinic and had been diagnosed with schizophrenia, were stable, and taking prescribed antipsychotic maintenance medications. The outpatient participants in the depression group included 30 participants, all of who were receiving anti-depressant medications. Participants completed questionnaires in order to allow the assessment of health literacy and medical adherence. The participants in the depression group were significantly older and had more years of education than the participants in the schizophrenia group; a significantly higher number of participants in the schizophrenia group were unemployed as compared to the depression group. This study found that a majority of the participants in both groups scored adequate health literacy and that health literacy was positively correlated with education; there was no correlation between health literacy and medication adherence. This study demonstrated that the Australian population with mental illness has good overall health literacy. This was in contrast to US-based studies, which found that patients suffering from mental illness have poor health literacy and poor adherence to medications as a result. Do people with serious mental illness profit from other health literacy or health-related skills training? This study relates to the proposed question, as it demonstrates that the population to be included in the study may have poor health literacy and also have poor adherence to medication.

Both of these may impact the management of the SMI the person suffers from and, as a result, impact overall and oral health.

The studies above conducted on the non-disordered population as well as a sample population suffering from mental illness demonstrate that education can lead to an improvement in health literacy, which can positively impact oral health. Negative symptoms of schizophrenia, which lead to a lack of self-care may have a severe impact on oral health. Compliance with medications is critical in the improvement of symptoms of schizophrenia. Symptom improvement should lead to an improvement in self-care to some extent. However, as discussed previously, the medications do affect cognitive skills and memory. The methods above can be adapted to those who suffer from SMI with some modifications and adaptations.

Patients suffering from SMI may need closer supervision and monitoring by dental professionals to ensure compliance with oral hygiene care. This may include but is not limited to intensive oral home care education that includes monitoring and regular follow-up visits to the dental office. Patients should be educated on the side effects of the medications to manage the symptoms of schizophrenia. The negative impact on cognitive skills may increase the need for repetition of instructions and constant reminders to the patient regarding oral care home care. Additionally, families and/or caregivers should be educated regarding the impact of the medications, symptoms of schizophrenia and their connections to poor oral care, and the importance of monitoring and encouraging the patients to improve oral health. In order to ensure compliance with oral home care and/or dental visits family members should be involved in the health care of the patient.

The studies discussed in this subheading all demonstrate that education and health literacy are important components of improving oral health. Additionally, the studies in this subheading implement the use of the behaviorist learning theory and the cognitive learning theory in a manner that is congruent with the research study proposed in Chapter 3.

The behaviorist learning theory by B. F. Skinner maintains that the learner is passive and can be molded through positive and negative reinforcement (Skinner, 1976). In addition, cognitive learning theory proposes that behavioral, extrinsic and intrinsic factors influence learning (cite the cognitive theorist to whom you are referring here). The basic concepts of the cognitive learning theory state that the learner gains knowledge through observation; reproduction of the observed behavior can reinforce skills; the learner becomes self-reliant by practicing the observed skills, a nurturing environment will enhance learning. The proposed study outlined in Chapter 3 will include these two theories in order to determine the benefits of oral healthcare education on the population with SMI.

Primary Studies that Evaluate Cognitive Skills

Cognitive deficits in the patient with SMI have a negative impact in the ability to perform oral home care as well as the ability to learn new skills. For the dental practitioner, it is important to address cognitive deficiencies in patients with this disorder. In order to determine an effective method of overcoming cognitive deficits caused by those with SMI, Zanello, Perrig and Huguelet (2006) examined the cognitive and problem-solving skills in patients suffering from schizophrenia, and these skills were compared to those of non-disordered participants. This group specifically evaluated

"verbal memory, visual-spatial organization and visual-spatial memory, executive functioning, attention and general intellectual ability. Additionally, social problem-solving skills were assessed with a video-based test. Zanello et al. (2006) initially evaluated which "specific cognitive functions were altered in the patient suffering from schizophrenia when compared to the healthy group and also which symptoms explained the differences found in the patient groups." This study included 20 patients diagnosed with schizophrenia and 20 healthy patients as the comparison group. All subjects were tested for verbal memory. This test evaluated the recall of 15 common words after a 45-minute delay of words being provided. Visio-spatial organization and memory were also tested by each subject being asked to copy a given figure, reproduce it without notice and then being asked to reproduce it again after 45 minutes. Executive functioning was tested by asking each subject to produce 60 words related to the category of animals, produce a series of nonsensical shaped drawings within five minutes without repeating any drawings and sorting 128 cards based on color, shape or number. Attention and intellectual ability were also assessed along with social problem-solving skills. This group of researchers found that the patients who were diagnosed with schizophrenia performed significantly lower on all tests when compared to the group of 20 healthy participants. Correlation coefficients were also obtained. It was found that there was no age, illness duration and dosage of antipsychotic medication, as well as neuropsychological measures and processing skills were not significantly inter-correlated with one another. The highest positive correlation was between duration of illness and processing skills. This study also found that the negative symptoms of schizophrenia did not have an impact on the test scores any more than the positive symptoms of

schizophrenia. The study conducted by Zanello et al. (2006) provides the background that patients suffering from schizophrenia do suffer from decreased cognitive and social skills when compared to the general population. Studies conducted by other researchers evaluated whether or not these cognitive skills can be restored through education and remediation. This study relates to the question of whether or not reinforcement of oral health education can improve the cognitive function, improve home care and improve oral health (Zanello et al., (2006).

Bowie et al. (2012) also examined whether or not cognitive remediation would aid in the restoration of functional competence in the real world. One hundred seven outpatients were randomly assigned to receive cognitive remediation followed by functional skills training. Clinical symptoms, cognition, social skills, functional skills and real-world behavior were assessed at baseline, at the end of treatment and at 12 weeks to assess the longevity of training. This study found that cognitive skills improved after cognitive skills training but not after functional skills training and that the effects were durable. Social skills improved with combined skills training and were durable. Cognitive remediation and combined training improved real-world behavior. Thus, in a short treatment time, there was significant improvement that was durable in cognitive skills, social skills and real-world skills. This study is important as it demonstrates that cognitive remediation and combined training did result in an improvement of cognitive skills. This study applies to the proposed study in that reinforcement of oral health education can improve the cognitive function, improve home care and improve oral health.

Summary of the Literature Review

Factors that may affect the oral health of patients with SMI were studied by several groups of researchers. It is important for the dental care provider to consider all variables that may influence oral health. Janardhan et al. (2007) demonstrated that although many factors can potentially influence poor oral health in patients with schizophrenia, certain factors are significant; addressing those would significantly improve the oral health of this population. The effect of the negative symptoms of schizophrenia were studied by Giglio and Laskin (2010), Arniaz et al. (2011) and Thomas et al. (1996) and found to have a more severe impact on oral health than the positive symptoms of schizophrenia. Furthermore, Arnaiz et al. (2011) determined that age, smoking, medications, depression and negative symptoms resulted in a greater DMFT index.

Financial status and education level also influences oral health and this was evaluated by Janardhanan et al. (2011) and Kilbourne et al. (2007) in those who suffer from SMI. Nielsen et al. (2011), Thomas et al. (1996) and Kilbourne et al. (2007) found that length of hospitalization and medications such as SSRIs and tricyclic antidepressants can negatively impact oral health in patients who suffer from SMI due to their xerostomic effect. Kilbourne et al. (2007) also evaluated the impact of smoking on the oral health of this particular population.

Oral home care education of the patient suffering from SMI is an important component of oral health maintenance. Several researchers identified this in a variety of ways. Almomani et al. (2006) and Bell et al. (1973) both conducted studies regarding the importance of oral health care education for patients with psychiatric disorders. Bell et al.

(1973) provided evidence that fear-arousing methods are not beneficial to this particular group and that education should be presented in a positive manner. Both of these groups of researchers provided evidence that patient education is not only critical but must be provided in a manner that is beneficial to the patient. Additionally, the relationship between education and health literacy was studied by Galletly et al. (2012) and was determined to be an important component in the improvement in oral health.

The use of a powered toothbrush may also play a role in oral health improvement. This was identified by Jain (2013) on a group of dental students who were already aware educationally of methods of oral home care. The addition of automatic toothbrushes improved oral health when compared to the group that was using the manual toothbrushes in this particular population. The results of this study can aid in developing a study that will implement both manual and automatic toothbrushes in a population that suffers from SMI; adding an educational component may also result in improved oral hygiene by improving oral home care in this group. The proposed study will evaluate whether or not a battery operated toothbrush or oral home care instructions can result in a significant improvement in oral health in those diagnosed with SMI.

CHAPTER III

METHOD

Participants

A total of 103 participants were enrolled in the current study. This sample

consisted for 55 men (53%) and 48 women (47%), ranging in age from 18 to 83 years old

years with a mean age of 44.77 (*S.D.* = 12.42). Of the 103 participants, a total of 87

completed the study. In contrast, 16 participants did not complete the study. Of these 16

participants, six dropped out of the study due to lost contact, four withdrew from the

study, and another six did not qualify for the study based on an initial assessment. Those

who did not qualify either had a dental hygiene visit within the past 6 months, lacked the

minimum number of teeth required or had a full complement of maxillary and

mandibular crowns.

Table 1 shows that there were no differences between those participants who

dropped out and withdrew or did not qualify compared to those who complete the study

in terms of gender, age, handedness, ethnic background or pre-test plaque and gingival

index scores**.** Participants were in good general health, and had at least 12 natural teeth

that could be evaluated periodontally (excluding third molars), and had not had

periodontal therapy in the past six (6) months.

Table 1

Similarities based on data collected between those that dropped, withdrew or did not qualify versus those who completed the study

	Dropped, withdrew or did not qualify (*N*)	Completed Study (*N*)
Male	7	49
Female	9	38
Right hand	10	73
Left Hand	3	14
AfricanAmerican	8	30
Non-Hispanic WhiteWhite	1	23
Asian	7	32
	0	2
Mean pre-test plaque scores (S.D.)	1.63 (.83)	1.37 (.86)
Mean pre-test gingival index scores (S.D.)	1.43 (.60)	1.25 (.67)
Range baseline plaque index score	.70-3.12	.17-6.20
Range baseline gingival index score	.67-2.13	.00-3.7

The participants were recruited from various outpatient mental wellness centers in NJ located in rural and urban areas of the central and northwestern part of the state. Tables 2 and 3 show the names of the recruitment centers and the number of participants from each of these locations.

Table 2

Number and percentage of participants from urban centers in NJ that enrolled in the study

	Northwest Essex Community Healthcare Network Belleville, NJ	Rutgers University Behavioral Health Care, Newark NJ	Bridgeway Rehabilitation Services, Elizabeth, NJ	Project Live, Newark, NJ	Rutgers University Behavioral Health Care, New Brunswick, NJ
Male	9 (8.7)	3 (2.9)	12 (11.7)	7 (6.8)	0 (0)
Female	6 (5.8)	4 (3.9)	13 (12.6)	6 (5.8)	3 (2.9)
Total	15 (14.6)	7 (6.8)	25 (24.3)	13 (12.6)	3 (2.9)

Table 3

Number and percentage of participants from rural and other centers in NJ that enrolled in the study

	Private referral	Hunterdon Behavioral Health Flemington, NJ	Richard Hall Community Mental Health Center Bridgewater, NJ	Family Guidance Center of Warren County	Better Future Self Help Center, Warren, NJ
Male	1 (1)	9 (8.7)	5 (4.9)	6 (5.8)	3 (2.9)
Female	0 (0)	7 (6.8)	4 (3.9)	3 (2.9)	2 (1.9)
Total	1 (1)	16 (15.5)	9 (8.7)	9 (8.7)	5 (4.9)

Smoking data was obtained from 81 participants based on current smoker status or never smoker status; 47 participants were current smokers and 44 participants were never smokers. Handedness was obtained from 100 participants and included. 83 and 17 right handed and left handed individuals, respectively. Data regarding handedness was not obtained from 3 of the participants enrolled. The age range of the participants was

from 18 to 83 with a mean of 44.77. The ethnic breakdown, mean age in years and the

numbers of right and left handed participants enrolled is provided in Table 4

Table 4

Ethnicity, age and handedness of participants enrolled in the study

African American (%)	22 (21.0)	16 (15.2)	46.2
Non-Hispanic White (%)	23 (21.9)	16 (15.2)	47.3
Hispanic (%)	11 (10.5)	13 (12.4)	42.8
Asian (%)	0 (0)	2 (1.9)	36.0
Right handed (%)	44 (42)	39 (37.9)	54.3
Left handed (%)	10 (9.7)	7 (6.79)	46.9

All participants in the study had a diagnosis of an Axis I psychiatric disorder (i.e.,

schizophrenia, schizoaffective disorder, bipolar disorder, major depression, or anxiety

disorders) and have received mental health services for at least two years. Participants

were diagnosed with schizophrenia based on International Classification of Disease

(ICD-10) code F20 symptoms for schizophrenia such as delusions, hallucinations,

disorganized thoughts and behavior, positive symptoms and/or negative symptoms.

Participants were also diagnosed with one or more major depressive disorder (clinical

depression, unipolar disorder) based on ICD-10 codes F32 and F33 and schizoaffective

disorder (schizophrenia plus depression or mania) based on ICD-10 codes F25. Medical

histories were self-reported if participants were able to provide specifics regarding their

diagnosis, and their self-reports were confirmed via medical histories from centers. For

participants who were not able to provide medical histories, the information was obtained

from each recruitment center after the participant had signed the consent to release the

medical history. Although releases were signed at all centers for medical histories,

complete medical histories were not obtained for 13 participants. A total of 74 complete

medical histories were obtained from the participants who completed the study. This include 42 males and 32 females of which 25 were African American, two were Asian, 16 were Hispanic and 31 were non-Hispanic White. Refer to Table 5 for details regarding diagnoses of the participants who completed the study. Percentage totals in Table 5 are more than 100% as the majority of participants had more than one diagnosis. Refer to Table 6 for details regarding medications of the participants who completed the study.   Percentage totals in Table 6 equal more than 100% as the majority of participants were taking more than one medication.

Table 5

Disorder diagnoses in percentages of the participants who completed the study based on medical histories received (N=74)

Schizophrenia/ SAD/psychoses	Bipolar	Anxiety/Panic	Depression	Other*
45.9	41.3	25.7	40.5	13.5

*other disorders include impulse control disorder, explosive personality disorder, post-traumatic stress disorder, borderline personality disorder and body dysmorphic disorder

Table 6

Medication percentages of the participants who completed the study based on medical histories received (N=74)

Antipsychotics (other than clozapine)	Clozapine	Mood stabilizers	Anti-depressants	Anti-anxiety	Anti-convulsants	Cogentin
93.2	5.4	13.5	43.2	20.3	36.5	5.4

Inclusionary and Exclusionary Criteria

Individuals had to meet certain inclusionary criteria to be included in the present study. These criteria included the following: participants taking atypical antipsychotic

medications, typical antipsychotic medications, or a combination of the two. With these criteria, a range of participants taking medications for atypical antipsychotic and antipsychotic disorders were represented in this research project.

Furthermore, individuals were excluded from the study based on another series of criteria. The exclusionary criteria are as follows: those that had disabling medical conditions that would interfere with testing, mental deficits that result in the inability to understand instructions provided, history of stroke that resulted in physical or mental deficits that may affect the ability for self-care, recent myocardial infarction, and study results, are edentulous or severely periodontally involved. Furthermore, potential participants with severe periodontal disease, rampant decay, medications that may interfere with results (NSAIDs, aspirin, Dilantin), pregnancy, medical conditions that require antibiotic prophylaxis prior to dental treatment, systemic disorder that may influence or preclude subject participation (HIV, AIDS, Type I diabetes), orthodontics and those unable to comply with instructions due to physical or mental deficits were not included in the study. Additionally, participants who were determined to have excellent dental health and no improvement in dental health was possible, were excluded from this study. Physical deficits included those that may not allow a person to adequately have the ability to perform oral hygiene care (cerebrovascular accident with residual damage to the dominant hand, loss of dominant upper extremity, cerebral palsy, vision disorders, hearing disorders and debilitating arthritis). Mental deficits included degenerative neurological disorders, Alzheimer's disease, mental retardation and genetic disorders such as Down's syndrome). Those with language barriers were also excluded from the study.

Design

The hypotheses of this study were tested using a 2 x 2 between subjects factorial design. The details of this design are described in the Data Analytic Strategy section. This design was based upon the model of similar studies conducted by researchers in populations with psychiatric disorders and without psychiatric disorders, with an attempt to modify identified limitations. Group assignment was based upon the recruitment treatment center with all participants in each center being assigned to the same condition. The two dependent variables are improvement in plaque index and gingival index.

The IRB of Rutgers University prior to implementation approved the study. As transportation was problematic, the PI was able to complete data collection at the centers, as all needed supplies were portable. All participants signed an IRB approved informed consent prior to participation. The Principal Investigator reviewed the consent with the participants. Upon reviewing, the participants completed a short quiz that asked each participant about the study. This quiz ensured that the participants understand the study and that they are able to provide consent based on successful completion of the quiz. All participants were able to read and sign the consent form prior to beginning the study.

Measures

Indices are used in dentistry to quantify the assessment of a disease in a simplified manner. Indices are quick, reproducible, and simple to perform and require minimal instruments to complete. There are several plaque assessment indices that a clinician can utilize to assess plaque levels and the effectiveness of home care. However, the Quigley Hein plaque index is used most commonly to evaluate the effectiveness of plaque removal after the use of a plaque removal aid (Indices in Dental Epidemiology, n.d.).

This index is calculated by applying a disclosing solution to the non-restored buccal and lingual surfaces of all teeth present with the exception of the 3rd molars. Each surface is evaluated for plaque and scored according to the presence of plaque:

- 0 = no plaque

- 1 = isolated flecks of plaque at the gingival margin

- 2 = a continuous band of plaque up to 1mm at the gingival margin

- 3 = a band of plaque at the gingival margin greater than 1 mm and covering up to 1/3 of the tooth surface

- 4 = plaque covering between 1/3 to 2/3 of the tooth surface

- 5= plaque covering more than 2/3 of the tooth surface

  The assigned numbers are totaled and divided by the number of surfaces. Maximum number of surfaces is 56 which would provide the mean plaque index for that participant. For a person, the scores are added and divided by the number of teeth surfaces which is the sentences above. For a population it would be the individual scores divided by the number of people. When this index is utilized on a population, all the scores are added and the number of subjects in the population divides the total score

The Loe and Silness (Indices in Dental Epidemiology, n.d.) gingival index was selected for use for this study. This index provides a visual of gingival inflammation and is commonly used for epidemiological studies. It can be used on all teeth or selected teeth (in this study standard selected teeth will be utilized). Partially erupted teeth, retained roots, teeth with periapical pathologies and third molars should be excluded. The gingival

inflammation on all surfaces of selected teeth will be recorded with the use of a

periodontal probe and scored as below:

- 0 = no inflammation

- 1 = mild inflammation, slight change in color, slight edema, no bleeding on

  probing (BOP)

- 2 = moderate inflammation, moderate glazing, redness, BOP

- 3 = severe inflammation and redness, hypertrophy, ulceration and spontaneous

  bleeding

When this index is utilized on a population, all the scores are added and the number of

subjects in the population divides the total score. The following range is used to

determine the extent of gingival disease:

- .1 to 1 mild

- 1.1 to 2 moderate gingivitis

- 2.1 to 3 severe gingivitis

The measures collected for each participant were a plaque index and a gingival

index. Specifically, the Quigley-Hein plaque index was used to determine the extent of

plaque reduction for each participant during the study period. The Loe and Silness

gingival index was used to determine the change in gingival health for each participant.

The Loe and Silness Index gingival index was developed in 1963 and has been used since

as a reversible index that can measure the extent of gingival disease (Indices in Dental

Epidemiology, n.d.). G.A. Quigley and J.W. Hein defined the Quigley Hein Plaque Index

in 1962 (Quigley-Hein plaque index - Oxford Reference, n.d.).

Mander and Mainwaring (1980), established the validity of the Loe and Silness gingival index by calculating the gingival index and comparing it to the plaque dry weight from all accessible smooth tooth surfaces. The participants were fifty (50) eleven (11) to twelve (12) year old children. The researchers found a positive correlation between the gingival index and the amount of plaque dry weight calculated with the use of the Podshadley and Haley Patient Hygiene Performance Index (PHPI)

McCracken, Preshaw, Steen, Swan, DeJager, and Heasman (2006) established the validity of the Quigley Hein plaque index. Twelve (12) healthy volunteers were recruited and were asked to abstain from oral hygiene for twenty-four (24) hours for three occasions and then for 48 hours for three more occasions in order to accumulate plaque. The researchers used the plaque index and compared the results to the amount of dry plaque on the teeth. There was a correlation between the plaque weight and the plaque index, thus establishing the validity of the Quigley Hein plaque index.

In this study, the same two (2) standard dental indices were recorded twice during the duration of the study. The dental hygiene students were calibrated regarding the collection of the gingival index and the plaque index. Calibration ensured that the data for the plaque index and the gingival index, were obtained in the same manner at each visit for each participant. Calibration included an orientation session that reviewed the study protocol as well as the steps in obtaining the two (2) indices. Additionally, the principal investigator (PI) evaluated each patient at each visit to ensure that all data was collected as specified. This ensured the consistency of the indices as the test results were deemed stable and reliable. Consistent test results allowed for the validity of the data analysis.

The Self-Evaluation of Negative Symptoms Survey or SNS (Dollfus et al., 2015) was used to determine level of negative symptoms related to serious mental illness. The validity of the SNS was established by Dollfus et al., (2015). This group of researchers established the validity of this study by including forty-nine (49) participants with a diagnosis of schizophrenia and schizoaffective disorder. Two factors were extracted through factor analysis – apathy and emotional. There was a significant correlation, demonstrating convergent validity, of SNS with Scale of Assessment of Negative Symptoms ($r = .63$) (Minas, Klimidis, Stuart, Copolov and Singh, 1994) and the Clinician Global Impression (Busner and Targum, 2007) regarding the severity of negative symptoms ($r = .60$). There was no correlation between SNS and level of insight ($r = .01$), Parkinsonism ($r = .18$) or Brief Psychiatric Rating Scale positive subscores ($r = .25$) (Dazzi, 2016), thus demonstrating good discriminant validity. SNS revealed intrasubject reliability through excellent intraclass correlation coefficients ($ICC = .94$). These findings demonstrate that the SNS is a valid psychometric test. Additionally, the patients with a diagnosis of schizophrenia are able to report their life events in an accurate manner. The SNS consists of 40 questions. Each question is scored 0, 1, 2 based on the patient's response selection with a minimum score of 0 to a maximum score of 40.

For the current study, the ANOVA test showed that there was no effect of baseline negative symptoms by type of toothbrush: $F(1,75) = .81$, $p > .05$. The ANOVA test also showed that there was no difference in negative symptoms survey score between groups based on the provision of home care instructions: $F(30,75) = 1.01$, $p > .05$.

Additional participant information that was collected about the current sample included age, gender, ethnicity, handedness, medications, health history, presence of negative symptoms of schizophrenia.

Procedure

The participants were randomly assigned by center to one of four conditions. Study Group A received oral hygiene education as well as a battery operated Arm and Hammer Truly Radiant Spin Brush. Group B received the same battery operated as Group A toothbrush but did not receive any oral hygiene education. Members of Group B were observed for their oral hygiene techniques only during visits, but no home care education was included. Group C received the oral hygiene education as well as the Sun Star Gum ultrasoft manual toothbrush. Group D received the same manual toothbrush but no oral hygiene education. This group was observed for their oral hygiene techniques but no education was included. All participants received and were instructed to use Crest Cavity Protection toothpaste for the duration of the study to control for the type of toothpaste used across all four groups.

All participants completed a standard medical history form. An initial baseline Quigley Hein plaque index and a Loe and Sillness gingival index was obtained for all participants in the study. Both Groups A and C received detailed oral hygiene instructions that include video demonstration. Group A's video demonstration included the use of the battery operated Spin Brush by Arm and Hammer. Group C's video demonstration included oral hygiene instruction that demonstrates the use of the modified Bass technique utilizing a soft bristled manual toothbrush. The modified Bass technique implementation is as follows:

1. Hold the toothbrush sideways against your teeth with some of the bristles touching the gingiva.

2. Angle the brush so the bristles are at a 45-degree angle and pointing at the gingival margin.

3. Move the brush back and forth, using short strokes. The tips of the bristles should stay in one place, but the head of the brush should wiggle back and forth. Also make tiny circles with the brush. This allows the bristles to slide gently under the tissues. Do this for about 20 strokes or 20 circles.

4. Repeat for every tooth, on the insides and outsides.

5. The toe bristles of the brush can be used to clean the lingual (tongue) surface of the anterior teeth.

6. After the above has been completed in each area, sweep the bristles over the crown of the tooth, toward the surface of the tooth (Mechrome, n.d.).

Participants were observed while performing oral hygiene with their respective toothbrushes while in the dental chair; modifications were made as needed to participants in Groups A and C by the dental hygiene student and the PI.

All participants were evaluated regarding their performance for baseline pre-test at the initial visit and post-test scores at the end of the 4 weeks. Obtaining of medical histories, collection of the Quigley Hein plaque index and the Loe and Silness gingival index on all participants as well as provision of home care instruction to participants in groups A and C were completed by the PI and the 4th semester dental hygiene students in the Department of Allied Dental Education while supervised by the PI. The research project was part of their 4th semester course, Clinical Services III (CSIII). The data

collection for this study was conducted between August 2017-August 2018. All students were calibrated to ensure that all patients receive ten (10) minutes of evaluation and instruction per visit. Additionally, the students received three (3) hours of training prior to the start of the study by professionals in psychiatric rehabilitation. The training included topics such as sensitivity towards patients with mental illness and dental fears of patients with mental illness. Prefilled Hurriview Snap and Go swabs were utilized for collection of the plaque index. A mean plaque score and gingival index score was calculated for each group as a baseline and as a post-treatment score.

During each session for groups A and C, each student completed the following:

- Obtained Quigley Hein plaque index and gingival index

- Provided a hand mirror to the participant and ask the participant to demonstrate home care brushing technique

- Reinforced instruction on the Bass toothbrushing technique as needed for groups A and C (script for Bass technique is provided above on p. 48).

In order to ensure that participants are performing oral care at home, a calendar with the 4 study weeks was provided to each participant. Each participant was asked to perform oral care twice daily (morning and evening before bedtime) at home for the length of the study. Stickers were also provided to the participants. Each time the participant performed home care, he or she was asked to affix a sticker to the calendar for that particular day. It was requested that the calendar be returned to the clinic during the post-test visit.

A questionnaire to determine competency regarding expectations during the four (4) week period was also completed by each participant prior to dismissal at the end of

the baseline visit. Participants received a reminder phone call by the student or the PI each week. This phone call will remind the participant to perform oral home care twice daily and also answer any questions that the participant may have.

Of the 87 that completed the study, 61 participants (70.11%) returned the calendar that they were provided with in order to track their frequency of brushing. The participants who did not return the calendar stated that they forgot to bring with them or misplaced it. Based on the calendars returned, brushing frequency ranged from once daily to 2.03 times daily ($M = 1.8$, $SD = .36$).

Data Analytic Strategy

Initially a MANOVA was conducted with the independent variables of the type of toothbrush and oral home care instructions on the dependent variables of the change in plaque index and the change in gingival index. The MANOVA allows for testing of the hypothesis regarding one or more independent variables on two or more dependent variables. Subsequently, change scores were collected via the pre-test and post-test data for this between-subjects design was analyzed with the use of a 2 x 2 analysis of variance (ANOVA). The ANOVA allows for a direct statistical comparison of more than two groups. The two independent variables were education (education versus no education) and type of toothbrush (manual toothbrush versus battery powered toothbrush). Participants were assigned to one (1) of the four (4) groups. The study was designed as a randomized cluster study. Participants were assigned to one of the four groups based on the center recruited from.

Power Analysis

The sample size for this study was based on evidence of the effectiveness of education on the improvement in oral hygiene home care of other similar studies. Robinson et al. (2005) found that the Turesky modification of the Quigley Hein Plaque index for those using the oscillating toothbrush was a plaque index of .27 and for those using a manual toothbrush was a plaque index of 2.55. Robinson et al. (2005) converted the standard mean difference in plaque and gingivitis reduction to equivalent values used in common plaque indices. This group of researchers found that at one to three months, the rotation oscillation automatic toothbrush demonstrated a 0.27 or 11% plaque reduction on the Quigley Hein plaque index and a reduction of 0.06 or 6% on the Löe and Silness gingival index. In studies over 3 months, the difference is the equivalent of a 17% reduction on the Ainamo Bay bleeding on probing index.

Lazarescu, Boccaneala, Illiescu and De Boever (2003) used the plaque index (PI) and gingival bleeding index (GBI) as dependent measures. The learning effect, expressed as the percentage of plaque reduction after three minutes of supervised brushing, was 33% for Group 1 and 26% for Group 2 at week 0. This percentage increased at week 18 to 64% in Group 1 and 44% in Group 2 and was statistically significant; the learning effect nearly doubled for Group 1 and increased by approximately 40% for Group 2. The effect size for learning on efficacy of plaque removal demonstrated by this study was significant yet small ($d = .24$). This study demonstrated that in healthy patients, the power toothbrush was significantly more efficient in removing plaque and improving gingival health than the manual brush in the group of subjects unfamiliar with electric brushes. Similarly, the study conducted by Jain (2013) demonstrated an improvement in oral hygiene in the group of dental students that was provided the automatic toothbrush as

compared to the manual toothbrush. The effect size of this study that included sixty (60) dental students was medium ($r =.34$) and was clinically and statistically significant for an improvement in plaque sores, gingival index scores and oral hygiene index.

Almomani et al. (2006) conducted an educationally-based study on patients with schizophrenia. The effect size for improvement in oral hygiene home care seen by Almomani et al. (2006) for a group of fifty participants was large ($d=.72$). Data found in studies conducted with non-disordered participants had a medium effect size as demonstrated by Robinson et al. (2005) and Lazarescu et al. (2003)

The software G*Power 3.1.9.2 was used to determine the sample size needed for this study. The number of participants was derived from effect size calculations utilizing ANOVA, a one-tailed test for statistical significance, statistical test for two independent means, assuming an effect of $d =.3$, type l error level $\alpha = .05$ and desired power $=.8$ (Beck, 2013). In order to allow for attrition, a total of 100 participants were included (21 participants per group). Based on these assumptions the final study included 84 participants with four (4) study groups.

Chapter IV

RESULTS

In this chapter, the results from the study outlined in Chapter 3 are presented and examined in detail. In this study, two hypotheses were tested: whether or not a battery operated toothbrush or oral home care instructions can result in a significant improvement in oral health in those diagnosed with SMI. Table 7 provides a breakdown of the retention in the groups by the type of toothbrush and whether home care instructions were provided.

Table 7

Breakdown of number of participants that completed the study per group based on N and percentage of the sample

	Battery operated toothbrush		Manual toothbrush	
	Group A	Group B	Group C	Group D
N per group	22 (91.67%)	19 (79.17%)	22 (95.65%)	24 (96%)

Note: Group A received battery toothbrush plus home care instructions.
Group B received battery toothbrush and no home care instructions.
Group C received manual toothbrush plus home care instructions.
Group D received manual toothbrush and no home care instructions.

Dependent Variables - Descriptive Statistics

The baseline GI of the enrolled participants ranged from 0.00 to 3.70 with a mean of 1.26 (*S.D.* = .66). The final GI ranged from 0.00 to 2.66 with a mean of .82 (*S.D.* = .61). The baseline PI of the enrolled participants ranged from 0.17 to 6.20 with a mean of 1.39 (*S.D.* = .86). The final PI of the participants ranged from 0.00 to 2.85 with a mean of 1.06 (*S.D.* = .58).

Hypothesis Testing

A MANOVA was conducted with the independent variables of type of toothbrush and oral home care instructions and the dependent variables of change in gingival index and change in plaque index. The Box's Test of Equality of Covariance Matrices checks the assumption of homogeneity of covariance across the groups using $p < .001$ as a criterion. For this study, *Box's M* (13.67,) was not significant ($p = .16$)). Therefore, the assumption is not violated and Wilk's Lambda is an appropriate test to use. There was a statistically significant effect of the type of toothbrush, $F(2, 82) = 4.06$, $p < .05$; Wilk's $\Lambda = .91$. There was no effect of oral home care instructions, $F(2, 82) = 1.05$, $p > .05$; Wilk's $\Lambda = .98$. Furthermore, there was no significant effect of the interaction of home care instructions and the type of toothbrush $F(2, 82) = .77$, $p > .05$; Wilk's $\Lambda = .98$.

A follow up ANOVA was then conducted for effect of toothbrush type on the change in gingival index. Levene's test of equality of error variance was non-significant demonstrating homogeneity of variance across groups $F(3,83) = 1.31$, $p > .05$. The change in gingival index was significantly different based on the type of toothbrush that was used: $F(1,86) = 4.52$, $p < .05$, $\eta^2 = .05$. Use of the battery-operated toothbrush resulted in a greater reduction in the gingival index compared to the manual toothbrush. See table 8.

A follow up ANOVA was then conducted for effect of toothbrush type on the change in plaque index. Levene's test of equality of error variance was non-significant demonstrating homogeneity of variance across groups $F(3,83) = 2.33$, $p > .05$. The difference in change in plaque index based on type of toothbrush was not statistically significantly: $F(1,86) = 1.04$, $p > .05$, $\eta^2 = .01$. See table 9.

Table 8

Mean change in gingival index by type of toothbrush and home care instruction

	Battery operated toothbrush	Manual toothbrush	Total
No oral home care instructions	-.55	-.41	-.48[1]
oral home care instructions	-.58	-.18	-.38[1]
Mean change by toothbrush	-.57[2]	-.30[2]	

[1] $F(1,86)=.71, p >.05$
[2] $F(1.86)= 4.5, p < .05$

   A follow up ANOVA was then conducted for effect of oral homecare instructions on the dependent variable of change in gingival index. Levene's test of equality of error variance was non-significant demonstrating homogeneity of variance across groups $F(3,83) = 1.31, p > .05$. The mean change in gingival index was not statistically significantly different based on the provision of oral home care instructions: $F(1,86) = .71, p > .05, \eta^2 = .01$. Table 8 provides the mean gingival index based on type of toothbrush and provision of home care instructions.

A follow up ANOVA was then conducted for effect of oral homecare instructions on the dependent variables of change in plaque index. Levene's test of equality of error variance was non-significant demonstrating homogeneity of variance across groups $F(3,83) = 2.33, p > .05$. The mean change in plaque index was not significantly different based on the provision of oral home care instructions: $F(1,86) = .63, p > .05$. Table 9

provides the mean plaque index based on type of toothbrush and provision of home care instructions.

Table 9

Mean change in plaque index by type of toothbrush and home care instruction

	Battery operated toothbrush	Manual toothbrush	Totals
No oral home care instructions	-.15	-.30	-.23[1]
oral home care instructions	-.26	-.51	-.38[1]
Mean change for toothbrush	-.21[2]	-.40[2]	

[1] $F(1,86)=.63, p > .05$
[2] $F(1.86)= 1.04, p > .05$

Negative Symptoms Survey

Seventy-six (76) participants (87%) completed the Self-Evaluation of Negative Symptoms Survey (Dollfus et al., 2015) to determine level of negative symptoms related to serious mental illness. The survey scores for this group ranged from 0 to 40 with a mean score of 15.25. There was no correlation between negative symptoms and the post-test mean gingival index: $r(75)= .11, p > .05$ or post-test mean plaque index $r(75) = .04, p > .05$. A negative correlation was found, however, between the number of times brushed and the negative symptoms score $r(75) = -.35, p = .01$. This found that participants who brushed their teeth more had lower negative symptom scores. Sixty-one participants (70.11%) returned the calendar. There was no correlation between frequency of brushing and the mean change in plaque index $r(59)= -.12, p = .35$. Additionally, there was no

correlation between the number of times brushed and the mean change in gingival index

$r(59)=-.13$, $p = .30$

Smoking

The dependent variable change in gingival index met the homogeneity of variance assumption: $F(1,85) = 1.30$, $p > .05$. The dependent variable change in plaque index met the homogeneity of variance assumption: $F(1,85) = .20$, $p > .05$. The impact of smoking was not significant in relation to change in mean gingival index: $F(1,87) = .00$, $p > .05$, and change in mean plaque index: $F(1,87)=.24$, $p > .05$.

Diagnoses

A series of ANOVA tests were conducted to determine the effect of the diagnosis on the mean change in gingival index and mean change in plaque index. Table 10 provides the results of the analyses which found that the diagnosis of a specific serious mental illness compared to all other diagnoses did not have an impact on the mean change in either index.

Table 10

Relationship between diagnoses and mean change in gingival and plaque indices

	N	F
Change in gingival index schizophrenia	31	1.70
Change in plaque index schizophrenia	31	.38
Change in gingival index bipolar	30	1.03
Change in plaque index bipolar	30	1.45
Change in gingival index depression	31	.37
Change in plaque index depression	31	.13
Change in gingival index panic/anxiety	19	.05
Change in plaque index panic/anxiety	19	.01
Change in gingival index other	31	.26
Change in plaque index other	31	2.46

*all p values > .05
** all df = 72

CHAPTER V

DISCUSSION

One key finding of this study was that the battery-operated toothbrush resulted in an improvement in the mean change in gingival index of the participants that completed the study as compared to the manual toothbrush. The battery operated toothbrush did not result in a statistically significant improvement in change in mean plaque index. However, the change in mean plaque index appears to be of practical significance. If it was found to be reliably different from zero, it would be statistically significant (Refer to Table 9). The participants who received the battery operated toothbrush as well as those who received a manual toothbrush, demonstrated a reduction in the mean change in plaque index. These two conditions could reach statistical significance if the contrast to the other conditions were larger or if power was increased with a larger sample. In this case the manual toothbrush would have the advantage. Perhaps a larger sample would result in greater power and a statistically significant result. It is also possible that a longer time period between pre-test and post-test collection of indices may have resulted in a statistically significant contrast in plaque index. This study found that home instruction and the interaction of the home care instructions with the type of toothbrush did not result in an improvement in plaque index or gingival index in this study. This study also found that the diagnosis of specific serious mental illnesses did not have an impact on the mean change in gingival index or mean change in plaque index.

The results of this study can be compared to and contrasted with existing studies from the literature review. Jain (2013) determined that an automatic toothbrush was beneficial in improving the oral health of a group of non-disordered dental students. The findings of Jain (2013) can be extrapolated to the current study and the participant pool that includes patients with a diagnosis of SMI. The current study also supports the findings of Almomani et al., (2006) who determined that an automatic toothbrush can improve the oral health of the population with serious mental illness. However, this study differs from the study conducted by Almomani et al., (2006) in that the current study did not find that the provision of home care instructions resulted in an improvement in oral health of the participants. One reason may be the difference in the type of reminder system implemented. The study conducted by Almomani et al., (2006) utilized a post-it reminder system whereas the current study utilized a calendar with stickers. Cognitive remediation strategies such as a reminder system may be important in increasing the frequency of brushing in the population with serious mental illness. For the current study, the calendar and stickers were not considered as an independent variable but such strategies should be considered as an intervention in future studies. Future studies may compare and contrast the benefits of using a reminder system in participants with a diagnosis of serious mental illness. The current investigation also differed from the study conducted by Almomani et al., (2006) in that the current study used two types of toothbrushes (manual and automatic) as a comparison. D'Cruz and Aradhya (2013) found that home care instructions did significantly improve the oral health of non-disordered school children in India based on change in mean plaque and gingival indices.

Provision of oral home care instructions is normal for all patients during preventive dental visits. Although this study did not find that oral home care instructions resulted in a statistically significant change in the plaque index and the gingival index, it can be assumed that oral home care instructions during preventive dental visits would be beneficial in the population that suffers from serious mental illness based on the findings from Bowie at al., (2012) and Almomani et al., (2006). The study conducted by Bowie et al., (2012) assessed the longevity of cognitive remediation after twelve (12) weeks. It is possible that reinforcing oral care over a longer period of time in the current participant pool may have found that oral home care instructions can significantly improve oral health in the enrolled participants of this study. Additionally, the study conducted by Almomani et al., (2006) found that the group that received the post-it reminders and the visual instruction had a significantly greater improvement in the plaque index than the group that received just the toothbrush. D'Cruz and Aradhya (2013) also found that oral home care instructions resulted in an improvement in oral health, however the participants of this study were non-disordered school children. Based on the results of the study conducted by D'Cruz and Aradhya (2013) it can be can assumed that oral home care instructions may be beneficial to the population that suffers from SMI. In general studies which include adults with SMI are limited. Several studies evaluating the benefits of a battery brush and/or oral care instruction included children and young adults. It is possible that it may be easier to change habits in the younger population.

Zannello at al., (2003) determined that the patient suffering from serious mental illness also experiences significant cognitive deficits that can impact daily functions. Bowie at al., (2012) and Lee at al., (2013) determined that cognitive skills remediation

can benefit the performance of functions. Thus, improving general and oral health literacy should be a component of future studies as higher health literacy improved overall health and oral health in patients overall (Khokhar et al, 2011). There is a common misconception that those who suffer from serious mental illness cannot learn or retain skills. However, this study found that in a short time there was a statistically significant improvement with a simple intervention. It is possible that if cognitive deficits are accounted for in this population, home care instructions may be beneficial.

The current study also found that the impact of smoking was not significant in relation to change in mean gingival index or change in mean plaque index in the participants of the current study. However, since smoking was a dichotomous variable in the current study, it was not possible to assess the degree to which levels of smoking impacted oral health.

Although this study found that a negative correlation was found between the number of times brushed and the negative symptoms score, the negative symptoms survey score was not significantly correlated with the post-test mean gingival index or post-test mean plaque index. The current study found that there was no correlation between the negative symptoms that the participant was experiencing and the post-test indices for oral health.

It is possible that poor oral health may be related to the negative side effects of the medications prescribed for management of SMI. However, since 69 of the 74 participants from whom complete medical histories were obtainable were taking antipsychotic medications and other medications which result in xerostomia, evaluating the effects of the medications on the oral cavity was not possible because a between medications

contrast was not possible. Only a small number of participants (N=4) were taking

clozapine instead of other anti-psychotics which are associated with xerostomia, Clozaril

is not associated with xerostomia, but can causs sialorrhea (excess salivation). Since only

a small number of participants were taking clozapine, determining a contrast of oral

effects of clozapine as compared to other antipsychotic medications was not possible.

One limitation of the study was that random assignment was not feasible due to

unanticipated characteristics of the centers. For example, at the initial center that

participants were recruited from, all of the participants wanted the battery operated

toothbrush. True random assignment would have resulted in resistance to the study.

Therefore, the participants at each center received the same toothbrush and the same

intervention. Randomization was accomplished based on the recruitment center. It is

possible that individuals may differ from center to center due to the formation of

preformed groups. As a result, it may be difficult to determine whether or not the

characteristics of the center and caseworkers are confounded with the treatment.

Characteristics may include encouragement and reminders to perform home care.

Another factor to consider is the calendar.

Additionally, since true random assignment was not possible, the previous history

of oral health and oral disease may be a confounding factor. These non-controlled

historical factors may have influenced some of the outcomes. However, this was

controlled to some extent by obtaining baseline gingival and plaque indices and including

the changes in mean indices for all four groups. Since medical histories could be obtained

from one of the centers, diagnoses and medications could not be confirmed for thirteen

participants; this may be considered a limiting factor as well.

The average rate of brushing for the study period was similar for all conditions. Additionally, it is difficult to determine if the calendar itself became an intervention. A Hawthorne Effect may occur as participants, knowing that they are involved in a study and are being monitored by the PI, may perform tasks differently as a result of their involvement in the study. As a result, it is possible that the calendar would confound the independent variables of interest.

The results are an important addition to the limited body of literature that exists on the topic of oral health and SMI. The important effect found in this study for dental care providers is that the recommendation of an automatic toothbrush to the patient suffering from SMI can result in a significant improvement in oral health. Prevention of oral disease is critical to maintaining the dentition free from dental decay and from periodontal disease. Prevention is also the most cost effective method to maintaining oral health. Including the use of an automatic toothbrush as part of a home care regimen for patients with a diagnosis of SMI would be a simple and cost effective way to prevent disease. Providing a reminder system such as a calendar so that the patient can track brushing and have a visual reminder with more frequent preventive dental office visits is also important in maintaining oral health. Additionally, involving the caregiver of the patient with a diagnosis of mental illness may also be beneficial in promoting oral health.

As an additional step in the research of oral health among SMI individuals, the education of dental providers is important (Giglio and Laskin, 2010). This should begin at the level of pre-doctoral dental school education; students should be taught about identifying mental illness based on a medical history and also how to dentally manage patients with mental illness. Oral effects of medications have an impact on oral health of

the patient with a diagnosis of serious mental illness. Pre-doctoral dental students should receive this information as part of pharmacology classes while in dental school. Interprofessional care, which can improve the collaboration between oral health care providers and mental health providers, is important in improving the oral health of this population (Janardhanan et al., 2011). Educating clinicians about incorporating home care reminders may be important in improving the oral health of the population diagnosed with SMI. Expanding programs that include promotion of oral health may be beneficial to this population. A longitudinal study that investigates the long-term effects of oral home care instructions in the population suffering from SMI may also be beneficial in identifying methods of oral health improvement in this population.

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Appendix

Supplementary data

Self-evaluation of Negative Symptoms
(SNS, S. Dollfus and C. Mach, V1_2014)

For each statement, put a cross in the box which best corresponds to your current feelings (based on the previous week).

	Strongly agree	Somewhat agree	Strongly disagree
1. I prefer to be alone in my corner			
2. I'm better off alone, because I feel uncomfortable when anyone is near me			
3. I'm not interested in going out with friends or family			
4. I don't particularly try to contact and meet friends (letters, telephone, text messaging, etc.)			
5. People say I'm not sad or happy and that I'm not often angry			
6. There are many happy or sad things in life but I don't feel concerned by them			
7. Watching a sad or happy film, reading or listening to a sad or happy story does not especially make me want to cry or laugh			
8. It is difficult for people to know how I feel			
9. I don't have as much to talk about as most people			
10. I find it 10 times harder to talk than most people do			
11. People often say that I don't talk much			
12. With friends and family, I want to talk about things but it doesn't come out			
13. I find it difficult to meet the objectives I set myself			
14. It's hard to stick to doing things on an everyday regular basis			
15. There are many things I don't do through lack of motivation or because I don't feel like it			
16. I know there are things I must do (get up or wash myself for example) but I have no energy			
17. I don't take any great pleasure in talking to people			
18. I find it hard to take pleasure even when doing things I have chosen to do			
19. When I imagine doing one thing or another, I don't feel any particular pleasure in the idea			
20. I am not interested in having sex			