

The oral hygiene status of people with dysphagia: a descriptive study.

By

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Submitted in fulfillment of the requirements for the degree of Master in Speech Therapy, in

the School of Health Sciences, University of Kwa-Zulu Natal.

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April 2018

DECLARATION

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ACKNOWLEDGEMENTS

First and foremost, I would like to thank my Heavenly Father for his blessings and guiding me through this process.

I would like to extend my sincere appreciation to Professor Mershen Pillay who supervised and guided this research, for his assistance and support in the development, completion and review of this thesis, as well as to Dr. Lavern Samuels for his advice and assistance.

The study would not have been possible without financial assistance provided by a CHS Masters Scholarship, through the University of Kwa-Zulu Natal, Durban, South Africa.

Grateful thanks to the Hospital manager of the research site, for allowing data collection to take place at the institution, and the participants and family members for their willingness to take part in the study.

A special note of thanks is given to the Oral Hygienist, Noekie Grobler, for contributing her services during data collection, and Ampath Laboratories, Greenacres Hospital, Port Elizabeth.

Last and by no means least, my loving family for their understanding, continued support and encouragement throughout the process.

ABSTRACT

The aim of the study was to assess and describe the oral hygiene problems of adults admitted to a sub-acute rehabilitation hospital who presented with dysphagia.

A descriptive, cross-sectional survey study design was followed and took place at a sub-acute rehabilitation hospital, based in the private sector. The 40 participants, 57.50% (n=23) male and 42.50% (n=17) female, were identified using non-probability, purposive sampling and underwent various assessments during the two phases of data collection. Phase I consisted of three steps: (1) assess the swallow function of participants, using the Mann Assessment of Swallow Ability (MASA), (2) screening the oral hygiene of participants with confirmed dysphagia, using an adapted version of the Oral Health Assessment Tool to identify any oral hygiene problems, and (3) sample the oral microbiota to detect bacteria not considered part of the normal oral flora. Phase II of the study refers to the descriptive and statistical analysis of the data.

A high likelihood for aspiration was a common feature for most participants who presented with dysphagia (42.50%). The main swallowing problems were related to lingual strength, the ability to manage saliva, bolus clearance and effectiveness of the cough. A high prevalence of deficient oral hygiene and oral colonization (62.50%) was found. The most commonly occurring bacteria groups and species were: (1) *Candida albicans* and (2) respiratory pathogens, e.g. *Klebsiella pneumoniae* and *Staphylococcus aureus* growth. The oral hygiene status of people who presented with dysphagia showed that it increases the likelihood for poor oral hygiene, which creates favourable environments for bacteria to flourish, as well as the prevalence of pathogenic oral bacteria, which is associated with the development of aspiration pneumonia. The management of oral health issues for persons with dysphagia should receive greater attention during hospitalization.

Key words: Dysphagia, oral hygiene, swallowing function, aspiration pneumonia, oral bacterial colonization

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CHAPTER 1.

INTRODUCTION AND OVERVIEW OF THE STUDY

1.1 INTRODUCTION

The mouth is the entrance to the digestive, vocal, and at times the respiratory tract, and is thus regarded as the gateway to the body, with what happens in the mouth effecting overall health and illness. A healthy oral status, and the need to maintain this is thus essential not only for comfort, but for general well-being and systemic health. The association between oral health and general systemic health has become the subject of intense study over the past decade, and has been highlighted in numerous reports (Claffey, Ioannis, Polyzois & Williams, 2010, as cited in Genco & Williams, 2010). Many studies have demonstrated a remarkable association between oral infections and systemic diseases or health complications (Carrilho Neto, Ramos, Sant'ana & Passanezi, 2011). The most significant association, and the one of particular interest to Speech-Language Therapists is the association between the presence of pathogenic bacteria in the oral cavity and the occurrence of pneumonia, especially in patients who present with swallowing difficulties, also known as dysphagia. It is thus not surprising that the concept of oral health has become an emerging area of interest among Speech-Language Therapists. Due to its association with the development of aspiration pneumonia (AP) it has the potential to significantly impact and change the daily management of the patient who presents with dysphagia, thus evolving the daily practice of speech therapy.

Chapter 1 provides the background and problem, as well as a comprehensive introductory review of the key concepts of the study, namely; (1) oral health, (2) dysphagia and (3) the high-risk patient in relation to the pathogenesis (manner of development of disease) of (4) AP. Furthermore the problem statement, aim, objectives, research approach and the significance of the study are presented.

1.2 BACKGROUND

The oral cavity harbours a very complex microbial ecology (Munro, 2014; Tada & Hanada, 2010), while it was previously estimated that 700 to 1000 different kinds of

micro-organisms live in the oral cavity, advances in gene-sequencing technology have improved our ability to explore and understand the oral flora (Boaden et al., 2017). Researchers Keijser, Zaura and Huse (2008), as cited in Boaden et al. (2017) revealed a high level of diversity of microbial phylotypes in the human oral microflora, and identified 10 000 micro-organisms, which is considerably more than the 700 that were previously identified.

Micro-organisms live in a state of balance with the host, but being open to the surroundings, the oral cavity is continuously exposed to the entrance of new micro-organisms, which can tip this delicate balance toward infection (Dahlén, 2009). The oral cavity thus has the potential to become a reservoir for opportunistic pathogens. Poor oral health and hygiene are known precipitating factors for increasing the number of oral bacteria (Konradsen, Trosborg, Christensen & Pedersen, 2012; Konradsen, Trosborg, Christensen & Pedersen, 2014; Luk & Chan, 2014).

Oral diseases, such as dental caries, periodontal disease, tooth loss, oral mucosal lesions, and human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS) related oral diseases are becoming major public health problems worldwide (Dye, 2017), with poor oral health having a considerable effect on general health and quality of life (Adedigba, Ogunbodede, Jeboda & Naidoo, 2007). Oral health is generally poor in many African communities, this being related to poor water and sanitation, the extensive use of chewing sticks, as well as little to no access to fluoride (Petersen, Bourgeois, Ogawa, Estupinan-Day & Ndiaye, 2005). Although numerous studies have been undertaken to determine the oral health status, trends and needs of people of South Africa, most of these have focused on school children, while only a few included adults (van Wyk & van Wyk, 2004). Furthermore van Wyk and van Wyk (2004) reported that the last documented survey on the oral health status of both adults and children in the five major metropolitan areas in South Africa was conducted by the national Department of Health in 1988/89. It is thus not possible to report on the current status of oral health among the adult population in South Africa, indicating a major gap in knowledge (van Wyk & van Wyk, 2004; Ramphoma, 2016).

A poor understanding of the oral status of a country, as well as deficits in management, has considerable economic implications, as the traditional treatment of oral disease is extremely costly (Dye, 2017). Oral disease is the fourth most expensive disease to treat in most industrialized countries (Petersen et al., 2005). In developing countries, investment in oral health care is low, and public health resources are primarily allocated to emergency oral care and pain relief, such as tooth extraction (van Wyk & van Wyk, 2004; Ramphoma, 2016). Public health problems related to tooth loss and impaired oral functions are therefore expected to increase in many developing countries (Petersen et al., 2005). Furthermore, numerous studies have documented the significant correlation that exists between poor oral health, the presence of pathogenic bacteria in the oral cavity, and the occurrence of pneumonia and the critical role it plays in one of the most common and costly health outcomes, AP (Munro, 2014; Barnes, 2014; Luk & Chan, 2014; Kwok, McIntyre, Janzen, Mays & Treasell, 2015; Tada & Hanada, 2010; Yoon & Steele, 2007).

Pneumonia is one of the most commonly occurring infectious pulmonary diseases, and is described as an inflammatory condition of the lung parenchyma, usually initiated by the introduction of bacteria into the alveolar sacs (Finegold, 1991, as cited in Shay, Scannapieco, Terpenning, Smith & Taylor, 2005). Pneumonia has become a major health care issue, and plagues the critically ill, the elderly and residents in long-term care (Barnes, 2014; Yoon & Steele, 2007).

The U.S Department of Health Services compiled data on the deaths, death rates and causes of deaths in the United States in 2013. A list of fifteen main causes of death in adults was identified, with pneumonia being listed as the eighth highest. Pneumonia had an incidence of 15.9% among both males and females, while pneumonitis caused by aspiration of solids and liquids was listed as fifteenth on the list, with an incidence of 5.2% (Jiaquan, Sherry, Murphy, Kenneth & Kochanek, 2016). Similar statistics have been reported in South Africa with Statistics South Africa (2014) noting that pneumonia, which includes AP, was identified as one of the leading causes of mortality among males and females. Deaths related to pneumonia were listed as the eight leading cause of death in the Eastern Cape, with an incidence of 3.1%. Pneumonia is thus a global phenomenon, is associated with significant morbidity and mortality, and is the leading cause of acute care hospitalization in patients who present with dysphagia (Sørensen et al., 2013). Pneumonia

results in longer hospital stays while its treatment and care are very costly to the health care system (Shay, Scannapieco, Terpenning, Smith & Taylor, 2005).

1.3 PATHOGENESIS OF ASPIRATION PNEUMONIA

Fernández and Clavé (2013) state that the pathophysiology of AP can be explained as the combination of risk factors that alter swallowing function, cause aspiration, and predispose the oropharynx to bacterial colonization from the oral cavity that arise due to poor oral hygiene, and in part due to a disordered swallow. A full description of each of the three risk factors namely; oral health, dysphagia and high-risk patients, which play a role in the pathogenesis of AP (Figure 1.1) will be discussed hereunder.

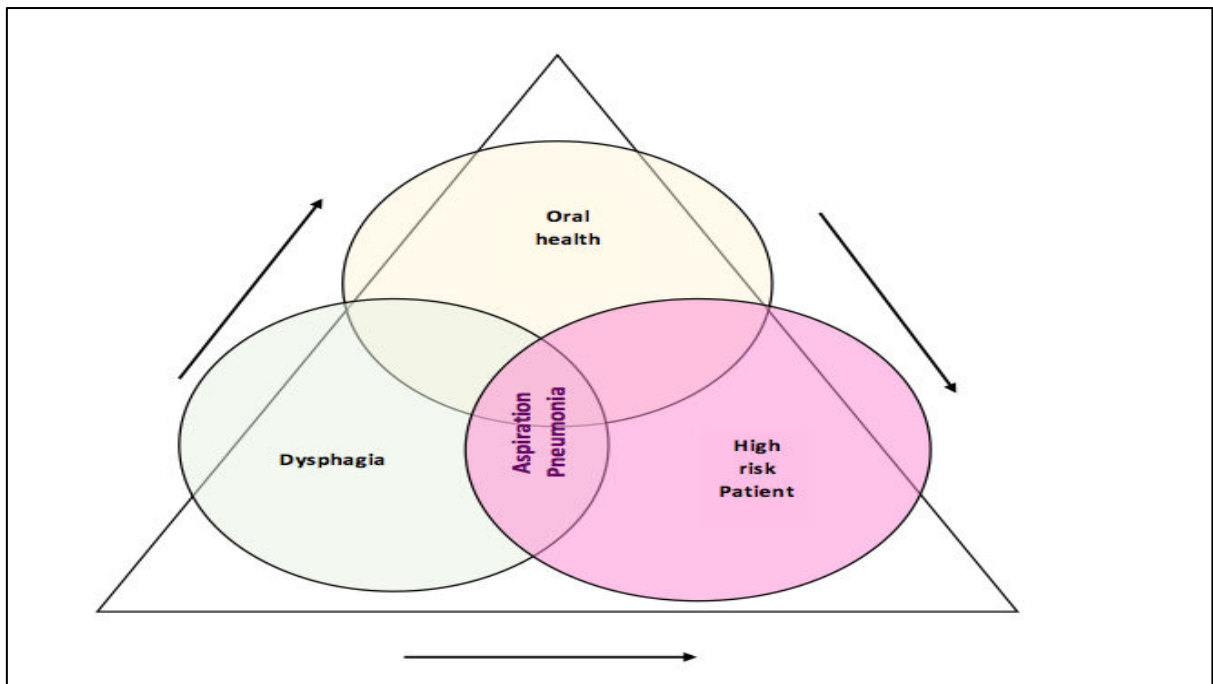


Figure 1.1 Proposed interaction between the three documented risk factors involved in the pathophysiology of aspiration pneumonia.

1.3.1 Oral health

The relationship between oral and general health has been increasingly recognized during the past two decades (Rautemaa, Lauhio, Cullinan & Seymour, 2007). Furuta and Yamashita (2013) define oral health as a state of being free of mouth and facial pain, oral and throat cancer, oral infection and sores, birth defects, such as cleft lip and palate,

periodontal (gum) disease, tooth decay and loss, and other diseases and disorders that limit an individual's capacity to bite, chew, smile, speak and experience psychosocial well-being.

Colonization of the mouth and oral secretions with bacteria that are respiratory pathogens due to poor oral hygiene has been identified as a major vector for the development of AP, particularly in patients with dysphagia. Konradsen et al. (2012) conducted a study on the oral status among patients hospitalized with acute medical conditions and their need for oral health care. Their study was the first to describe the prevalence of oral health problems in patients admitted to hospital for acute medical conditions and found the prevalence of oral health problems was as high as 91%, indicating a significant and largely overlooked health problem. Furthermore, their study on the oral health status of hospitalized patients in 2011 found that the majority of patients did not present with satisfactory oral hygiene (Konradsen et al. 2014) and that the length of stay in hospital was associated with increased dental plaque and gingival inflammation index scores (Konradsen et al. 2012).

To provide a comprehensive understanding about the association between AP and oral micro-organisms, it is necessary to understand the micro-organisms present in the oral cavity during health and illness. The oral microbiota is both rich and unique, with the normal oral flora being in a state of balance with the host, and the composition of the microbial communities remaining relatively stable in normal healthy individuals (March & Percival, 2006, as cited in Tada & Hanada, 2010). As long as micro-organisms do not harm the host, they are part of the microbial community that are regulated by the microbial-ecological homeostasis (Marsh & Martin, 1999, as cited in Dahlén, 2009). However, factors such as poor oral hygiene, oral diseases and infections have the potential to tilt the delicate balance toward infection.

Poor oral hygiene can occur when oral care is suspended which disrupts the microbial homeostasis allowing some pathogenic bacteria to compete, establish, grow and finally infect (Dahlén, 2009). These processes are better explained by Franceschini (2009), who reported that without regular oral care, or when oral care is suspended, such in the case for hospitalization following a stroke or a surgical procedure, periodontal disease develops

rapidly. Within just 48 hours, the oral cavity becomes virulent and over-laden with gram-negative bacteria, staphylococcus aureus and yeast. Under stress, the patient's immune system cannot sustain itself against this bacterial onslaught, and systemic disease will occur. The mouth has thus become a significant potential source of both infection and inflammation that contributes to the total burden of disease, and to overall health and well-being (Rautemaa et al., 2007). The mouth, and subsequently poor oral hygiene thus play a part in one of the most common and costly health outcomes, AP, especially in the case of a disordered swallow (Furata & Yamashita, 2013; Barnes, 2014; Yoon & Steele, 2012; Konradsen et al., 2012).

1.3.2 Dysphagia

Swallowing is a complex neuromuscular activity that consists of oral, pharyngeal and oesophageal phases and involves the coordinated function of many muscles (Hiramatsu, Kataoka, Osaki & Hagino, 2015), with physiological deficits in any of the swallowing phases potentially giving rise to dysphagia (González-Fernández & Daniels, 2008). Dysphagia, or problems with swallowing, is a global problem that is commonly a symptom of an underlying disease, usually of neurogenic or mechanical origin (Groher & Crary, 2010). Dysphagia may also occur in the absence of illness or medication, and simply be part of the aging process (Barnes, 2014; Japanese Respiratory Society, 2009). Even with healthy aging, there is a physical toll on head and neck anatomy, as well as changes to the physiologic and neural mechanisms that support swallowing (Ney, Weiss, Kind & Robbins, 2009, as cited in Liantonio, Salzman & Snyderman, 2014). Furthermore advanced age by itself, was shown to be correlated with an increased incidence of aspiration (Martin, 1994, as cited in Shay et al., 2005).

Dysphagia can result in impaired safety of the swallow that can cause aspiration, which is defined as the inhalation of oro-pharyngeal or gastric contents into the lower respiratory airways (Luk & Chan, 2014). Aspiration is a common feature of dysphagia that leads to respiratory infections or AP (Yoon & Steele, 2007; Sørensen et al., 2013), and while it is a prerequisite for AP not all individuals who aspirate develop infection (Perry & Love, 2001). Although half of healthy adults aspirate saliva during sleep, these individuals do not necessarily develop AP (Gleeson, Eggli & Maxwell, 2002, as cited in Luk & Chan, 2014).

If a person has normal immunity, a good cough reflex, normal respiratory ciliary movement and good oral hygiene, there are usually no harmful effects of aspirating saliva. Therefore, although dysphagia leads to aspiration, it has been proven that dysphagia by itself is not sufficient to cause AP unless other risk factors, such as poor oral health are present.

1.3.3 High-risk patient

Shay et al. (2005) reviewed a study done by Scannapieco et al. (2003) who undertook a systematic review of the literature up to April 2002 to establish a link between pulmonary and periodontal diseases. Their conclusions, accepted by a scientific review board of the America Academy of Periodontology, were that there is evidence of an association between nosocomial pneumonia and poor oral health in the high-risk patient. The development of AP is dependent on the presence of pathogenic oral bacteria, which occur due to poor oral hygiene co-occurring with the presence of dysphagia, and results in the uncontrolled entrance of bacteria laden oro-pharyngeal secretions into the lower respiratory airways (Craven, Stever & Barber, 1991, as cited in Shay et al., 2005). In the presence of reduced immunity, the body is unable to fight off the onslaught of the bacteria leading to the onset of infection. The population of people who generally have these co-occurring conditions and are thus considered high-risk populations are hospitalized patients, those in long-term care and the elderly. The oral cavity of hospitalized and bedridden patients is often a reservoir for opportunistic respiratory pathogens (Tada & Miura, 2012). Oro-pharyngeal dysphagia is a very prevalent condition in the chronically ill in hospitals and long-term care facilities (Barnes, 2014), and in patients with neurological disorders, such as cardiovascular accident, traumatic brain injury, Alzheimer's disease, parkinsonism, dementia or other neurological disorders (Fernández & Clavé, 2013; Liantonio et al., 2014). The combination of these risk factors often results in the development of AP, especially when the risk factors are not adequately managed.

1.4 PROBLEM STATEMENT

While AP is a serious and fatal complication of dysphagia, secondary to the ingestion of bacteria laden secretions, no studies have documented the oral hygiene features present in

patients with dysphagia within the South African private sector hospital setting. Although poor oral hygiene is a known precipitating factor for increasing the number of oral bacteria (Konradsen et al., 2012), and hospitalization itself impacts on oral hygiene (Danckert, Ryan, Plummer & Williams, 2016), numerous studies have documented that oral care practices are often an overlooked component in the care of hospitalized patients (Chipps et al., 2014).

This has significant and far reaching consequences, as Konradsen et al. (2014) state that poor oral hygiene increases oral bacteria, which might be aspirated, causing infection and affecting the patient's medical condition thus resulting in longer hospital stays and more costs to the health care system. The fact that oral hygiene receives little attention during hospitalization could be due to the oral health status of acutely hospitalized patients, with the need for oral health care in this population remaining relatively unknown (Konradsen et al., 2012).

In addition, while reviewing various literature sources (Matthews et al., 2012; Ajwani et al., 2016; Kwok, McIntyre, Janzen, Mays & Teasell, 2015; Kobayashi et al., 2016; Putten, de Baat, Visschere & Schols, 2013), it became clear that the information about oral conditions of hospitalized populations have mostly focused on the elderly, children, cancer and psychiatric patients. While no studies having reported on the oral hygiene findings in relation to the hospitalized adult patient who presents with dysphagia, indicating a significantly overlooked problem.

In the absence of this information, it has been difficult to reduce the occurrence of AP and improve speech therapy management practices. Furthermore Speech-Language Therapists are called upon to assess the risk that dysphagia poses to their patient, and to decide whether they have dysphagia or non-dysphagia related AP, nosocomial pneumonia or aspiration pneumonitis, with the clinical decision making often not taking into account other likely conditions that could have caused the pneumonia, as it is often not covered in training programmes.

Understanding the oral hygiene features present in people with dysphagia will assist in indicating which features to screen for, when to refer and assist with the design and

implementation of management protocols. The findings could encourage inter-professional collaboration in the management of people with dysphagia, and have far reaching implications within the health care setting as maintenance of oral health to reduce the risk of AP is easier and less expensive than managing the disease once it occurs.

1.5 RESEARCH QUESTION

What is the oral hygiene status of hospitalized patients that are associated with the clinical features of dysphagia?

1.6 AIM AND OBJECTIVES

The aim of the study was to establish if hospitalized patients who present with dysphagia are at increased risk of poor oral hygiene.

The study had the following objectives:

1. To assess the swallow function of each participant, using the Mann Assessment of Swallow Ability (MASA), to allow for characterization of dysphagic features present.
2. To describe the oral hygiene status of each participant using an adapted version of the Oral Health Assessment Tool (OHAT).
3. To determine the degree to which the oral cavity of individuals who present with dysphagia is colonized by pathogens not associated with normal oral flora.

1.7 TYPE OF STUDY AND METHOD

The study followed a descriptive, cross-sectional design. As dysphagia predisposes to aspiration (Perry & Love, 2001; Carlaw et al., 2012), and swallowing dysfunction and/or oral motor dysfunction can affect oral hygiene (Langmore et al., 1998), swallow function will be assessed according to oro-motor and sensory components to determine the integrity of the patient's swallow and the probability for aspiration. The oral hygiene status of the

patient with dysphagia will be profiled, and the oral cavity assessed for the presence of gram-negative bacteria, such as *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Escherichia coli*, i.e. organisms reported in literature to be associated with AP (Shay et al., 2005; Japanese Respiratory Society, 2009; Barnes, 2014; Luk & Chan, 2014). This will be done as opportunistic respiratory pathogens are only found in the oral cavities of compromised hosts (Tada & Hanada, 2010) and the current study aims to specifically explore the concept of risk.

The study will follow a descriptive theory to further explore and describe the oral hygiene status of hospitalized patients who present with dysphagia. This will provide a clearer understanding about the oral hygiene variables that give rise to the greatest probability for developing AP in the presence of dysphagia.

1.8 ORGANIZATION OF THE THESIS

This thesis is presented in the following five chapters:

Chapter 2. Literature Review: A discussion of the background to AP as a multifactorial problem, which leads to significant morbidity in the high risk hospitalized patient, is provided. The chapter also refers to various sources within the literature to highlight the factors, namely poor oral health and the clinical features of dysphagia, which play a role in the pathogenesis of AP. These areas are further unpacked by referring to the conceptual framework within which the risk issues for AP will be studied.

Chapter 3. Methodology: A description of the research site, study design, research subjects, study sample and the materials used for data collection are described. Other issues, such as the need to employ the services of an Oral hygienist to assist with data collection, as well as difficulties experienced ensuring patient autonomy during the informed consent process, are addressed.

Chapter 4. Results: The results of the study are contained within the study article. It presents the results with respect to the three research objectives in tabular form and where

possible graphical format and an interpretation thereof. Lastly it concludes with a synthesis and critique of the study.

Chapter 5. Discussion: Further findings supporting the study findings, are presented, as well as the theoretical implications drawn from the study, significance of the findings and recommendations are presented to augment the article furthermore, further critique of the study is given.

1.9 SUMMARY

This chapter provided an introduction to the key concepts of the study, namely oral health, dysphagia, and the high-risk hospitalized patient that play a role in the pathophysiology of pneumonia, as well as the rationale why oral hygiene in individuals with dysphagia has been the focus of this study. The dimensions of the research were discussed in terms of background, problem statement, research question and the three objectives of the study, followed by an outline of the chapters included in the thesis.

CHAPTER 2. LITERATURE REVIEW

2.1 INTRODUCTION

Many published articles indicate a clear causal link between the lack of oral hygiene, oral health issues and dysphagia, and how these affect the patient's general health, particularly by resulting in AP (Ajwani et al., 2016; Konradsen et al., 2012; Luk & Chan, 2014; Tada & Hanada, 2010; Tada & Miura, 2012; Sørensen et al., 2013; Yoon & Steele, 2007). In order to provide a context to the study and to establish a background to the conceptual framework, a comprehensive introductory review of oral health, oral micro-organisms, dysphagia and the high-risk patient, in relation to the pathogenesis of AP was provided in Chapter 1.

In this chapter, relevant literature sources were reviewed to enable a better understanding of the relationship between oral health, dysphagia, oral pharyngeal colonization and its association with AP. The researcher devised a conceptual framework (Figure 2.1) depicting the potential causal relationship between the abovementioned factors by coalescing the most recent understandings from the literature. This consisted of the link between the high-risk hospitalized patient, poor oral health, dysphagia, and the development of AP.

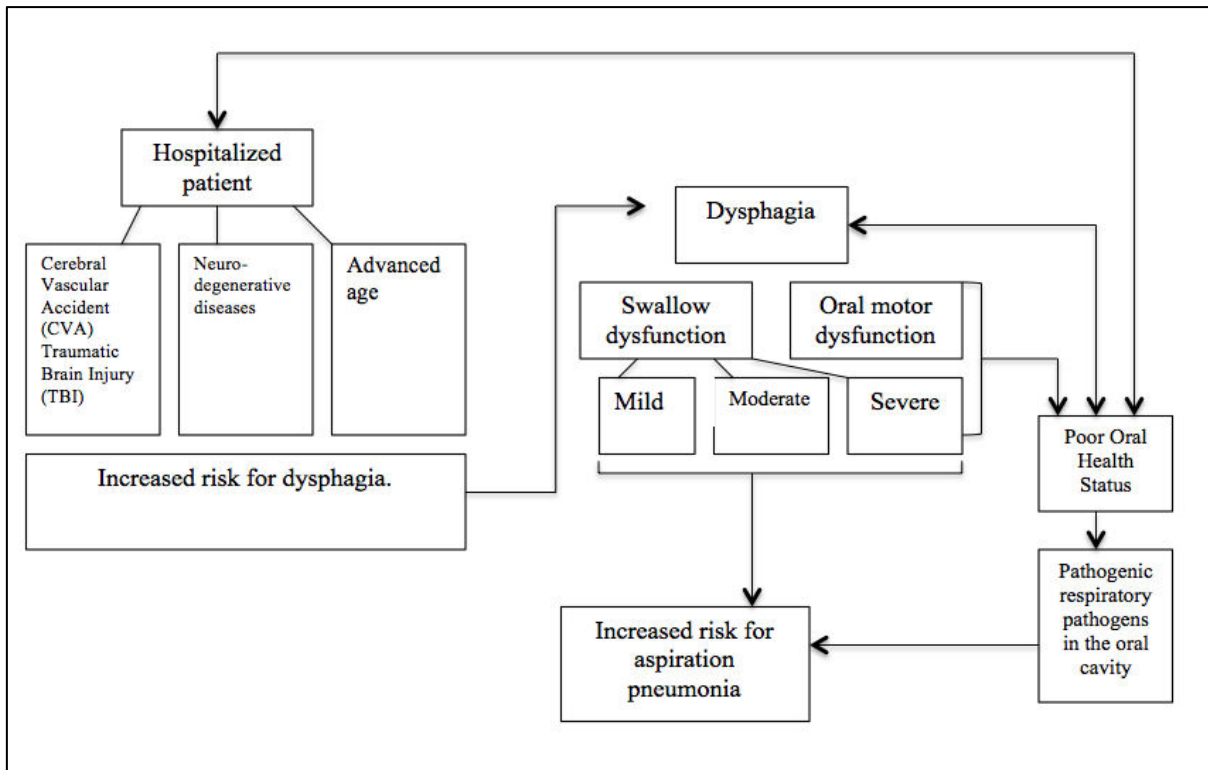


Figure 2.1 A hospitalized patient’s risk for aspiration pneumonia, based on the interaction between oral health and dysphagia.

2.2 BACKGROUND TO THE CONCEPTUAL FRAMEWORK

AP a serious and fatal complication of dysphagia, which is associated with significant morbidity and mortality, and longer hospital stays and thus increased costs to the health care system. Although there is ample evidence to highlight that oral bacterial colonization due to poor oral hygiene is one of the important aspects in the pathophysiology of AP (Ortega et al., 2015), knowledge is sparse regarding the oral health status, which includes the composition of oral flora of hospitalized patients who present with dysphagia (Boaden et al., 2017). The following section provides the background within which oral hygiene was studied.

The literature states that the oral health status of hospitalized patients, who were also identified as high-risk populations for this study, present with an increased risk for dysphagia, as well as poor oral hygiene. As poor oral hygiene is a known precipitating factor for increasing the number of oral bacteria, in the presence of dysphagia, the risk for developing AP is significantly increased. Furthermore, some studies have alluded to the fact that issues relating to poor oral health could be attributed to the presence of dysphagia,

and conversely in certain situations, dysphagia results from poor oral hygiene (Kikutani et al., 2009; Tada & Hanada, 2010; Luk & Chan, 2014). The conceptual framework therefore proposes a causal, bi-directional relationship between oral health and dysphagia as it relates to the development of AP. It is thus hypothesized that a patient who is hospitalized and presents with dysphagia will present with deficient oral hygiene.

2.3 IMPLICATIONS OF HOSPITALIZATION ON SWALLOWING AND ORAL HEALTH.

Research has shown that hospitalization itself impacts on oral hygiene, and hospitalized patients present with the main oral risk factors such as oral lesions, dental plaque, and periodontal diseases, to develop local and systemic disease (Tada & Hanada, 2010; Carrilho Neto et al., 2011; Danckert et al., 2016). During hospitalization, the oral cavity undergoes certain changes, the mucous membranes deteriorate with poor or neglected care, and because teeth and dentures have non-shedding surfaces without adequate cleaning they become covered with oral biofilms, which are susceptible to colonization by respiratory pathogens.

Chips et al. (2014) found that oral care practices are often an overlooked component in the care of hospitalized patients. This could be attributed to the fact that poor oral hygiene is not a highly visible condition, as oral care concerns are only visible upon closer inspection of the mouth (Yoon & Steele, 2012). The problem is that there are numerous diseases that often require hospitalization, of which dysphagia is a common underlying symptom (Groher & Crary, 2010; Fernandez & Clave, 2013).

An elevated risk for dysphagia, and the subsequent risk for AP, is common in the elderly, as well as multiple neurological diseases, which include (1) non-degenerative diseases (e.g. cerebral vascular accident (CVA) and traumatic brain injury (TBI), (2) degenerative diseases (e.g. Alzheimer's and Parkinson's diseases) (Gonzalez-Fernandez & Daniels, 2008). Complications from these conditions, such as the need for tube feeding, polypharmacy, malnutrition, decreased physical activity and decreased immune function, often result in colonization of the oral cavity with respiratory pathogens (Tada & Hanada, 2010).

Dysphagia commonly occurs in approximately 50% of stroke cases (González-Fernández & Daniels, 2008; Schimmel, Ono, Lam & Müller, 2017). According to the figures released by Statistics South Africa (2014) on the mortality and causes of death during 2013, cerebral vascular diseases, which include CVA's, were the leading cause of death among persons aged 65 years and older. CVA, TBI, and Parkinson's and Alzheimer's diseases often result in dysphagia due to the incidence of oral motor or pharyngeal dysfunction, which increases the risk for aspiration.

2.4 THE ROLE OF ORAL MOTOR DYSFUNCTION

The oral cavity is a chamber surrounded by and containing hard and soft tissues, notably the lips, cheeks, tongue, palate and teeth. Thus, the structures of the oral cavity serve multiple functions in speaking, breathing, mastication and swallowing. Oral motor function refers to the coordinated action of the lips, jaw, tongue, soft palate, pharynx and larynx that are intended to prepare the food into a bolus that is conducive to swallowing, and to influence the timing of food transport and swallow initiation. Disturbances in the condition and function of these muscles can interfere directly with muscle behaviour, which has a direct influence on bolus preparation and clearance, as well as oral hygiene. Non-degenerative and degenerative diseases, as well as aging, can cause motor and sensory impairment of the lips, tongue, masticatory muscles, soft palate and pharynx, which may directly and significantly affect eating, drinking and oral clearance (Zhu, McGrath, McMillan & Li, 2008, as cited in Kwok et al., 2015; Schimmel et al., 2017).

Decreased sensation and paralysis of the face and tongue can lead to hoarding of food, where the patient is unable to recognize that food has been left behind in the mouth, which can significantly affect oral hygiene in terms of cleanliness, and provide favourable environments for bacteria to flourish (Schimmel et al., 2017; Gopal, 2008). Oral motor dysfunction thus has the potential to provide an advantageous environment for the colonization of pathogenic organisms in the oro-pharyngeal region (Tada & Hanada, 2010).

In patients with complaints of dysphagia, the Speech-Language Therapist will conduct a clinical swallow evaluation (CSE) to determine swallow safety in terms of aspiration risk,

which includes an assessment of oral structural integrity, observations about dentition and oral motor function, and cranial nerve functioning (González-Fernández & Daniels, 2008). The CSE, which was used during the study to determine the presence of dysphagia and aspiration risk, incorporates all these areas of assessment.

2.5 ORAL HEALTH AND SWALLOWING PROBLEMS

Studies have shown the influence of oral health conditions on swallowing and nutrition. It is also clear that maintaining good oral health is essential for the general health, quality of life, chewing ability and mainly the reduction of pneumonia risk, as bacterial colonies in the oropharyngeal tissues and in dental plaque are the greatest precursors for the development of aspiration related respiratory infections (Ajwani et al., 2016; Mituuti et al., 2015).

An extensive literature search was undertaken to identify the factors that affect oral health and swallow function in a causal, bi-directional relationship. Research has highlighted eight categories as specific risk factors for bacterial colonization, as these are affected by deficient oral care and can inadvertently affect swallow function (Table 2.1). The risk factors are: the lips, gums and surrounding mucosal tissues, tongue, natural dentition, dentures, oral cleanliness and salivary flow rate, all of which were included as areas of assessment during the oral health assessment conducted as part of the study. The next section presents a brief review of literature illustrating the effect of the eight risk factors on swallowing and oral hygiene.

2.5.1 Lips

Achieving stable lip closure is essential during intraoral food manipulation (Groher, 1997), as failure to achieve lip seal results in oral spill or drooling. Furthermore, cracked, dry lips may cause discomfort or bleeding when eating.

2.5.2 Tongue

The tongue together with the lips is an anatomical structure that plays a part in preparing food to be swallowed, as well as being related to oral self-cleaning function. Patients with dysphagia, which involves the tongue, present with complaints of difficulties chewing and initiating the swallow (Groher, 1997) due to insufficient tongue motility or excessive fatigability. Furthermore, partial paralysis of the tongue may affect its debridement ability, which results in the formation of a tongue coating and thus assists in the colonization of bacteria (Kwok et al., 2015). Yeagaki and Sanada (1992), as cited in Kikutani et al. (2009), describe tongue coating as a moss-like deposit which is made up of organisms, food residues and abrasive epithelia, which forms over the tongue surface. Luk and Chan (2014) reported on a Japanese study conducted by Abe, Ishihara, Adachi and Okuda (2008) that identified tongue coating as a risk factor for AP. This finding is unsurprising given the fact that the dorsum of the tongue is the major oral site of bacterial multiplication, and the major source for the bacteria found in saliva. A disturbance of the bacterial equilibrium of the tongue dorsum thus leads to an overgrowth of opportunistic micro-organisms, infection and symptomology (Dahlén, 2009).

Table 2.1 Association between oral motor function, oral health and swallow function

Category	Risk factor	Effect on oral health	Effect on swallow	Reference
1. Lips	Dry/cracked	Bleeding	Lack of motivation to eat	Iorgulescu (2009)
2. Tongue	Periodontal disease Lack of cleaning Reduced motor function	Tongue coating Halitosis Formation of debris Increased presence of pathogenic bacteria	Lack of motivation to eat Pocketing and residue	Dahlén (2009) Kikutani et al. (2009).
3. Gums	Xerostomia	Bacterial colonization	Difficulty swallowing Slower oral stage	Barnes (2014) Gil-Montoya et al. (2015) Ortega et al. (2015)
4. Oral mucosal tissues		Inflammation Periodontal disease Candidiasis Mucositis Burning mouth		

5. Natural dentition	Number of remaining teeth	Increase risk for gingivitis Loose teeth Increased oral debris	Reduced chewing efficiency	Gopal (2008) Furata & Yamashita (2013) Long et al. (2012) Palmer (2001) Yoon & Steele (2007) Petersen & Yamamoto (2005)
	Condition of teeth (caries, bruxism)	Periodontitis Bacterial colonization Tooth wear	Pain - avoidance of certain foods	
6. Dentures	Ill-fitting/ broken dentures	Denture stomatitis Denture hyperplasia Traumatic ulcer	Decreased taste and palatal sensation Choking risk	
7. Oral cleanliness (oral biofilms)	Plaque on tooth surface	Maturation of plaque increases gram negative bacteria	No direct effect on swallow, but will result in AP when aspirated	Tada & Hanada (2010)
8. Oral secretions (saliva)	Hyper-salivation	Inflammation in oro-pharyngeal regions	Drooling affects masticatory function	Furata & Yamashita (2013)
	Hypo-salivation	Xerostomia Bacterial colonization Deterioration of oral Health	Affects masticatory function Reduced taste	Barnes (2014) Tada & Miura (2012) Yoon & Steele (2007)
	Salivary levels of micro-organisms	Recurrent candida	Malnutrition	Iorgulescu (2009) Poisson, Lafford, Campos, Dupuis and Bourdel-Marchasson (2016)

2.5.3 Gums

Gingivitis is a form of periodontal disease that refers to the inflammation of the gums and is usually caused by tartar build-up due to poor oral hygiene (Dahlén, 2009). It may also be caused by nutrient deficiencies due to malnutrition. Patients with dysphagia are thus at an increased risk due to the fact that dysphagia often results in malnutrition. Symptoms of unhealthy gums include puffy and swollen gums, pain, bleeding of the gums when brushing the teeth and bad breath (Genco & Williams, 2010).

2.5.4 Oral mucosal tissues

Oral infections of the mucosa can be caused by: dental and medical devices (e.g. dentures and implants), trauma (e.g. cheek biting and ulcers), poor oral hygiene and health, as well as periodontitis, candida and virus infections. Patients with oral mucosal infections present with symptoms ranging from the almost unnoticeable with some discomfort, such as reduced taste sensation, to severe oral discomfort or pain, which is followed by clinical inflammation detectable by redness and wasting of tissues (Dahlén, 2009).

2.5.5 Dentition

In terms of a patient's dentition, chewing, oral food transport and swallowing is a continuum (Palmer, Rudin, Lara & Crompton, 1992, as cited in Furata & Yamashita, 2013), with chewing ability being dependent on the number of functional, remaining teeth (Furata & Yamashita, 2013). Chewing is also important to maintain the healthy condition of teeth and periodontal tissues through self-cleaning with adequate saliva. Thus tooth loss is expected to indirectly disturb the coordinated execution of pre-swallow and swallow behaviours, and result in the accumulation of dental plaque (Furata & Yamashita, 2013; Simpelaere et al., 2016). The number and condition of the remaining teeth play an important role in chewing and nutritional intake and are further explored.

2.5.5.1 Condition of the teeth

The occurrence of oral parafunctional activities such as bruxism is not an unusual finding in certain neurological disorders, such as traumatic brain injury (TBI) (Chaudhuri, 2014). Bruxism is defined as repetitive jaw muscle activity characterized by the clenching and grinding of the teeth and by bracing or thrusting of the mandible (Long, Liao, Wang, Liao & Lai, 2012). It can affect the condition of the teeth by resulting in oro-facial lesions and wearing down of teeth, as well as indirectly affect oral hygiene by making the rendering of nursing care such as tooth brushing more difficult. Poor oral hygiene can result in the accumulation of debris which results in the formation of dental plaque and without the mechanical removal of plaque using a toothbrush, results in the breakdown of tooth enamel

and the formation of caries (Danckert et al., 2016), which provides a niche for respiratory pathogens (Dahlén, 2009).

2.5.5.2 Number of remaining teeth

The final stage of caries and periodontal disease, which has not been treated, is tooth loss and eventually edentulism. Tooth loss reduces chewing ability while edentulism is directly related to mastication and nutritional problems (Gil-Montoya et al., 2015). A longitudinal study conducted by Gilbert, Meng, Duncan and Shelton (2004), as cited in Furuta and Yamashita (2013), demonstrated that people who had tooth loss were more likely to exhibit chewing difficulty than those who had all their teeth. Individuals with dysphagia may avoid certain food textures due to impaired masticatory function, conversely, individuals receiving texture-modified diets for an extended period of time may have atrophied masticatory muscles and reduced bite force overall. Both chewing impairment and dysphagia compromises nutritional intake, which will affect the immunity of hospitalized patients with poor immunological defence being one of the risk factors for the development of AP (Tada & Miura, 2012).

2.5.6 The use of dentures

A denture is a prosthesis that replaces one or more natural teeth (Furata & Yamashita, 2013). Although the use of dentures can assist with chewing by maintaining proper mandible position and occlusion (Tamura, Mizukami, Ayano & Mukai, 2002, as cited in Furata & Yamashita, 2013) the use of maxillary dentures, which cover the taste buds on the upper palate, can blunt taste sensation as well as make it difficult to detect food in the mouth. For this reason, dentures are a major cause of choking in the elderly (Palmer, 2001). Plaque can also accumulate on dentures, promoting oropharyngeal colonization by respiratory pathogens (Sumi et al., 2003, as cited in Yoon & Steele, 2007). Poor denture care is considered one of the mitigating factors for denture stomatitis (irritation of the oral mucosal surfaces which come into contact with the dentures), which is reported to be a precipitating factor for the development of oral yeast infections (Yoon & Steele, 2007).

2.5.7 Oral cleanliness

Factors such as the deterioration of salivary function and swallowing problems, which result in food or saliva not being fully cleared from the oral cavity, can negatively affect oral cleanliness. Furthermore oral biofilms, such as dental and denture plaque and tongue coating are reservoirs for the increased colonization of opportunistic respiratory pathogens in the oral cavity of hospitalized and bedridden patients (Kikutani, et al., 2008; Dahlén, 2009; Pace & McCullough, 2010; Ortega et al., 2014). This is mainly due to the lack of mechanical tooth brushing needed to remove dental plaque and build-up, thus increasing the risk for bacterial colonisation and subsequent pneumonia in these patients (Tada & Hanada, 2010).

Oral biofilms provide a favourable environment for bacteria to flourish, and oral bacteria growing in dental plaque often show a resistance to antimicrobial agents, such as mouth rinses. A study done by Fourrier et al. (1998), as cited in Tada and Hanada (2010), identified dental plaque colonization with aerobic pathogens to be associated with the occurrence of nosocomial pneumonia among elderly patients admitted to a medical ICU, suggesting that dental plaque is a potential source for nosocomial infections.

2.5.8 Oral Secretions

The functions of saliva include cleansing the oral cavity, solubilisation of food substances, bolus formation, facilitation of mastication and swallowing, food and bacterial clearance, lubrication of mucosa, and facilitation of speech (Perdesen, Bardow, Jensen & Nauntofte, 2002, as cited in Furata & Yamashita, 2013). Considering the role of saliva in swallowing, swallowing disorders can arise in the event of salivary hypo-function. A reduction in the flow of saliva thus leads to impaired mastication and food swallowing, patient complaints about an excessively dry mouth, described as burning mouth syndrome, and a fissured or hairy tongue (Barnes, 2014). The consequences of the absence of saliva on oral health include the development of caries, periodontal disease and candidiasis (Gil-Montoya et al., 2015), which leads to an increased concentration of bacteria in the oral cavity (Luk & Chan, 2014).

Inflammation in the oral-pharyngeal regions, neurological disorders, such as Parkinson's disease, muscle weakness following a stroke and certain medications, can result in the salivary hyper-function experienced as the excessive production of saliva (Furuta & Yamashita, 2013). Hyper-salivation, in addition to swallowing difficulties, may result in the excessive pooling of saliva in the oral cavity, and the aspiration of saliva or the unintentional loss of saliva from the mouth (drooling). Drooling can impair masticatory function by making food more difficult to control in the mouth, and may thus cause a vicious cycle of swallowing problems (Meningaud, Pitak-Arnop, Chikhani & Bertrand, 2006, as cited in Furata & Yamashita, 2013).

AP is caused by dysfunctional swallowing and results in the aspiration of material colonized by respiratory pathogens (Ortega et al., 2015). The abovementioned factors have the potential to cause oral dysbiosis by creating high-risk environments for oral colonization by respiratory pathogens, which appear in the oral cavity before colonizing the lungs in patients with AP (Tada & Hanada, 2010). Bacterial species that have the potential to cause respiratory diseases in compromised hosts, known as opportunistic respiratory pathogens, e.g. *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, *Staphylococcus aureus*, *Streptococcus pneumoniae*, have not been isolated from the oropharyngeal region and oral cavity of healthy adults (Dahlén, 2009; Linderman et al., 1985, as cited in Tada & Hanada, 2010). Although there is ample evidence to indicate that oral bacterial colonization due to poor oral hygiene is one of the important aspects in the pathophysiology of AP, oral bacterial colonization is not being properly screened for or managed during hospitalization, and the provision of oral care remains a primarily frontline nursing task, although Speech-Language Therapists often play a supplementary role in oral hygiene (Yoon & Steele, 2012).

2.6 THE ROLE OF SPEECH THERAPY IN ORAL HEALTH

Conclusions drawn from research studies in oral health indicate that it is often an area of concern in dysphagia, particularly in those with neurological disease and the elderly (Kobayashi et al., 2016). Individuals referred to Speech Therapy for swallowing rehabilitation often arrive with oral and dental conditions or risk factors, which go unnoticed by doctors and ward staff (Kobayashi et al., 2016). The importance of

maintaining adequate oral health has thus long been recognized by Speech-Language Therapists (Simpelaere, Van Nuffelen, Vanderwegen, Wouters & De Bodt, 2016; Carlaw et al., 2012; Luk & Chan, 2014) whose primary motivation regarding good oral health stems from an awareness that the presence of pathogenic bacteria in the oro-pharyngeal secretions is linked to the risk for AP, especially in patients who present with dysphagia (Yoon & Steele, 2012; Fernandez & Clave, 2013; Simpelaere et al., 2016). Speech-Language Therapists view oral health as both the absence of oral discomfort, and the absence or control of risk factors for developing AP; their role in oral care being to identify patients who present with dysphagia and who have a risk of aspirating (Yoon & Steele, 2012).

Speech-Language Therapists have developed diagnostic tools and interventions, such as the use of postural manoeuvres, diet modifications and the use of feeding tubes that have assisted in decreasing the incidence of AP. However, despite having knowledge about the importance of oral health in preventing AP, clinicians often overlook the potential risk that poor oral structural integrity and health pose to the patient with dysphagia. They forget that these pneumonia risk factors outweigh the potential harm of aspiration and may use interventions that could pose greater risks to the patient than the swallowing disorder itself. One such intervention is the use of feeding tubes, such as nasogastric (NG) and gastrostomy tubes, which have not been proven effective in preventing AP, but have also been shown to increase the incidence and risk of AP (Luk & Chan, 2014). Furthermore although oral care is generally poor in dysphagic patients, and Speech-Language Therapists are in a position to detect oral ailments during routine assessments, they have no standardised method for screening the oral health of patients with dysphagia (Simpelaere et al., 2016). Speech-Language Therapists thus have to familiarize themselves within the developing field of oral health and hygiene, especially if they are to improve the complexity of their clinical decision-making, as well as be involved in the development of policies and procedures to solve this health care issue. Speech-Language Therapists can play an important supplementary role in oral care, which includes advocacy, educational activities, providing oral care when necessary (Yoon & Steele, 2012), and encouraging a transformative change toward inter professional collaboration through the use of ongoing research to provide solutions for oral care for patients at high risk for all types of aspiration pneumonias (Barnes, 2014).

Poisson, Lafford, Campos, Dupuis and Bourdel-Marchasson (2016) investigated the relationship between oral health, dysphagia and under nutrition in the hospitalized elderly. Their study found that poor oral health was strongly associated with dysphagia and subsequent malnutrition; emphasizing the importance to develop and implement oral care strategies and dental examinations into gerontological assessments. Countries such as Japan, Canada and Australia have implemented oral care programs with great success (Ajwani et al., 2016; Shibata, Stegariou, Nakazawa & Ohuchi, 2017). Although the oral care practices in hospital settings, as well as the success of implementing oral care programs have been the topics of research in the South African setting (Seedat & Penn, 2016; Perrie, Scribante & Windsor, 2011) to the researcher's knowledge, no such programs have been successfully sustained within the South African context, further highlighting the gap in current management practices. Research has indicated that for one to overcome such gaps is through inter-professional collaboration.

2.7 INTER-PROFESSIONAL COLLABORATION

Research done by Carrilho Neto et al. (2011) has shown that the oral health of hospitalized patients is generally deficient, with an elevated prevalence of caries, periodontal disease and tooth loss, which will result in mastication difficulties and disease destabilization (Gil-Montoya et al., 2015). While the provision of oral health care has been proven effective in reducing the incidence of AP (Tada & Miura, 2012; Furuta & Yamashita, 2013), dentists and oral hygienists have the knowledge base and clinical experience in dental care provision, but they are often not part of the multidisciplinary team. In South Africa, oral health services are provided by dentists, dental therapists and oral hygienists, with more than 80% of the oral health workforce working in the private sector (van Wyk & van Wyk, 2004), with professional dental care delivery or preventative dental procedures often not being available as in-patient hospital services.

Furthermore, as previously discussed, oral care practices during hospital stays are either neglected, not sufficient or ineffective, opening the door to possible infection, thus necessitating a longer hospital stay. Terpenning and Shay (2002) summarized it simply "oral hygiene is cost-effective to maintain, but costly to ignore" (p. 584). Future action is thus needed either by broadening the Speech Therapy scope of practice or including

dentistry professionals in hospital facilities as an integral part of the multi-disciplinary team to address the problem (Pace & McCullough, 2010).

2.8 CONCLUSION

The prevention of pneumonia has become a public health priority, with researchers such as Yoon & Steele (2007), Pace & McCullough (2010), Fernández and Clavé (2013), Sørensen (2013), Konradsen et al. (2014) and Simpelaere et al. (2016) stating that strategies to prevent AP are not entirely effective, given that it continues to occur frequently. Although many studies have highlighted the relationship between poor oral health, dysphagia and the development of systemic disease, there remains a discontinuity between what is known and the implementation of effective screening and management protocols. While Speech-Language Therapists aim to reduce the occurrence of aspiration due to dysphagia, it is hard to negate the role of oral hygiene in the safe and effective management of a patient with dysphagia, and research within this area calls for improved screening of oral health conditions among hospitalized patients.

It is thus evident that further studies, especially within Speech Therapy, are needed to investigate all relevant risk factors and to look beyond any single risk factor, such as dysphagia, in order to prevent AP. It is thus imperative that true risk factors are identified to enable interventions to be planned and implemented. Unless Speech-Language Therapists and other professionals who manage oral health and AP increase their knowledge and strengthen their understanding of the risk posed by poor oral hygiene to individuals with dysphagia, opportunistic respiratory bacteria originating in the mouth have the potential to become the silent killer of our vulnerable hospitalized patients who present with dysphagia.

2.9 SUMMARY

This chapter provided a review of the literature pertaining to the problem statement within the context of the study, i.e. oral hygiene within the dysphagic population. The oral health conditions associated with swallowing are discussed in detail, as found in literature. Although it is known that hospitalization results in poor oral hygiene and subsequent

development of systemic disease, minimal information is available to describe the oral health status of hospitalized patients especially within the South African hospital setting. The next chapter discusses the methods employed to carry out the current study.

CHAPTER 3. METHODOLOGY

3.1 INTRODUCTION

This chapter presents the research methodology, which consists of a description of the study design, research site, research participants, sample selection, pilot study, and the instruments and methods used for data collection. Other issues such as the need to employ the services of an Oral Hygienist to assist with data collection, as well as difficulties experienced in ensuring patient autonomy during the informed consent process are described. The study consists of three objectives (Table 3.1, lists the three objectives of the study each of which has its own method the structure of this chapter detailing those processes.

Table 3.1 The study objectives and associated methods

Phase of study	Objectives		Methods
Data collection	1	To assess the swallow function of each participant, during a clinical swallow evaluation (CSE), consisting of a battery of procedures, to allow for characterization of dysphagic features present.	CSE a. Mann Assessment of Swallowing Ability. b. Pulse Oximetry. c. Cervical auscultation.
	2	To describe the oral hygiene status of each participant using an adapted version of the Oral Health Assessment Tool (OHAT).	OHAT d. Assessment of oral hygiene.
	3	To determine the degree to which the oral cavity of individuals who present with dysphagia is colonized by pathogens not associated with normal oral flora.	e. Swab tests
Data analysis	Analysis of collected data, to answer the research question.		Descriptive and statistical analysis

3.2 STUDY DESIGN

A descriptive, cross-sectional survey study design, which took place over a period of eight weeks from April to May 2016 was followed. Participants were selected using non-probability sampling, as they needed to meet specific criteria to be included in the study. The various tests resulted in the collection of quantitative data, on which descriptive and statistical analysis was performed. The study is therefore presented in two phases, the first being data collection, and the second the summative analysis to achieve the study aim to establish if hospitalized patients who present with dysphagia are at increased risk of poor oral hygiene. Phase 1 consisted of the following tools:

- Objective 1: Assess the swallow function using the clinical swallow evaluation (CSE), to profile the swallowing ability and possible dysphagic characteristics of each participant, which consisted of a) the Mann Assessment of Swallowing Ability test, augmented by the use of b) Pulse Oximetry (PO) and c) Cervical auscultation (CA).
- Objective 2: Screening their oral health using the d) Oral Health Assessment Tool to document the oral hygiene problems.
- Objective 3: Collection of oral mucosa samples for microbial diagnostic testing using e) swabs to detect the presence of organisms not considered part of the normal oral flora.

Phase 2 of the study refers to the descriptive and statistical analysis of data to enable conclusions regarding the risk for oral hygiene problems among patients with dysphagia to be drawn from the data, and to answer the research question; “what is the oral hygiene status of hospitalized patients that are associated with the clinical features of dysphagia?”

3.3 RESEARCH SITE

Data was collected at a sub-acute rehabilitation hospital based in the private sector, in Port Elizabeth, the largest city in the Eastern Cape Province. The hospital has 60 beds and specializes in the neurological rehabilitation of adults following a cerebral vascular accident, traumatic brain injury, and neurodegenerative diseases such as Parkinson’s and

Alzheimer's. Patients have access to 24-hour medical care and services, such as a medical doctor and nursing staff as well as multidisciplinary team management, which includes daily Physiotherapy, Occupational therapy, Speech therapy, Psychology and Dietetics.

The hospital where data was collected, has adopted the six rehabilitation outcomes levels as described by Landrum, Schmidt and Maclean (1995), as cited in Hassan, Visagie and Mji (2012), by classifying the hospital wards into six patient families, based on the distinctive pattern of care required from nurses, doctors, carers and therapists. Participants for this study were selected from the two high care wards of the hospital, namely the Physiological Instability ward (PI) and the Physiological Maintenance with Cognitive Impairment ward (PM-C). A description of each ward is provided below.

- Physiological Instability (P.I.): Individuals admitted to this ward have completed their medical and surgical management in an acute hospital, but are not yet physiologically stable. They require high levels of care with the aim to achieve physiological stability.
- Physiological Maintenance with cognitive impairment (P.M-C): These individuals are medically stable with severe cognitive impairment that necessitates long-term dependence on others for care.

The researcher is a Speech-Language Therapist who works at the specific rehabilitation hospital, and thus took the decision to conduct the research at this site. As an employee of the hospital, she was familiar with the setting and hospital operations, and therefore had the benefit of convenience and offered ease of access to participants for data collection. Furthermore, the researcher had first-hand experience with the poor priority given to oral health, especially among patients with dysphagia, as well as the lack of policies regarding the provision of oral health care at this hospital.

3.4 TARGET POPULATION

The target population for this study included all hospitalized patients admitted to the two identified high care wards of the hospital who presented with dysphagia. These included patients with various neurological diseases, such as Parkinson's disease, Alzheimer's

disease, cerebral vascular accident (CVA) and traumatic brain injury (TBI), as well as the elderly.

3.4.1 Sample size

A priori statistical power analysis was performed for sample size estimation using varied effect sizes to compare oral health in individuals with dysphagia who develop AP to those who do not develop AP. The effect size (ES) in this study was assumed to be 0.8, which is considered to be adequate using Cohen's (1988) criteria. With an alpha = 0.05 and power = 0.80, the projected sample size needed with this effect size (according to GPower 3.0.10) was N = 42 for Two-sample (independent group) t-test (one-tailed); N = 34 for Mann-Whitney U-test (ANOVA); N = 21 for Chi-square test; and N = 46 for Spearman's rank correlation coefficient (Spearman's rho). Thus, the expected sample size of 52 ($N_{\max} + 6$) was considered to be adequate for the main objective of this study, assuming that all 52 individuals provided data (100% response rate). Due to time constraints and difficulties in obtaining informed consent, the researcher could only recruit forty participants who met the study criteria and provided informed consent during the eight-week data collection period.

3.4.2 Selection of study population

Non-probability convenience sampling was used to identify participants for Objective 1 of the study. This type of sampling method was used as a relatively large sample size was needed within a relatively short period of time and due to the convenient accessibility and proximity of subjects to the researcher (Creswell et al., 2016). All individuals who most closely met the selected characteristics and attributes of the study population, as stipulated in the inclusion criteria, were approached to become part of the study and participated in Objective 1.

Purposive sampling is used in situations where a specific predetermined group is sampled (Creswell et al., 2016). Only participants with confirmed dysphagia underwent the oral health assessment, thus participants for Objectives 2 and 3 of the study were identified using purposive sampling. However, all forty participants who underwent the CSE

(Objective 1) presented with dysphagia and consequently underwent the oral health assessment (Objectives 2 and 3).

The following inclusion criteria applied:

All patients male or female over the age of 18 who were admitted to either of the two high care wards and placed on a dysphagia diet on the day of admission indicating the presence of swallowing difficulties, or who had self-reported complaints or concerns regarding their swallow ability, were approached to become potential study participants.

On the first day of admission, the diet level a patient commenced with was screened for and determined either by nursing staff or the Speech-Language Therapists employed by the hospital. At this hospital, diet levels 0, 1, 2, 3T and 3, indicate the presence of swallowing difficulties, as the patient cannot manage with a normal (level 4 or 5) diet. A complete description of the diet classification system used at the rehabilitation hospital is attached as Appendix A. Based on the specific diet level on which each new admission was placed the patients were either excluded from the study or identified as potential participants. All patients who were nil per mouth (NPO), or placed on either a dysphagia diet (level 1, 2) or a transitioning dysphagia diet (level 3T, 3), were identified as potential research participants, awaiting informed consent.

The following exclusion criteria applied: if patients did not meet the above criteria, e.g. they were minors, were on a normal ward diet or if they, their family members or caregivers did not provide consent.

3.5 DATA COLLECTION

The study consisted of three objectives and was divided into two phases: Phase 1 entailed collecting data according to a set of procedures to meet the first three objectives, with the combined analysis taking place in Phase 2 (Table 3.1). A brief introduction of the procedures followed during data collection, as well as a description of the sampling process for each is provided, followed by a description of the data collection instruments and methods.

The instruments for each of the actions followed during the process of data collection are described in the following section.

3.5.1 Objective 1: Clinical Swallow Evaluation

3.5.1.1 Mann Assessment of Swallowing Ability

The data extraction sheet, labelled as the Mann Assessment of Swallowing Ability (MASA) developed by Mann (2002) (see Appendix B), is a validated bedside examination for the evaluation of dysphagia (González-Fernández, Sein & Palmer, 2011). The MASA was used to provide diagnostic information on the components of the swallow, which was augmented with the use of pulse oximetry (PO) and cervical auscultation (CA) to profile the nature of dysphagia of each participant.

3.5.1.2 Pulse Oximetry

Pulse oximetry is a non-invasive method for taking real time readouts as it monitors a patient's oxygen saturation (SpO_2) during a bedside evaluation of swallow function (Sherman, Nisenbom, Jesberger, Morrow & Jeseberger, 1999). Literature has shown a relationship between arterial oxygen saturation (SpO_2) as measured by pulse oximetry and aspiration during eating. For this study, pulse oximetry was used to confirm the association between swallowing abnormalities and oxygen desaturation. Pulse oximetry monitoring was used to predict and/or detect aspiration during the CSE. An Edan Pulse Oximeter, H100B model was used to monitor participant SpO_2 . The pulse oximetry protocol used during the study is attached as appendix C.

3.5.1.3 Cervical auscultation

Cervical auscultation (CA) is an assessment of the sounds of swallowing and swallowing-related respiration (Cichero & Murdoch, 2006). It is used as an adjunct-screening tool during the CSE and employs an additional medium, namely that of sound, to further enhance the understanding of the patient's swallow presentation. The WelchAllyn Professional Paediatric Stethoscope was used during cervical auscultation to listen to the

swallowing sounds during the CSE. The protocol for CA followed during the study is attached in Appendix D.

3.5.2 Objective 2: Oral health assessment.

An Oral Hygienist used the data extraction sheet labelled as the Oral Health Assessment Tool (OHAT) to screen the oral hygiene of each participant (Appendix E). The OHAT used for this study was modified from the version originally developed by Chalmers, King, Spencer, Wright and Carter (2005) (Appendix F). The study format of the tool was formulated using the input of a qualified Oral Hygienist, Dr. Shenuka Singh, as well as modifications following the pilot study, to refine the criteria assessed thus providing more meaningful data related to the current study as well as to the South African setting.

3.5.3 Objective 3: Oral swabs

Microbiota composition was evaluated using swab samples collected from the oral cavities of participants after completion of the OHAT.

3.5.4 Pilot study

3.5.4.1 Aim

The researcher piloted all the data collection instruments at the same research hospital site over a period of four weeks, specifically during March 2016. The pilot study followed an observational study design and employed a cohort, repeated measures design. The purpose of the pilot study was to meet the following objectives: (i) evaluate the reliability and validity of the data collection instruments, and to (ii) improve upon the study design and instruments.

A biostatistician was consulted to assist in determining the sample size for the pilot study with a sample size of 20% of the sample projected for the larger study being recommended to ensure that the pilot results truly reflected the population being studied. A total of 10

patients who met the inclusion criteria were systematically selected using purposive sampling and were invited to participate in the pilot study. Once consent was obtained participants were assigned to one of two groups: (i) new admissions, and (ii) existing admissions (patients who had already been in the hospital for longer than seven days) to further stratify the sample. The division of participants into different subgroups was only applied to the pilot sample as a means to observe the differences between these especially with the study focus being on new admissions.

All 10 of the pilot participants underwent a battery of assessments, which consisted of:

- a. Mann Assessment of Swallowing Ability;
- b. Pulse oximetry;
- c. Cervical auscultation;
- d. Assessment of oral hygiene using the Oral health assessment tool;
- e. Oral swabs;
- f. Salivary flow questionnaire (developed by the researcher for the purpose of this study).

The construct validity of the salivary flow questionnaire (SFQ), which was initially developed by the researcher, for the purpose of data collection on salivary flow rate, was investigated during the pilot study. The SFQ would report on the over or diminished production of saliva, as perceived by the participant. To ensure reliability of study findings, test-retest reliability was employed, and the OHAT and SFQ were re-administered to the entire pilot study sample, while swabbing of the oral cavity was only done on the five newly admitted patients following the initial assessment. The literature suggests that time intervals should not be too long or too short to prevent reactivity. A time interval of two weeks to one year is usually used, although any time interval may be used if it can be justified (Botma, Greef, Mulaudzi & Wright, 2010). A time interval of seven days was used for the purpose of this study to prevent external factors such as medication, hospital care and therapy from influencing the variables under study.

There appeared to be no pattern with regard to the number of oral hygiene issues participants presented with or the detection of pathogenic respiratory pathogens in the oral

cavity. Newly admitted patients had less oral hygiene issues compared to the previously admitted participants who had been in hospital longer. Furthermore, due to the specific participant population, where the majority of participants could not provide informed consent, due to cognitive and language impairments, it was thus necessary to obtain consent from patients' next of kin. As a result, it was extremely difficult to obtain consent on the day of admission, which affected the researcher's ability to test on the same or even the second day of admission. The researcher therefore decided to lengthen the time allowed for assessing a newly admitted patient to no longer than a week (7 days) after their first day of admission.

3.5.4.2 Modification of the Oral Health Assessment Tool (OHAT)

The pilot study to assess the participants' oral hygiene identified that the original version of the OHAT (Chalmers et al., 2005) focused on providing a specific score for each patient based on the health of the oral cavity. However, to meet the objectives of the current study more emphasis had to be placed on identifying and describing oral hygiene problems, rather than simply screening and scoring. The OHAT used for the purpose of this study was thus modified in the following ways, using the inputs from a qualified dentist. Firstly, the adapted OHAT maintained the eight categories of the original tool namely: lips, tongue, gums and tissues, natural dentition, dentures, saliva, oral cleanliness and dental pain, with additional elements being added under each category to give a richer description of each area assessed. This resulted in a change to the original scoring system from the three possible scores of the tool (0: healthy, 1: changing or 2: unhealthy) to 0-5 possible scores under each sub-category on the adapted version, where each score represented additional oral health abnormalities observed, as well as their severity. In this way, the information could be used to assist with identifying specific oral hygiene problems participants with dysphagia present with in order to effectively meet the objectives of the study.

3.5.4.3 Changes to the salivary flow questionnaire (SFQ)

The SFQ could only be conducted with patients who presented with intact receptive and expressive language. Of the 10 pilot study participants, eight were unable to complete the

questions on the SFQ due to cognitive and/or language impairments. Furthermore, large variations were found between patient perceptions of their saliva and the observations made by the Oral Hygienist, possibly as the perception of conditions, such as dry mouth, are very subjective. Furthermore, the salivary flow questionnaire did not provide any additional information to the assessment of saliva during the oral hygiene assessment or during the CSE. The SFQ was thus found to lack validity as it was not appropriate for the target population and lacked precision in measuring the variable it was developed to investigate. In an attempt to minimize potential measurement errors, the SFQ was therefore not used as a standalone data collection tool and elements such as clearly documenting saliva were incorporated into the MASA and the modified OHAT.

3.6 DATA COLLECTION PROCESS

Data collected for Phase 1 consisted of obtaining the data for the first three objectives once consent was obtained from the identified participants.

3.6.1 Objective 1: Clinical swallow evaluation

All new admissions admitted to either of the high care wards of the hospital, who were allocated a dysphagia diet by nursing staff or Speech-Language Therapists employed at the hospital were approached by the researcher to become part of the study. Forty patients were found to meet inclusion criteria and provided informed consent to become study participants.

These forty participants underwent a clinical swallow evaluation (CSE), to assess their swallow function using (a) The Mann Assessment of Swallow Ability (MASA), (b) Cervical auscultation (CA) and (c) pulse oximetry (PO), as a means to confirm the presence of dysphagia and document the clinical characteristic of their swallow function, in terms of efficacy and safety.

3.6.1.1 MASA

Each participant underwent an assessment of swallow function, using the MASA, to confirm the presence of and identify the distinctive clinical dysphagic features by describing the nature of the dysphagia in terms of the severity of dysphagia, aspiration risk and the oral and pharyngeal phase symptoms. The MASA protocol designed for and followed during the study is attached as Appendix G.

3.6.1.2 Pulse Oximetry

Continuous SpO² readings were obtained using an Edan Pulse Oximeter, H100B model by placing the pulse oximeter probe on the index or middle finger of the participant. Participant SpO² was monitored for a minimum of one minute, to determine the baseline SpO² prior to providing the first bolus to be swallowed. Following the baseline measurement, liquid and paste were sequentially presented, while continued monitoring of SpO² occurred, followed by documenting of readings on the PO assessment form (See Appendix H). A difference of $\geq 3\%$ from baseline SpO² was considered positive for the presence of aspiration.

3.6.1.3 Cervical Auscultation

Observations on swallow-respiratory timing and sounds were made before, during and after the swallow by placing the stethoscope over the area of the lateral border of the trachea, immediately inferior to the cricoid cartilage. Any abnormal swallow sounds, such as gasping, wet respirations, coughing, clearing and stridor, heard before during or after the swallow of the presented food consistency were clearly documented on the CA assessment form (see Appendix I). These findings assisted with providing information regarding the safety of the swallow, as well as pharyngeal phase symptoms.

3.6.2 Objective 2: Oral health assessment

Only those participants who were confirmed to present with dysphagia following the CSE underwent a screening assessment of their oral health. All forty participants who were initially identified were confirmed to present with dysphagia during the CSE and thus underwent the oral health assessment, which consisted of a screening of their oral health using the modified OHAT and the collection of an oral swab sample.

3.6.2.1 OHAT

The oral health and hygiene of participants who presented with dysphagia was screened by a qualified Oral Hygienist using the modified OHAT, a mouth mirror and dental probe, to evaluate and score problems identified under each of the following specific areas, lips, tongue, gums and tissues, natural teeth, dentures, oral cleanliness, saliva and dental pain. The information was used to describe the oral hygiene problems in participants who presented with dysphagia.

3.6.3 Objective 3: Oral health assessment continued

3.6.3.1 Oral swabbing for microbial analysis.

The Oral Hygienist used a sterile, cotton tipped swab to take a sample of the oral microbiota from the participants' oral cavity. This was a once off sample taken from either one of the following three locations, inside the oral cavity, the tongue, the buccal mucosa or the oro-pharynx. These specimens were sent for microbiology analysis at Ampath Laboratories, which provides diagnostic pathology services to medical practitioners and various institutions belonging to the National Pathology Group in South Africa. This was done to allow for the analysis and isolation of any pathogens that do not form part of the normal oral flora, most specifically to detect for the presence of gram-negative bacteria associated with AP (Dahlén, 2009).

3.7 DATA ANALYSIS AND METHODS

The data was analysed by a statistician, with the following statistical methods being used:

3.7.1 Descriptive analysis

According to Howell (2004) whenever the purpose of a study is to describe a set of data, descriptive statistics should be employed. The clinical data from the MASA, OHAT and pathology swab results were extracted and organised into Microsoft-Excel spread sheets, which employed the data analysis operations of Excel to interpret data, by coding the various data sets, by assigning numeric values to categorical variables as a means to group observations in each category. In order to report on the data analysed, the mean, mode, median, range of scores and frequency distributions minimum and maximum standard deviation were measured. This was done for each objective. The outcome of the descriptive analysis was used to establish trends and patterns to facilitate comprehension of the data.

3.7.2 Statistical analysis

Descriptive statistics derived from objective one, were analysed using SPSSTM version 24, employing a test of independence, namely the Fischer's Exact Test, to determine whether or not the relationships between the variables were statistically significant. This entailed cross-tabulations between the categorical data, PO and CA as the independent variables, with the MASA scores. A p-value of ≥ 0.005 was considered to be statistically significant.

3.8 ETHICAL CONSIDERATIONS

Ethical approval for the study was obtained on the 9th of March, 2017 from the Biomedical Research Ethics Committee (BREC) of the University of Kwa-Zulu Natal, South Africa (Ethics reference number: BE454/15). Gatekeeper permission was obtained from the hospital management at the research site prior to commencing data collection, attached as Appendix I.

The researcher was guided by the following ethical principles to act responsibly and report findings honestly and accurately: informed consent and ensuring patient autonomy, anonymity and confidentiality, minimization of harm, and justice.

3.8.1 Informed consent and ensuring patient autonomy

The process of informed consent was specifically designed for the purpose of this study, to respect participants' rights to self-determination and ensure autonomy, which was a unique practice not typically undertaken during research studies.

For patients who presented with intact cognitive-linguistic function, the researcher provided both written and verbal information regarding the purpose of the study and the time frame regarding involvement with ample time being given to make an informed decision (Hennink, Hutter & Bailey, 2011).

The researcher, who is also a Speech-Language Therapist, identified potential participants who were not competent in terms of their cognitive-linguistic function, and were thus unable to understand their role as a research participant. In these cases, or when a response was inconsistent, a proxy was identified to provide consent.

In cases where the potential participant was able to understand the conditions of participation, but presented with alexia (deficits in reading ability), agraphia (deficit in writing ability) or apraxia (inability to control the speech musculature to form words), and was thus unable to write or provide a verbal response or consistent gesture, the researcher offered the use of Alternative and Augmentative Communication charts (AAC) as a means to indicate yes or no, to ensure patient autonomy (Appendix J). Furthermore, a thumbprint was taken in the presence of a witness in cases where the participant was unable to write or provide a signature. The informed consent process designed for the purpose of this study, and the information sheet and consent forms are provided in Appendices K and L.

3.8.2 Anonymity and confidentiality

During the research study anonymity of participants was ensured by removing as much identifiable information from the data collection forms, and not reporting the name of the research site, participants and/or their caregivers in the write up of the study. Confidentiality was maintained by ensuring that data records were kept confidential, not disclosing information discussed between the researcher and the participant and restricting who had access to patient information.

3.8.3 Minimization of harm

The researcher aimed to minimize harm at every stage of the research process, by ensuring a clear data collection cycle and using a trained Oral Hygienist for oral health screening and ensuring adequate follow-up when abnormal results were found and communicating follow-up strategies effectively with participants and/or their caregivers.

3.8.4 Justice

The research project was conducted in an ethically correct manner, with the data analysis and findings of the study recorded in a truthful manner, and by not deliberately selecting data to sensationalize findings that do not reflect the real situation (Hennink et al., 2011). The greatest care was taken to avoid plagiarism throughout the research study through appropriate referencing of all sources used throughout the research study.

3.9 VALIDITY AND RELIABILITY MEASURES

The MASA was chosen as the study instrument to assess swallow function for objective one, as there are existing literature sources demonstrating the reliability of the instrument in detecting aspiration in mixed-disease populations. Furthermore pulse oximetry and cervical auscultation were used in conjunction with MASA, as a means to improve the sensitivity and specificity of the results. Testing the relationship between PO and CA with MASA findings respectively using Fischer's exact test was done to achieve this.

An existing screener for oral health, namely the Oral Health Assessment Tool was modified for the purpose of this study. It was thus necessary to test the reliability and validity of the tool and this was done through pilot testing to test the reliability and validity of the study instrument, and the following factors were taken into consideration, internal consistency of the study instrument through the use of test-retest reliability and construct validity (Botma et al., 2010) applied during pilot testing.

A qualified Oral Hygienist conducted the oral health assessments to obtain the most accurate and reliable findings regarding an individual's oral hygiene. Triangulation was used to ensure intra-examiner consistency, as well as validity of the results, by comparing data on saliva from the MASA to salivary flow data on OHAT. Triangulation is the use of multiple measures to investigate a single concept or phenomenon, to gain a multidimensional understanding of the phenomenon of interest.

3.10 SUMMARY

This chapter presented the methodology, which was followed during this study. A descriptive, cross-sectional survey design was followed to collect data, which were analysed through the use of descriptive and statistical analysis to meet the three objectives of the study. The findings will be presented in the following chapter.

CHAPTER 4. RESULTS

This dissertation aimed to describe the oral hygiene status of hospitalized individuals who present with dysphagia, upon admission to a sub-acute hospital. It required a manuscript by publication, thus this chapter presents the primary research findings of the study within a manuscript titled “The oral hygiene status of people with dysphagia; a descriptive study,” and provided the information in a sequence which followed a manuscript layout which differs from the format of the rest of the dissertation.

The chapter will start with an introductory overview of the study, which provides a brief discussion of the aim, methods, results and conclusions, as contained in the abstract. An introductory overview of the information contained in chapter 1 and 2, namely the background and problem, as well as the clinical relevance of the study, based on current literature is presented. This is followed by a discussion on the methodology and methods followed during the study, which documents the two phases of data collection, describing the battery of assessments each of the 40 study participants underwent, which included a clinical swallow evaluation, screening of their oral health and the collection of swab samples from the oral cavity.

The research findings, which is the bulk of this chapter is presented according to the three objectives of the study, followed by a discussion of the results. This chapter is followed by a discussion of supporting research findings, as well as a synthesis and critique of the study, contained in chapter 5.

The manuscript was written with the intention for publication in The International Journal of Dental Hygiene, the manuscript written according to the author specifications, as outlined by the journal is attached as appendix M.

4.1 ABSTRACT

The aim of the study was to assess and describe the oral hygiene problems of adults admitted to a sub-acute rehabilitation hospital who presented with dysphagia. A descriptive

cross-sectional survey study design was followed. The 40 participants, 57.5% (n=23) male and 42.5% (n=17) female, underwent various assessments during the two phases of data collection. Phase I consisted of three steps: (1) assess the swallow function during a clinical swallow evaluation, (2) assess oral hygiene using an adapted version of the Oral Health Assessment Tool to identify any oral hygiene problems, and (3) sample the oral microbiota to detect bacteria not considered part of the normal oral flora. A high likelihood for aspiration (42.5%), was a common feature for most participants who presented with dysphagia. The main swallowing problems were related to lingual strength, the ability to manage saliva, bolus clearance and effectiveness of the cough. A high prevalence (62.5%) of deficient oral hygiene and oral colonisation was found. The most commonly occurring bacteria groups and species were: (1) *Candida albicans* and (2) respiratory pathogens, e.g. *Klebsiella pneumoniae* and *Staphylococcus aureus* growth.

Conclusions: The oral hygiene status of people who presented with dysphagia shows that it increases the likelihood for poor oral hygiene, which creates favourable environments for bacteria to flourish. It also increases the prevalence of pathogenic oral bacteria, which is associated with the development of aspiration pneumonia (AP). The management of oral health issues for persons with dysphagia should receive greater attention during hospitalisation.

Key words: Dysphagia, oral hygiene, swallowing function, aspiration pneumonia, oral bacterial colonisation

4.2 INTRODUCTION

The oral cavity of hospitalized and bedridden patients is often a reservoir for opportunistic respiratory pathogens (Tada & Miura, 2012; Boaden et al., 2017) and can thus serve as a source of infection for the lungs when aspirated. Many published articles have identified a significant correlation between the presence of pathogenic bacteria in the oral cavity and the occurrence of respiratory diseases, such as pneumonia, especially in people who present with dysphagia (Yoon & Steele, 2012; Simpelaere et al., 2016; Sørensen et al., 2013; Konradsen et al., 2012; Fernández & Clavé, 2013). Swallowing is a complex neuromuscular activity that consists of oral, pharyngeal and oesophageal phases, and

involves the coordinated function of many muscles (Hiramatsu et al., 2015). Physiological deficits in any of the swallowing phases result in dysphagia (González-Fernández & Daniels, 2008) and may affect swallow efficacy (deficits with mechanical clearance) and/or safety (subsequent aspirations). Impaired safety of the swallow not only increases the risk for aspiration and the uncontrolled introduction of pathogenic pathogens into the lower respiratory tract (Fernández & Clavé, 2013) but has also been associated with the presence of gram-negative bacteria; dysphagia is thus an important risk factor for the development of AP.

The incidence of pneumonia caused by aspiration of pathogenic bacteria in dysphagic patients increases both the mortality and the need for acute care hospitalization (Sørensen et al., 2013), which in turn can impact on oral hygiene (Tada & Hanada, 2010; Carrilho Neto, et al., 2011; Danckert et al., 2016). This is partly due to the fact that oral infections often remain asymptomatic and may still result in bacteraemia despite an absence of overt symptoms (Rautemaa et al., 2007). Oral care practices are often an overlooked component in the care of hospitalized patients (Chipps et al., 2014) as poor oral hygiene is not a highly visible condition, and related concerns require closer inspection to be given to the mouth (Yoon & Steele, 2012). Furthermore potentially pathogenic bacteria are frequently carried in the oral cavity and hospitalization appears to create conditions that favour oropharyngeal colonization (Sedgley & Samaranayake, 2008, as cited in Boaden et al., 2017). The problem, however, is that there are numerous diseases that often require hospitalization, of which dysphagia is a common underlying symptom. The methods used to treat these medical conditions and the dysphagia often promotes colonization of the oropharynx with bacterial pathogens (Kishimoto et al, 2016).

4.3 CLINICAL RELEVANCE

There is ample evidence to highlight that oral bacterial colonization due to poor oral hygiene is one of the important contributors in the pathophysiology of AP (Terpenning & Shay, 2002) and that AP can be prevented with adequate identification and care of oral health and hygiene conditions. Despite this the composition of the oral flora of dysphagic patients is not well described in literature and oral bacterial colonization is not being properly screened for or managed during hospitalization.

While the aim should be to prevent AP, strategies are not entirely effective (Tada & Miura, 2012; Luk & Chan, 2014; Munro, 2014) as is indicated by its frequent ongoing occurrence. The challenge for health care professionals who form part of the management team for hospitalized patients who present with dysphagia, specifically nursing staff, Speech-Language Therapists, medical doctors and dental professionals is to further reduce the occurrence of AP by adequately managing the risk factors and reducing the aspiration of bacteria-laden secretions. Preventing AP and reducing the associated risk factors are ongoing challenges as the oral hygiene status of acutely hospitalized patients, especially in relation to the clinical features of dysphagia, is largely unknown making it the focus of this study. Unless we increase our knowledge and strengthen our understanding of the risk posed by poor oral hygiene to individuals with dysphagia, opportunistic respiratory bacteria originating in the mouth have the potential to become the silent killer of our vulnerable hospitalized patients who present with dysphagia.

4.4 METHODS AND MATERIALS

4.4.1 Design

The aim of the study was to describe the oral hygiene status of persons who present with dysphagia. A descriptive cross-sectional study was conducted over an eight-week period from March to April 2016, at a sub-acute neuro-rehabilitation hospital, based in the private hospital sector in Port Elizabeth, the largest city in the Eastern Cape Province of South Africa.

4.4.2 Procedures

The study procedures consisted of two phases: Phase 1 entailed collecting data during a three step process, and its analysis took place in Phase 2.

Phase 1 consisted of the following procedures:

- **Step 1:** Clinical swallow evaluation (CSE) to profile the swallowing ability and possible dysphagic characteristics of each participant, which consisted of a) the

Mann Assessment of Swallowing Ability test (MASA), augmented with the use of b) cervical auscultation (CA), and c) pulse oximetry (PO).

- **Step 2:** Screening of participants' oral health using the d) Oral Health Assessment Tool to document the oral hygiene problems.
- **Step 3:** Collection of oral mucosa samples for microbial diagnostic testing using e) swabs to detect the presence of organisms not considered part of the normal oral flora.

Phase 2 of the study refers to the descriptive and statistical analysis of data to identify rough trends of the oral condition of patients who present with dysphagia.

4.4.3 Sample selection

All male or female patients, over the age of 18, who were admitted to one of the two high care wards of the hospital and placed on a dysphagia diet on the day of admission, indicating the presence of swallowing difficulties, or who had self-reported complaints or concerns regarding their swallow ability, were approached to become potential study participants. Patients were excluded if they did not meet the above criteria, e.g. they were minors, they were on a normal ward diet or if they, their family members or caregivers did not provide consent.

Participants for step 1 were selected using non-probability convenience sampling, and all individuals who most closely met the selected characteristics and attributes of the study population, as documented in the inclusion criteria, were approached to become part of the study. Purposive sampling was used to recruit participants for step 2 and 3, as only those who were identified with swallowing difficulties and confirmed as having dysphagia, were included in step 2 and 3. A total of 40 participants, 23 males and 17 females, between the ages of 23 and 98 met the inclusion criteria. Participant diagnoses and reasons for admission to the rehabilitation hospital ranged from neurodegenerative conditions such as Parkinson's disease, cancer, traumatic brain injury, orthopedic injuries, T.B. meningitis and cerebral vascular accidents.

All 40 consented to become part of the study and underwent step 1 of the study, during which all 40 were confirmed to present with dysphagia and consequently underwent the oral health assessment.

4.5 METHODS

4.5.1 Phase 1

4.5.1.1 Step 1: Clinical swallow evaluation

During Step 1, the CSE, the swallow function of each of the 40 participants recruited, was assessed using (a) the MASA to confirm the presence of dysphagia by testing the 24 skills pertaining to the oro-motor and sensory components of swallowing. (b) CA was used to listen to the sounds of swallowing using a paediatric stethoscope to differentiate between normal and impaired swallow sounds (Cichero & Murdoch, 2006), and (c) PO was used to obtain real time readouts on a participant oxygen saturation (SpO_2) during swallowing (Sherman et al., 1999). For this study, pulse oximetry was used to confirm the association between swallowing abnormalities and oxygen desaturation, seen as the difference $\geq 3\%$ between baseline SpO_2 and SpO_2 after the swallow. CA and PO were included as adjuncts to the MASA to increase the sensitivity and specificity of the findings.

4.5.1.2 Step 2: Oral hygiene assessment

A qualified Oral Hygienist used an adapted version of the OHAT to visually assess and score a participant's oral hygiene according to the following eight categories: lips, tongue, gums and tissues, natural dentition, dentures, salivary flow, oral cleanliness and dental pain. An Oral Hygienist was used to ensure that the most accurate and reliable findings regarding each participant's oral hygiene were obtained. The OHAT was customized to meet the objectives of the current study, and while it maintained the eight categories of the original tool, more emphasis was placed on identifying and describing specific issues rather than simply scoring the responses. This allowed for additional structured observations that were added under each category to give a richer description of each area assessed and the scoring system was altered from three possible scores (0: healthy, 1: some

changes, 2: unhealthy) to a 0-5. The altered scoring represented additional oral health abnormalities observed according to severity under each sub-category, which enabled the responses to not only indicate severity but also provide a descriptive result of the problem.

4.5.1.3 Step 3: Microbial testing

The Oral Hygienist then collected samples from the oral cavities of the participants using cotton tipped swabs. This was a once off assessment and the collected specimens were sent for microbiology testing at Ampath Laboratories, which provides diagnostic pathology services to medical practitioners and various institutions belonging to the National Pathology Group in South Africa.

4.5.2 Phase 2

4.5.2.1 Statistical analysis

In Phase 2, the clinical data from the MASA, the OHAT and the pathology swab results were analysed statistically. Statistical analyses of data included descriptive analysis, namely frequency distributions, mean, mode and median and standard deviation values and testing the relationship between the PO, CA and MASA scores. The statistical analysis software SPSSTM Version 24, was used to test the relationship between the independent variables PO and CA, with the MASA score using a test of independence, namely the Fischer's Exact Test. The relationship for each comparison: PO to MASA, and CA to MASA was analysed with a P value of ≤ 0.005 being considered significant.

4.6 ETHICAL CONSIDERATIONS

The Biomedical Research Ethics Committee (BREC) of the University of Kwa-Zulu Natal, South Africa, approved this study, ethics reference number: BE454/15. The process of informed consent was specifically designed for the purpose of this study to respect participants' rights and ensure autonomy, such as using Augmentative Communication Charts (AAC) to indicate yes or no for those unable to speak, which was accepted as a form of consent. Furthermore, in cases where the participant was cognitively intact but

unable to write or provide a signature, a thumbprint in the presence of a witness was used and considered as written consent. Only participants who provided written consent were included in the study.

4.7 RESULTS

4.7.1 Clinical swallow evaluation

The clinical signs of dysphagia and risk for AP, such as signs of impaired efficacy and safety of the swallow, were found in the majority of participants. Table 4.1 presents the degree of dysphagia participants presented with, results being augmented by CA and PO measures. Of the 40 participants identified as having dysphagia during sample selection, the CSE confirmed the presence of dysphagia in 70.0% of the participants, with 17 (42.5%) presenting with severe, seven (17.5%) with moderate and four (10.0%) with mild dysphagia. Twelve (30.0%) presented with little evidence of dysphagia (LED).

Table 4.1 Results and degree of dysphagia

Components of the CSE		No.	%
MASA Presence of dysphagia (n=40)	Severe	17	42.5%
	Moderate	7	17.5%
	Mild	4	10.0%
	Total	28	70.0%
	Little evidence of dysphagia (LED)	12	30%
Cervical auscultation (n=40)	Normal swallow sound	21	52.5%
	Abnormal swallow sound	19	47.5%
Pulse oximetry (n=40)	Decrease of $\geq 3\%$ oxygen saturation	19	47.5%
	Maintained baseline oxygen saturation	21	52.5%

Figure 4.1 shows that from this sample of participants who had confirmed dysphagia, the majority (70.0%) presented with a degree of risk for aspiration, ranging from a definite to

possible risk. To test the relationship between PO and CA respectively as the independent variable and MASA scores, a cross tabulation between (a) MASA scores and PO and (b) MASA scores and CA was done, using Fischer’s Exact Test. A P-value of ≤ 0.005 was considered significant. This was done to confirm the findings on the MASA regarding the risk for aspiration. Performing a Fisher’s Exact Test, between PO and the MASA score a p-value of < 0.005 was obtained, similarly the p-value for CA to MASA scores was 0.000. A significant correlation was found between both the PO and CA and the MASA scores, indicating that the two supplemental procedures had a high rate of agreement with the MASA findings.

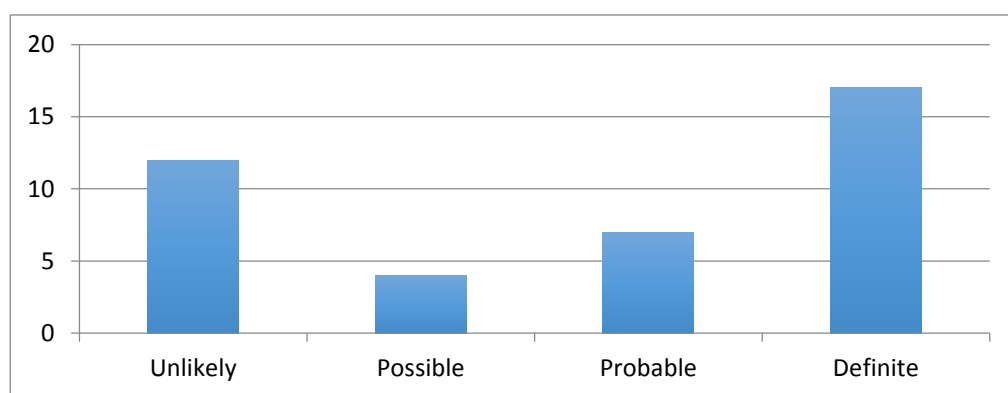


Figure 4.1 Frequency distribution for aspiration risk.

4.8 CLINICAL SIGNS OF DYSPHAGIA

Only ten (25.0%) of the participants demonstrated no deficits with regard to the efficacy of the swallow, which revealed that the larger majority 30 (75.0%) did. Table 4.2 provides a summary of the five deficit areas, relating to the efficacy of the swallow. These areas include the lip seal, tongue movement, strength and coordination and bolus clearance items of the MASA, each section being presented below.

Table 4.2 Predominant deficits affecting efficacy of the swallow

Oral phase deficits		No.	%
Poor lip seal	Unable to assess	4	10.0%
	No closure	4	10.0%
	Incomplete seal	8	20.0%
	Unilaterally weak/poor maintenance	9	22.5%
	Mild impairment	6	15.0%
	Total	31	77.5%
	No abnormalities detected (NAD)	9	22.5%
ii. Reduced tongue strength	Gross weakness	20	50.0%
	Unilateral weakness	7	17.5%
	Minimal weakness	13	32.5%
iii. Poor tongue coordination	No movement	10	25.0%
	Gross incoordination	4	10.0%
	Mild incoordination	11	27.5%
	Total	25	62.5%
	NAD	15	37.5%
iv. Impaired oral transit	No movement observed	5	12.5%
	Delay >10 sec	6	15.0%
	Delay >5 sec	15	37.5%
	Delay > 1 sec	10	25.0%
	Total	36	90.0%
	NAD	4	10.0%
v. Ineffective bolus clearance	No clearance	8	20.0%
	Some clearance/residue	13	32.5%
	Significant clearance/minimal residue	16	40.0%
	Total	37	92.5%
	Fully cleared	3	7.5%

Most of the study participants (77.5%) demonstrated difficulties with lip closure, which was not experienced by nine (22.5%) participants. The most significant difficulties observed with regard to the lips were weakness 22.5%, inability to achieve closure 10.0%, resulting in an open mouth posture or achieving only an incomplete seal 20.0%. The reduction of tongue strength was observed globally, as all the participants presented with some degree of tongue weakness. Twenty of the participants presented with gross weakness of the tongue (50.0%), seven (17.5%) with unilateral weakness and 13 (32.5%) with minimal weakness. This was closely followed by difficulties with tongue coordination observed in 25 (62.5%) participants.

Difficulties with oral transit or mechanical clearance of the bolus was experienced by the majority, 36 (90%) of the participants, with only four (10%) not having any problems; observed as a delay in the initiation of the swallow and ineffective clearance of the bolus, which resulted in residue remaining after the swallow observed in 37 (92.5%) of the participants.

Signs of impaired safety of the swallow (cough, voice change, impaired hyolaryngeal elevation, accompanied by oxygen desaturation and abnormal swallow sounds) were found, with 52.5% demonstrating some signs of penetration and/or aspiration while swallowing. Table 4.3 presents the predominant deficit areas relating to the pharyngeal phase. Signs of penetration were observed as gurgling during the swallow and coughing before, during or after swallowing which was detected in 12 (30.0%) and nine (22.5%) participants respectively. Twenty-six (65.0%) participants demonstrated difficulties with hyolaryngeal elevation.

Table 4.3 Predominant deficits affecting the safety of the swallow

Pharyngeal phase deficits		No.	%
i. Impaired reflexive and voluntary cough	No reflexive cough observed	8	20.0%
	Weak reflexive cough	15	37.5%
	No attempt at voluntary cough	12	30.0%
	Voluntary cough inadequate	8	20.0%
	Voluntary cough bovine	8	20.0%
	NAD	12	
ii. Change in voicing	Aphonic/unable to assess	10	25.0%
	Wet/gurgly	9	22.5%
	Hoarse	4	10.0%
	Mild impairment	7	17.5%
	Total	30	75.0%
	NAD Reflexive NAD Voluntary	17 12	42.5% 30.0%
iii. Impaired hyo-laryngeal excursion	No swallow	1	2.5%
	Pooling/gurgling (laryngeal elevation incomplete)	12	30.0%
	Laryngeal elevation mildly restricted/slow/incomplete	13	32.5%
	Total	26	65.0%
	NAD	14	35.0%
iv. Ineffective bolus clearance	No clearance	8	20.0%
	Some clearance/residue	13	32.5%
	Significant clearance/minimal residue	16	40.0%
	Total	37	92.5%
	Fully cleared	3	7.5%

The most concerning finding relating to the safety of the swallow, was that 57.5% of the participants did not present with a voluntary cough effective enough to clear penetrated material, and 70.0% could either not cough on command, or presented with an inadequate or bovine cough attempt. The poor cough response was observed during the pharyngeal phase of the swallow, as 12 participants were not coping during the swallow, but only nine demonstrated a cough before, during or after the swallow.

After initiating the swallow, poor bolus clearance and management of saliva was observed in nine (22.5%) participants, and was observed as a change in vocal quality, namely gurgly and or wet vocal quality. Ten (25%) of the participants were aphonic or could not voice on

command; for those who were aphonic wet, gurgly or crackles were heard after the swallow during CA, which were absent in participants who were able to effectively clear the bolus.

4.8.1 Oral hygiene and oral bacteria

Oral hygiene status was found to be very poor among all participants, with a high prevalence of bacterial colonization. Table 4.4 indicates that each participant presented with at least a minimum of one oral hygiene issue at the time of assessment, with a mean of 4.25, a median of 4 and a maximum of 7.

Table 4.4 Central tendency and dispersion for the number of oral hygiene problems (N=40)

Mean	S.D.	Minimum	Quartile 1	Median	Quartile 3	Maximum
4.23	1.85	1.00	3.00	4.00	6.00	7.00

4.8.1.1 Oral findings

The most significant oral hygiene issues, as listed in Table 4.5 were related to the use of dentures, saliva, oral cleanliness and the tongue, with 80%, having hygiene related issues related to the latter. The most prevalent issue was related to white patches on the tongue, with 37.5% being affected, closely followed by the tongue having an abnormal coating, such as a hairy tongue or thick plaque, which was noted in 32.5% of the participants.

Table 4.5 Oral hygiene indicators relating to the most prevalent conditions of the oral cavity

Variable	Status	Oral hygiene indicators	Number of participants	Percentage
i. Gums and tissues	Normal		19	47.5%
	Abnormal 21 (52.5%)	Dry/shiny	6	15.0%
		Red/white patches	2	5.0%
		Signs of inflammation	6	15.0%
		Oral mucosal lesions	6	15.0%
	Signs of possible fungal infection	1	2.0%	
ii. Tongue	Normal		8	20.0%
	Abnormal 32 (80.0%)	Some white patches	15	37.5%
		Red	0	0%
		Ulcerated/swollen	3	7.5%
		Abnormal coating	13	32.5%
	Unable to view	1	2.5%	
iii. Oral cleanliness	Normal		7	17.5%
	Abnormal 33 (82.5%)	Localized plaque	6	15.0%
		Generalized plaque	7	17.5%
		Tartar/calculus on teeth	3	7.5%
		Accumulated saliva	4	10.0%
	Food particles	13	32.5%	
iv. Saliva	Normal		16	40.0%

Although natural dentition was in a good condition for most of the participants, 24, (60.0%), of the 25 who had dentures, a large majority (71.43%) experienced problems relating to their use. Of those who needed to wear dentures, nine (32.1%) did not have them, which was often due to family members not bringing them to the hospital for fear that they would go missing, or participants not wanting to wear them due to a poor fit. Of the 19 who had dentures with them, 21.43% had difficulties with the dentures being loose. When dentures were worn they were starting to cause pressure or broken areas in two (7.2%) participants, while three (10.7%) demonstrated the presence of tartar build-up, as seen in Table 4.6.

Table 4.6 Type and condition of dentures (N = 40)

Type of dentures	Number of participants	Percentage
None	15	38.46%
Upper only	5	12.82%
Lower only	0	0%
Upper and lower	19	48.72%
Condition of dentures		
No broken areas, regularly worn	8	28.57%
Broken areas	1	3.57%
Causing pressure areas	1	3.57%
Loose	6	21.43%
Tartar build-up	3	10.71%
Not available	9	32.14%

4.8.1.2 Oral bacteria

Oral cleanliness was poor in a large majority of participants; 33 (82.5%) in total related to the accumulation of plaque seen in 33 (32.5%), tartar/calculus observed in 3 (7.5%), food particles in 13 (32.5%), and four (10.0%) presented with accumulated saliva. Clearance of saliva was a problem for 10 (15.0%) participants, which resulted in the pooling of saliva in the oral cavity, sticky ropery secretion sticking on the tongue, palate or cheeks (7.5%), and discoloured secretions due to bleeding in one (2.5%) participant.

Eleven (27.5%) had dry/sticky tissues, while three (7.5%) presented with tissue that was parched and red. Only 15 (37.5%) participants presented with normal oral flora, which means that the majority (62.5%) had bacterial organisms that are not part of the resident oral flora. Seventeen (42.5%) had at least one bacteria strain present; seven (17.5%) had up to two strains and one (2.5%) participant had up to three bacterial strains present. Table 4.7 lists the most commonly occurring organisms isolated from the oral cavity of participants, these being (a) candida and various strains of the candida species (47.5%) and (b) opportunistic respiratory pathogens (37.5%). Twenty-two (47.5%) participants had only yeast; the remainder of the participants' cultures had single isolates of opportunistic respiratory pathogens or opportunistic respiratory pathogens co-occurring with yeast.

Table 4.7 Bacteria isolated and degree (N = 40)

Organism isolated	Normal		Scanty		Moderate		Profuse	
Candida/yeast								
Candida species growth	0	0%	0	0%	1	2.5%	0	0%
Candida albicans growth	0	0%	1	2.5%	8	20.0%	5	12.5%
Candida tropicalis growth	0	0%	0	0%	1	2.5%	0	0%
Candida glabrata growth	0	0%	0	0%	1	2.5%	2	5.0%
Gram-negative bacteria								
Staphylococcus aureus growth	0	0%	0	0%	1	2.5%	2	5.0%
Klebsiella pneumoniae growth	0	0%	0	0%	0	0%	4	10.0%
Enterococcus faecalis	0	0%	0	0%	0	0%	3	7.5%
Pseudomonas aeruginosa growth	0	0%	0	0%	0	0%	1	2.5%
Group B Streptococci growth	0	0%	1	2.5%	0	0%	1	2.5%
Stenotrophomonas maltophilia growth	0	0%	0	0%	0	0%	2	5.0%
Normal oral flora	15	37.5%	0	0%	0	0%	0	0%

4.9 DISCUSSION

This study found that among hospitalized patients presenting with dysphagia, varying from LED to severe, oral hygiene status was found to be equally deficient across participants, with a high prevalence of bacterial colonization. The findings support those of previous studies, which report the prevalence of oral health problems among acutely hospitalized patients to be very high (Tada & Hanada, 2010; Matthews et al., 2012; Danckert et al., 2016).

Signs of impaired efficacy and safety of the swallow were found in most of the study participants, including those who presented with LED. Results thus indicated a high prevalence of oropharyngeal dysphagia among hospitalized patients and found that patients with oropharyngeal dysphagia had severely impaired swallow and airway protection mechanisms. This impairment was observed as problems with tongue strength and coordination, initiation of swallow, bolus clearance and impaired cough responses.

Studies have shown that effective salivary flow and swallowing is needed to clear bacteria laden secretions from the oral and pharyngeal cavities (Palmer et al., 2001; Ortega et al., 2015). Difficulties with saliva production and clearance were found in 60.0% of the

participants, ranging from hyposalivation to pooling of saliva in the oral cavity due to poor clearance. Poor mechanical clearance of the bolus, which included the clearance of accumulated saliva, resulted in oropharyngeal residue. This was found to be an area of significant difficulty for most participants with dysphagia in this study, particularly related to tongue weakness and difficulties with coordination. According to Palmer et al. (2001) the reduction in mechanical clearance of potential pulmonary and oropharyngeal pathogens may be the first step in the path that leads to oral pharyngeal colonization and pneumonia, as oropharyngeal residue which is not cleared promotes bacterial growth and invasion as it allows pathogens increased time in the mouth for proliferation. Reduction in mechanical clearance could also have accounted for the finding that all participants, 100% presented with deficient oral cleanliness related to the accumulation of plaque, saliva and debris e.g. food particles.

The motor function of the tongue is described to be related to its self-cleaning function (Kikutani et al., 2009), with reduced activity due to weakness possibly accounting for the finding that 80.0% of the study participants had oral hygiene related issues with regard to their tongue, more specifically tongue coating. What is concerning about this finding is that studies have identified the dorsum of the tongue as a major oral site of bacterial multiplication, as well as the major source for the bacteria found in saliva, thus, many salivary bacteria mirrors that coming from the flora of the dorsum of the tongue (Dahlén, 2009; Kikutani et al., 2009; Pace & McCullough, 2010), which could account for the high prevalence of pathogenic bacteria found in the oral cavities of participants with dysphagia.

A high prevalence (62.5%) of opportunistic bacteria was isolated from the oral cavities of participants who presented with dysphagia. A total of 42.5% of the participants had at least one bacteria strain present. In recent years the interaction between opportunistic respiratory pathogens and *Candida albicans* has been reported (Hogan & Kolter, 2002, as cited in Tada & Hanada, 2010). This finding was corroborated in the current study as the most commonly occurring bacteria in the oral cavity of participants were, (a) candida species and (b) opportunistic respiratory pathogens. In five (17.5%) participants *Candida albicans* was found to co-occur with an opportunistic respiratory pathogen.

Research states that as long as the microbial load is not too high, the harmony between pathogenic bacteria and oral resident flora will not be tilted toward infection (Rautemaa et al., 2007; Dahlén, 2009). However, the results of this study indicate that when bacterial species were found in the oral cavities, the virulence was already quite high, suggesting the delicate oral homeostasis potentially having already been tipped toward infection and if not treated could potentially lead to systemic disease such as AP.

4.10 CONCLUSION

Due to the many oral hygiene issues in patients with dysphagia that could lead to a high prevalence of colonization of respiratory pathogens, the findings of this research study showed that the oral hygiene status of people with dysphagia is concerning. It is thus not surprising that the concept of oral health has become an emerging area of interest among medical professionals who treat individuals with dysphagia. Oral hygiene remains an unmanaged factor in the context of pneumonia management; therefore the following recommendations are drawn from the study:

- Oral hygiene should be screened for, particularly in patients who present with dysphagia to prevent health complications.
- A multidisciplinary team approach to the management of dysphagia, which includes utilizing dental care professionals in mouth risk management, should be developed, implemented and supported in hospital care facilities.
- Future studies should focus on the effectiveness and use of oral hygiene screening tools used by Speech-Language Therapists during clinical swallow evaluations.
- Ongoing awareness and training should be provided regarding the importance and provision of oral healthcare, especially in the dysphagia population.

Obtaining and documenting clear, relevant data about the oral hygiene status of patients with dysphagia who are admitted to hospital facilities in South Africa is an essential first step in planning strategies to treat and prevent AP in hospital settings. This will have far reaching implications within the health care setting, as maintaining oral health to reduce the risk of AP is easier and less expensive than managing the disease once it occurs, and has positive implications for cost savings and improving patient care and health outcomes.

4.11 AKNOWLEDGEMENTS

A CHS Masters Scholarship, provided by the University of Kwa-Zulu Natal, Durban, South Africa, financially supported this study. The author thanks the hospital manager at the research site for allowing data collection to take place at the institution, and the participants and family members for their willingness to take part in the study. A special note of thanks is given to the Oral Hygienist, Noekie Grobler, for contributing her services during data collection, and Ampath Laboratories, Greenacres Hospital, Port Elizabeth and Dr. Louise Nut for their contribution toward interpretation of results and Professor Mershen Pillay for his guidance and supervision during the write up of the manuscript. The researcher declares no conflicts of interest.

CHAPTER 5. DISCUSSION

Chapter 5 will provide supporting information for the primary research findings presented in chapter 4, as contained in the study article. The chapter includes an interpretation of the results to answer the research question, as well as a further critique of the study and recommendations.

5.1 INTRODUCTION

The purpose of the study was to describe the oral hygiene problems in patients who present with dysphagia. It was the first study of its kind aimed at the sub-acute rehabilitation hospital setting within the South African context. Findings' suggesting that oral hygiene remains an unmanaged factor in the management of dysphagia, which is complicated by the lack of documented works on the oral hygiene status of people who present with dysphagia especially within the South African context.

The following section will present the results according to each objective.

5.2 OBJECTIVE 1: TO ASSESS THE SWALLOW FUNCTION OF EACH PARTICIPANT, USING THE MANN ASSESSMENT OF SWALLOW ABILITY (MASA), TO ALLOW FOR CHARACTERIZATION OF DYSPHAGIC FEATURES PRESENT

The concept of the high-risk patient was introduced as part of the conceptual framework in chapter 2 (Figure 2.1). Previous studies have identified certain patient factors, which are associated with the development of systemic diseases such as AP. These factors include; advancing age, critically ill patients who are medically and immunologically compromised, patients in long term care, individuals who have suffered a cardiovascular accident, traumatic brain injury, present with Alzheimer's disease, parkinsonism or other neurological disorders (Barnes, 2014; Shay et al., 2005; Rautemaa et al., 2007; Munro, 2014). For the purpose of the current study it was thus necessary to identify the host factors associated with a patient who is at risk for poor swallow function and thus increased

aspiration risk, as well as those factors, which could affect oral hygiene. Furthermore by researching the biographical profile of participants, it provided the opportunity to further investigate the concept of the high-risk patient with regard to the current context. The demographic details of the participants are attached in Appendix N, as Table 25.1.

5.2.1 Gender

Results regarding the biographical data obtained from study participants found that there were more males admitted to hospital during the study period, a total of 57.5% (n=23) as compared to 42.5% who were females (n=17), thus reflecting findings from Statistics South Africa (2014), which reported the proportion of male deaths persistently higher than female deaths. It can thus be assumed that males in South Africa are sicker and admitted to hospital more frequently. Furthermore a study done by Danckert et al. (2016) found that being male was one of the factors associated with higher plaque scores during hospitalization.

5.2.2 Diagnosis

It was unsurprising that stroke accounted for 42.5% of the total study population and was the main reason for admission to hospital and cause for dysphagia, as literature estimates the incidence of dysphagia after stroke to range between 20% and 90% (González-Fernández & Daniels, 2008). It was noteworthy that 20.0% of the sample did not have a specific diagnosis but rather presented with self-reported complaints of dysphagia or other conditions such as femur fractures or hip replacement. A study conducted by Love, Cornwell and Whitehouse (2013) found oropharyngeal dysphagia to be present in a large number of the elderly hip fracture population (orthogeriatric population) despite pre-admission reports that pre-existing dysphagia was low. Their study suggests that oropharyngeal dysphagia is under recognized and under diagnosed in the elderly orthogeriatric population. Given the fact that patients with diagnoses other than neurogenic conditions are often not referred to Speech-Language Therapists for swallow evaluations, the findings of this study provide insight that it may be feasible to suggest that Speech-Language Therapists become involved in elderly cases admitted for surgical issues

5.2.3 Age

Participants of the study sample were older, only two participants were in their twenties and two in their thirties, equalling only 10.0% of the total sample. The majority of participants were geriatric, with 67.5% of the participant population between the ages of 69-99 years and ninety-eight (98) being the age of the oldest participant.

It has been shown that advancing age represents an independent risk factor for dysphagia and it has been correlated with an increased incidence of aspiration (Ney et al., 2009, as cited in Liantonio et al., 2014; Martin, 1994, as cited in Shay et al., 2005). Furthermore previous studies have indicated that 55 – 86% of geriatric patients have been reported to have oral health problems upon hospital admission (Anderson et al., 2003, 2004, as cited in Konradsen et al., 2012; Ortega et al., 2014).

5.2.4 Diet level

In the current study all patients who presented with dysphagia were treated with conventional techniques and dietary modifications to reduce the incidence of aspiration, such as the use of tube feeding and modified dysphagia diets.

Tube feeding is generally implemented for patients who are severely dysphagic, debilitated or malnourished and are unable to sustain their caloric and nutritional needs on an oral diet. However, studies undertaken by researchers such as Langmore et al. (1998) and Luk and Chan (2014), report that tube feeding was significantly associated with AP. They found that tube feeding significantly increased the chances of developing AP, perhaps because patients continued to aspirate oropharyngeal secretions. Furthermore studies have demonstrated that the use of a feeding tube affects oral hygiene and promotes colonization because it often leads to a neglect of oral hygiene (Langmore et al., 1998; Luk & Chan, 2014).

Of the study participants 57.5% were receiving modified diets, with 32.5% of them receiving puree diets. As a means to reduce a patient's risk for aspiration, dietary modification is often recommended for patients who present with dysphagia. However,

Luk and Chan (2014) report that the effectiveness of thickening, blending and pureeing of food has not been proven clinically. It must also be taken into account that patients who present with dysphagia who are given modified food may still aspirate and researchers such as Langmore et al. (1998) report that it is more dangerous to aspirate on a puree than on a liquid.

Participants in the current study thus presented with most of the documented factors identified in literature, which would increase both the risk for aspiration and poor oral hygiene. These results thus strengthen recommendations, which call for the development of screening protocols, especially for oral hygiene within hospital settings. If a “high-risk” patient can be identified merely by his/her biographical details, it permits the opportunity for early identification and management, which could reduce possible complications.

Dysphagia is a necessary part of the pathogenesis of AP as it allows the introduction of pathogens into the lower airway (Shay et al., 2005). Sixty percent of participants presented with moderate and severe dysphagia, with 42.5% of the study population on alternative feeding methods such as PEG, 32.5% and NGT, 10.0% respectively. Given that 42.5% of the participants presented with a definite risk for aspiration, it can be concluded that patients with severe dysphagia were also prone to aspiration. Forty percent of the participants presented with mild dysphagia and little evidence of disease and thus were unlikely to aspirate. Although less severe dysphagia reduces the risk for aspiration it must be taken into consideration that most of the participants presented with diminished coordination and strength of the oral and pharyngeal musculature, which can affect bolus clearance resulting in residue and pocketing after the swallow, which can still be aspirated when sleeping. Furthermore poor clearance of food can affect oral hygiene.

The overall picture of the dysphagia that participants presented with was one of reduced strength, poor coordination, poor mechanical clearance and a weak and/or absent cough, thus indicating that nearly all participants demonstrated some difficulties with both the oral and pharyngeal phases of swallowing, i.e. oropharyngeal dysphagia of which AP is known to be a serious and often fatal complication (Yoon & Steele, 2007; Sørensen et al., 2013). Oropharyngeal dysphagia has been identified in literature to be an independent risk factor

for lower respiratory tract infections (Serra-Prat et al., 2012, as cited in Ortega et al., 2015).

Oral motor dysfunction, which was viewed as a clinical parameter to determine efficacy of the swallow was found to be an area of significant difficulty for most dysphagic participants in this study, and was attributed to the predominant issues affecting the efficacy of the swallow, namely poor lip seal, weakness of the tongue, which in turn affected oral transit and bolus clearance. The lips and tongue are two anatomical structures that play a part in preparing food to be swallowed. Given these findings it was thus unsurprising that participants experienced difficulties with drooling (oral spill), impaired oral transit (90.0%) and ineffective bolus clearance (92.5%), which resulted in oral residue due to insufficient tongue motility or excessive fatigability (Groher, 1997). These are significant findings as they correlate to previous studies, which identified delayed initiation of the swallow and excess residue as significantly related to AP and often used as predictors for aspiration (Langmore et al., 1998; Fernández & Clavé, 2013).

Although less severe dysphagia reduces the risk for aspiration, 30.0% of the participants in the study presented with mild dysphagia, namely there was little evidence of disease and thus the participants were unlikely to aspirate. It must be taken into consideration that the efficacy of oral motor function especially with regard to difficulties with lip closure, tongue strength, oral transit, bolus clearance and coughing were a problem for all participants. These factors are known to affect bolus clearance resulting in residue and pocketing after the swallow, which can still be aspirated when sleeping. Furthermore impaired clearance of food can affect oral hygiene and result in a greater bacterial load in the oral cavity increasing the chance of these bacteria entering the trachea and then the lungs causing AP (Ajwani et al., 2016).

The main clinical parameters describing the safety of the swallow were signs of reduced hyo-laryngeal excursion and poor bolus clearance, disordered cough and changes in vocal quality, which have been identified in literature as the main complications for respiratory infections and AP (Ortega et al., 2015; Rogus-Pulia & Robbins, 2013).

Hyolaryngeal excursion is a crucial event during the pharyngeal phase as it aids with closure of the laryngeal vestibule to prevent aspiration into the respiratory tract. However, this protective response was deficient in 65.0% of the study sample. In cases where this protective response fails and aspiration occurs, the cough reflex will eject the aspirated material from the airway and reduce the risk of pneumonia (Leith, Butler, Sneddon & Brain, 1986, as cited in Villardell et al., 2017). The laryngeal cough reflex is thus necessary to protect from significant aspiration and reduces the risk of respiratory complications such as pneumonia (Terré & Mearin, 2006). In healthy individuals coughing is the physiological response to aspiration and its presence during eating supposedly being a reliable sign for predicting aspiration, however, in patients suffering from neurogenic dysphagia, 40-70% do not present with a cough when aspirating (Terré & Mearin, 2006) or dysfunction of the cough reflex is found (Villardell et al., 2017). These findings were mirrored in the current study and 57.5% of the participants presented with poor airway protection mechanisms through the utilisation of a reflexive or voluntary cough, thus increasing the possible risk for aspiration.

Reduced vertical excursion of the hyolaryngeal complex contributes to incomplete airway closure with an associated risk for aspiration (Logeman, Paulosi & Rademaker, 2000, as cited in Steele et al., 2011), as well as reduced opening of the upper oesophageal sphincter and resulting in residue in the pyriform sinuses (Park, Kim & McCullough, 2013) due to poor bolus clearance. Furthermore reduced peristaltic movement due to weakness may also result in residue in the oropharynx (Park et al., 2013). Residue in the pharynx may place the patients at increased risk of aspiration after the swallow. After initiation of the swallow, poor bolus clearance and management of saliva were observed, in nine (9) of the participants (22.50%), which was observed as abnormal swallow sounds after the swallow and a change in vocal quality, namely gurgly and or wet vocal quality. It was noteworthy to report on CA for these ten (10) participants who were aphonic, to get an idea of secretion or bolus management post swallow. For all ten (10) of these participants the researcher used the words “wet, gurgly or crackles” to describe participant breathing or vocal quality after the swallow. This finding highlights the need to use CA as an adjunct to the CSE as it provided additional information about the integrity of the swallow.

5.3 OBJECTIVE 2: TO DESCRIBE THE ORAL HYGIENE STATUS OF EACH PARTICIPANT USING AN ADAPTED VERSION OF THE ORAL HEALTH ASSESSMENT TOOL (OHAT).

5.3.1 Oral hygiene issues relating to the tongue

Dahlén (2009) describes the dorsum of the tongue as fissured and containing long papillae, which promote bacterial accumulation and is thus the major oral site of bacterial multiplication and the major source for the bacteria found in saliva. Thus, the salivary flora mirrors that of the tongue. Disturbance of the bacterial equilibrium on the tongue dorsum may lead to overgrowth of opportunistic micro-organisms, infection and symptomatology. Kikutani et al. (2009) describe tongue coating as a moss-like deposit, which forms over the tongue surface and includes micro-organisms, food residues, and abrasive epithelia. The results of their study report on a correlation between the degree of tongue coating and a reduction in lingual motor function. It was thus unsurprising to find that 80.0%, a substantial part of the study participants, had hygiene related issues with regard to their tongue given the high incidence of deficits relating to the mechanical function of the tongue.

The most prevalent issue was related to white patches on the tongue with 37.5% of the sample demonstrating these; closely followed by the tongue having an abnormal coating, such as a hairy tongue or thick plaque and this was seen in 32.5% of the participants. This finding may also be related to the high prevalence of candida detected in study participants, as the clinical presentation of candida can be classified into white candida, seen as white bumps or patches on the tongue (Millsop & Fazel, 2016).

5.3.2 Natural dentition

According to Gil-Montoya et al. (2015) when not treated, the final stage of caries and periodontal disease is tooth loss and eventually edentulism, especially among the elderly. As mentioned previously the population of this study sample were predominantly geriatric. A total of 52.5% of the participants still had their natural dentition and surprisingly 60.0% of these participants presented with their natural teeth in good condition. . This study

mirrors that of previous research, which reported that the population of older individuals who retain their natural teeth is increasing (Rautemaa et al., 2007; Pace & McCullough, 2010). However, retaining natural teeth for longer periods of time means that they are often heavily restored which makes them prone to breakdown and increases the risk for periodontal disease among the dentate population. In this sample three participants (7.5%) had loose teeth due to periodontitis and one had caries, which had not been filled (2.5%).

5.3.3 Dentures

Fururata and Yamashita (2013) report a higher incidence of swallowing problems in individuals who have less natural teeth and in edentulous elderly who did not wear dentures. Fifteen (15) of the participants (38.46%) did not wear dentures, however, this was often due to the fact that family members chose not to bring dentures along to the hospital for fear that they would go missing or participants not wanting to wear them due to change in fit. A total of 21.43% of the participants had difficulties with loose dentures, while 32.14% of the participants did not have their dentures available to wear or for inspection. Furthermore a study by Son et al. (2013), cited by Furuta and Yamashita (2013) reported that denture wearing may have negative effects on swallow function, especially by affecting oral transit time. A large majority of the study population had difficulties with oral transit and thus the high incidence of problems relating to denture use may have attributed to this fact. Dentures were also a site for tartar build-up and this was seen in 10.71% of the participants. Food particles were also frequently found on the surfaces between the denture and palate and/or gums.

5.4 OBJECTIVE 3: TO DETERMINE THE DEGREE TO WHICH THE ORAL CAVITY OF INDIVIDUALS WHO PRESENT WITH DYSPHAGIA IS COLONIZED BY PATHOGENS NOT ASSOCIATED WITH NORMAL ORAL FLORA.

Oral candidiasis is defined as a commonly occurring opportunistic infection of the oral cavity (Akpan & Morgan, 2002; Millsop & Fazel, 2016) and is avoidable with a good oral hygiene regimen. However, when not treated it can spread through the upper gastrointestinal tract causing severe and possibly fatal infections. Candidiasis accounted

for 47.5% of the pathogenic organisms found in the oral cavities of participants who present with dysphagia; with candida albicans by far the most common form isolated accounting for 35.0% of the sample. The finding confirms the previous findings by Fanello et al. (2006), which identified a high colonization of yeasts in hospitalized patients over the age of 65 years.

Researchers such as Dahlén (2009) and Rautemaa et al. (2007) state that as long as the microbial load is not too high the harmony between pathogenic bacteria and oral resident flora will not be tilted toward infection. However, the results of this study indicate that half (50.0%) of the participants colonized were heavy carriers.

Oral colonization by respiratory pathogens was less prevalent than candida and accounted for 15.0% of the study sample. However, oral colonization by respiratory pathogens together with impaired safety of the swallow increase patient risk for developing AP.

Given the high prevalence of pathogenic bacteria found in the oral cavities of participants who present with dysphagia, it is advisable to screen for bacterial colonization in this patient population to ensure that timely and effective management is provided to ensure effective oral hygiene and reduce the possible risk poor oral hygiene poses to the patient.

5.5 STUDY LIMITATIONS

5.5.1 Sample size

The current study employed a relatively small sample size and thus it is not possible to generalize findings for the entire population of hospitalized patients who present with dysphagia. Further large-scale studies are needed to confirm the results of the current study.

5.5.2 Clinical swallow evaluation

The bedside clinical swallow evaluation is a subjective assessment of swallow function and in isolation it may underestimate the frequency of aspiration. As a result the lack of the use of the two objectives and “golden standard” swallow assessments namely, Video fluoroscopic swallow study (VFSS) and Fiber optic Endoscopic Evaluation of Swallowing (FEES), were some of the main limitations of the current study. These assessments have the advantage of detecting aspiration of food consistencies, while FEES would be able to detect the aspiration of saliva, which would have been a valuable addition to the current study. However, due to limited funding it was not possible to incorporate these formal assessments into the data collection process. As a means to achieve reliability of the results, the researcher implemented the use of two supplemental swallow assessments, pulse oximetry and cervical auscultation into the CSE.

5.5.3 Study population

5.5.3.1 Research site

The study location was a sub-acute rehabilitation hospital based within the private sector in South Africa. Patients admitted there thus had private medical aids and would present with very different socio-economic characteristics than those admitted to a government facility. As a result the researcher does not expect the sample from this study to be representative of all hospitalized patients in South Africa. Future research in South Africa should focus on obtaining population representative data by investigating oral hygiene in both private and government institutions.

5.5.3.2 Delay in initiation of data collection

The researcher experienced many difficulties with obtaining informed consent from possible participants due to them presenting with poor health, cognitive and/or language deficits and were thus unable to provide informed consent. In such cases a family member or proxy had to be contacted to provide consent, which could take up to four days. In the interim medical care and hospital practice would continue, which meant oral care regimens

and antibiotics may have been commenced prior to data collection; the oral hygiene reports from this study are thus potentially conservative estimates of the true incidence of poor oral hygiene in hospitalized patients.

5.5.3.3 Measures of pharmacological interventions

Illness and medication use can also affect or change the mouth flora and lead to conditions such as xerostomia or an increase in bacterial numbers. Not including medication lists or underlying systemic conditions such as HIV, diabetes, etc. in the biographical audit of patients could thus be a potential limitation of the study.

5.6 RECOMMENDATIONS

Despite the limitations of the study which have been acknowledged, some recommendations have been drawn from the study:

- Due to the high prevalence of oral hygiene problems and the known implications of poor oral hygiene when left untreated, the screening of oral health/hygiene upon admission should be encouraged, especially in patients with dysphagia;
- Non-dental care professionals need to improve their ability to detect oral health problems, which may involve incorporating oral health screening into daily management, and the development of improved referral protocols to ensure that improved priority is given to oral hygiene during hospitalization;
- Furthermore inter-professional training and skill development and knowledge sharing in dysphagia should be encouraged;
- Dental professionals should be encouraged to become part of the multi-disciplinary team, to assist with mouth risk management, as well as provide in-hospital dental services to high-risk patients.

5.7 STRENGTHS OF THE THESIS

The study was the first of its kind to investigate the oral hygiene status of hospitalized patients who present with dysphagia, within the South African, private health care setting. The information derived from the study provided an understanding on the relevance of oral hygiene in dysphagia, and highlighted the need to develop dysphagia management protocols which incorporates a review of oral hygiene. Furthermore the documentation of the research findings could be helpful to accredit medical care programs, and form the basis of guidelines for future research and education programs. It also provides an incentive for future and further research on management programs that focus on inter-professional collaboration in managing oral health during hospitalization, especially among people who present with dysphagia.

To ensure participants' rights to self-determination and ensure autonomy, the researcher, who is also a Speech-Language Therapist, took the time to specifically design the process of informed consent for the purpose of this study, which was a unique practice and not typically undertaken during research studies. This included the use of alternative and augmentative communication (AAC) boards and non-verbal means of providing consent.

5.8 CONCLUSION

Results of the study highlighted that oral hygiene is an unmanaged factor in dysphagia, during hospitalization. Oral hygiene status with a high prevalence of bacterial colonization was found to be deficient for all participants in the study. Given the high prevalence of dysphagia, which was associated with both impaired efficacy, and safety of the swallow among study participants, it can be concluded that patients with dysphagia present with a high likelihood to present with oral hygiene problems and bacterial colonization.

The oral cavity of patients who present with dysphagia thus represents an important reservoir for micro-organisms and thus becomes a potential source of infection for the development of AP; these micro-organisms thus should be screened for and appropriately managed during hospitalization, especially in patients who present with dysphagia. It is thus clear that unless we increase our knowledge and strengthen our understanding of the

risk posed by poor oral hygiene to individuals with dysphagia, opportunistic respiratory bacteria originating in the mouth have the potential to become the silent killer of our vulnerable hospitalized patients who present with dysphagia.

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APPENDIX A

Table 7.1 Outline of diet classification used at the rehabilitation hospital.

	Nil Per Mouth (NPO)	Full Dysphagia Diet		Transitioning		Normal	
Diet Level	Level 0	Level 1	Level 2	Level 3T (Soft therapeutic)	Level 3	Level 4	Level 5
Description	Nil per mouth	Liquidized	Puree	Minced and moist	Soft	Low Residue	Normal/regular mixed and or granular
Dysphagia type	Severe		Moderate-severe	Moderate	Mild-moderate	No evidence of swallowing difficulty	
Participant for study	Automatic inclusion *Depending on receipt of informed consent					Exclude from study	

APPENDIX B

THE MANN ASSESSMENT OF SWALLOW ABILITY (MASA)

Mann Assessment of Swallowing Ability (MASA) Scoring Sheet

Alertness	2 no response to speech	5 difficult to rouse	8 fluctuates	10 alert
Cooperation	2 no cooperation	5 reluctant	8 fluctuating cooperation	10 cooperative
Auditory comprehension	2 no response to speech	4 occasional motor response if cued	6 follows simple conversation with repetition	8 follows ordinary conversation with little difficulty
Respiration	2 chest infection suctioning	4 coarse basal crepitations chest physiotherapy	6 fine basal crepitations	8 sputum upper airway other condition
Respiratory rate (for swallow)	1 no independent control	3 some control/uncoordinated	5 able to control breath rate for swallow	
Dysphasia	1 unable to assess	2 no functional speech sounds/single words	3 expresses self in limited manner short phrases/words	4 mild difficulty finding words or expressing ideas
Dyspraxia	1 unable to assess	2 groping/inaccurate/partial or irrelevant responses	3 speech crude/defective in accuracy or speed on command	4 speech accurate after trial and error, minor searching movements
Dysarthria	1 unable to assess	2 speech unintelligible	3 speech intelligible but obviously defective	4 slow with occasional hesitation or slurring
Saliva	1 gross drool	2 some drool consistently	3 drooling at times	4 frothy/expectorated
Lip seal	1 no closure unable to assess	2 incomplete seal	3 unilaterally weak poor maintenance	4 mild impairment occasional leakage
Tongue movement	2 no movement	4 minimal movement	6 incomplete movement	8 mild impairment in range
Tongue strength	2 gross weakness	5 unilateral weakness	8 minimal weakness	
Tongue coordination	2 no movement unable to assess	5 gross incoordination	8 mild incoordination	
Oral preparation	2 unable to assess	4 no bolus formation no attempt	6 minimal chew thrust gravity assisted	8 lip or tongue seal bolus escape
Gag	1 no gag	2 absent unilaterally	3 diminished unilaterally	4 diminished bilaterally
Palate	2 no spread or elevation	4 minimal movement nasal regurgitation/air escape	6 unilaterally weak	8 slight asymmetry mobile
Bolus clearance	2 no clearance	5 some clearance/residue	8 significant clearance/ minimal residue	10 fully cleared
Oral transit	2 no movement observed	4 delay > 10 sec	6 delay > 5 sec	8 delay > 1 sec
Cough reflex	1 none observed/unable to assess		3 weak reflexive cough	
Voluntary cough	2 no attempt/ unable to assess	5 attempt inadequate	8 attempt bovine	10 NAD
Voice	2 aphonic unable to assess	4 wet/gurgling	6 hoarse	8 mild impairment slight huskiness
Trache	1 trache/cuffed		5 trache/fenestrated	
Pharyngeal phase	2 no swallow unable to assess	5 pooling/gurgling laryngeal elevation incomplete	8 laryngeal elevation mildly restricted slow initiation incomplete clearance	10 immediate laryngeal elevation clearance of material
Pharyngeal response	1 not coping/gurgling		5 cough before/during/after swallow	
Diet recommendations	NBM risk too great	thick vitaminized diet	modified soft	soft
Fluid recommendation	NBM	thick fluid (batter)	thick (honey)	thick (nectar)
Swallow integrity	definite dysphagia aspiration	probable dysphagia aspiration	possible dysphagia aspiration	unlikely dysphagia aspiration

Total =

Additional Problems: _____

Summary: _____

Recommendations: _____

Diagnosis: _____

Date: _____ Signature: _____

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APPENDIX C

PULSE OXIMETRY PROTOCOL

1. Continuous SpO₂ readings should be obtained.
2. Position the patient in an upright seated position (the wheelchair, if issued). If the patient is bedbound position patient at 90 degrees or as close to 90 degrees as possible.
3. Place the finger probe of the oximeter on the patient's index finger/suitable finger of the non-dominant hand.
4. The baseline SpO₂ should be determined for a minimum of 1 minute prior to initiation of saliva/food/liquid swallow tests.
5. Record baseline SpO₂ on the supplementary swallow assessment (SSA) record form.
6. Observe reflexive swallow or swallow of a real food bolus and document SpO₂ reading post swallow on the SSA record form.
7. Continue to monitor SpO₂ for 3 minutes after the conclusion of the swallow tests to evaluate for delayed aspiration effect.
8. SpO₂ decline for each patient is defined as the difference between baseline SpO₂ and the lowest SpO₂ recorded after the trial.

APPENDIX D

CERVICAL AUSCULTATION PROTOCOL

Adapted from Groher & Crary, 2010 and Cichero & Murdoch, 2006.

1. Place the bell of the stethoscope on the lateral aspect of the neck near the larynx.
2. Establish baseline breath sounds, by: Recording respiratory rate - Counting the number of inspiration and expiration breath cycles over 60 seconds.
3. Make a note on baseline breathing pattern and sound – record on the supplementary swallow assessment (SSA) record form, CA section (appendix F).
4. Make a note on pre-swallow sounds.
5. Ask the patient to complete the selected swallow task (saliva, food or liquid).
6. Listen for period of apnea and followed by 2 bursts of sounds to detect an absence of these sounds or any delay in initiation of the swallow.
7. Document swallow sounds on the SSA record form (quality, duration).
8. Note any abnormality heard post swallow.

<p>Lips <input type="checkbox"/></p> <ol style="list-style-type: none"> 0. Normal 1. Dry, chapped lips – rough to the touch 2. Red, starting to blister 3. Broken areas 4. Swelling, red or white patches 5. Bleeding/ulcerated 	<p>Tongue <input type="checkbox"/></p> <ol style="list-style-type: none"> 0. Normal 1. Some white patches 2. Red 3. Ulcerated/swollen 4. Abnormal coating –hairy tongue 5. Unable to view 	<p>Gums and tissues <input type="checkbox"/></p> <ol style="list-style-type: none"> 0. Normal 1. Dry, shiny 2. Red/white patches 3. Signs of inflammation -swelling/bleeding 4. Oral mucosal lesions e.g. ulcers 5. Signs of possible fungal infection
<p>Dentition <input type="checkbox"/></p> <p>Natural teeth: Yes <input type="checkbox"/> No <input type="checkbox"/></p> <ol style="list-style-type: none"> 0. No problems 1. Caries 2. Broken teeth 3. Filled with caries 4. Grinding, gritting and clenching of teeth 5. Loose teeth due to periodontitis 		<p>Dentures <input type="checkbox"/></p> <p>Upper <input type="checkbox"/> Lower <input type="checkbox"/></p> <ol style="list-style-type: none"> 0. No broken areas, regularly worn 1. Broken areas 2. Causing pressure areas 3. Loose 4. Tartar build-up 5. Not available
<p>Saliva <input type="checkbox"/></p> <ol style="list-style-type: none"> 0. Moist tissues, watery and free flowing saliva 1. Pooling of saliva (sulci, back of mouth) 2. Dry, sticky tissues (little saliva in mouth) 3. Tissues are parched and red 4. Sticky, ropery secretions 5. Discolouration of secretions (sticky, stuck to tongue, palate and cheeks) 	<p>Oral cleanliness <input type="checkbox"/></p> <ol style="list-style-type: none"> 0. Clean/no debris 1. Localized plaque 2. Tartar/calculus on teeth 3. Accumulated saliva 4. Generalized plaque 5. Food particles 	<p>Dental Pain <input type="checkbox"/></p> <ol style="list-style-type: none"> 0. No behavioural, verbal or physical signs of pain 1. Verbal reports of pain 2. Behavioural signs of pain - pulling face, chewing lips 3. Physical signs – swelling of lip, cheek, gum, ulcers. 4. Unresponsive participant
		<p>Total</p> <p><input type="checkbox"/> <input type="checkbox"/></p>

APPENDIX F

ORAL HEALTH ASSESSMENT TOOL (OHAT) DEVELOPED BY CHALMERS ET AL. (2005)

Resident: _____ Completed by: _____ Date: ___/___/___

Scores – You can circle individual words as well as giving a score in each category (* if 1 or 2 scored for any category please organize for a dentist to examine the resident)				
Category	0 = healthy	1 = changes*	2 = unhealthy*	Category scores
Lips	smooth, pink, moist	dry, chapped, or red at corners	swelling or lump, white/red/ulcerated patch; bleeding/ulcerated at corners	
Tongue	normal, moist roughness, pink	patchy, fissured, red, coated	patch that is red and/or white, ulcerated, swollen	
Gums and tissues	pink, moist, smooth, no bleeding	dry, shiny, rough, red, swollen, one ulcer/sore spot under dentures	swollen, bleeding, ulcers, white/red patches, generalized redness under dentures	
Saliva	moist tissues, watery and free flowing saliva	dry, sticky tissues, little saliva present, resident thinks they have a dry mouth	tissues parched and red, very little/no saliva present, saliva is thick, resident thinks they have a dry mouth	
Natural teeth Yes/No	no decayed or broken teeth/roots	1-3 decayed or broken teeth/ roots or very worn down teeth	4 + decayed or broken teeth/roots, or very worn down teeth, or less than 4 teeth	
Dentures Yes/No	no broken areas or teeth, dentures regularly worn, and named	1 broken area/tooth or dentures only worn for 1-2 hrs daily, or dentures not named, or loose	more than 1 broken area/tooth, denture missing or not worn, loose and needs denture adhesive, or not named	
Oral cleanliness	clean and no food particles or tartar in mouth or dentures	food particles/tartar/plaque in 1-2 areas of the mouth or on small area of dentures or halitosis (bad breath)	food particles/tartar/plaque in most areas of the mouth or on most of dentures or severe halitosis (bad breath)	
Dental pain	no behavioural, verbal, or physical signs of dental pain	are verbal &/or behavioural signs of pain such as pulling at face, chewing lips, not eating, aggression	are physical pain signs (swelling of cheek or gum, broken teeth, ulcers), as well as verbal &/or behavioural signs (pulling at face, not eating, aggression)	
<input type="checkbox"/> Organize for resident to have a dental examination by a dentist <input type="checkbox"/> Resident and/or family/guardian refuses dental treatment <input type="checkbox"/> Complete Oral Hygiene Care Plan and start oral hygiene care interventions for resident <input type="checkbox"/> Review this resident's oral health again on Date: ___/___/___				TOTAL SCORE: 16

APPENDIX G
MANN ASSESSMENT OF SWALLOWING ABILITY (MASA)
PROTOCOL

Pre-test: ¹Arrange to see patient at 12:30.

Arrange lunch diet according to specified diet level (noted on patient hospital database).

Level 2 (puree) – Mash potato, pureed chicken and water.

Level 3 and 3T (soft and soft therapeutic) – soft boiled potatoes, shredded chicken and water.

Position patient.

Seat patient in wheelchair (if allocated).

Bedridden patients – Position in head up, seated position at 90 degrees or as close to 90 degrees as possible.

Step 1: Determine exclusion

If answered yes to the following questions, do not assess swallow using real food items –observe dry/reflexive swallows of saliva.

Poor management of own secretions, with airway compromise – requires frequent suctioning

Patient demonstrates no response to speech (Alertness score of 2 or 5 on MASA)

Patient presents with no cooperation and poor following of instructions (Cooperation score of 2)

Step 2: Administration instructions

Oral motor evaluation (indicate scores on MASA record form).

Take baseline measures on supplementary swallow assessments, following protocol for PO and CA.

¹12h30 was chosen, as this is the time lunch is served at the hospital. This time also allowed the researcher to conduct the assessment without interfering with the normal daily functioning of the ward.

Patients who are not sufficiently awake and alert.

Saliva Test

Instruct patient to swallow on command.

If unable to follow instructions wait and time trigger of reflexive swallow over 30 seconds.

Document outcome on MASA record form.

Patients who are alert and awake:

Present one 5 ml bolus of mashed potato.

If patient self feeds, instruct patient to take a small bite sized portion.

If patient adequately clears bolus with no overt sign of penetration/aspiration - observe full meal (to observe swallowing competence as meal progresses), proceed to liquids.

Present 5 ml water or sip via glass.

Complete assessment by documenting findings on MASA record form.

APPENDIX H
SUPPLEMENTARY PROCEDURES FOR THE STUDY: THE
ORAL HYGIENE STATUS OF PEOPLE WITH DYSPHAGIA; A
DESCRIPTIVE STUDY.

PULSE OXIMETRY							
EDAN Pulse Oximeter H100B							
Respiration at rest (over 60s)	Baseline SpO2 (After 1 minute)	Lowest SpO2 (After 3 minutes)	Spo2 recorded during swallow	Percentage difference in SpO2	Length of change in SpO2 (seconds)	Aspiration present	
						No 0-2% diff	Yes 3+% diff

CERVICAL AUSCULTATION RECORDING			
WelchAllyn Professional Pedi. Stethoscope			
Pre-swallow	Swallow	Glottal release sound	Post-glottal release sound
Normal	Crisp Clear Quick Loud Coordinated	Present	Phonatory quality
Abnormal	Dull Dissociated Constricted Drawn-out Choking Other	Absent	Gurgling Bubbling Clearing Crackles Chocking

APPENDIX I GATEKEEPER PERMISSION

[REDACTED]
Hospital Manager

[REDACTED]
Port Elizabeth

6040

15th January 2016

Request to conduct a Masters Research Study

Dear Madam

I am currently a Masters student at the University of KwaZulu-Natal intending to conduct a research study in the field of dysphagia (swallowing disorders). My study is titled: *The oral hygiene status of people with dysphagia: a descriptive study*.

Aspiration of food, liquids and/or body secretion is a common feature of dysphagia. Oral hygiene has been identified as a causative factor for the development of aspiration pneumonia. Oral care practices are, however, often an overlooked component in the care of hospitalized patients (Chipps et al., 2014). This study aims to identify and describe the oral hygiene issues present in people with dysphagia. This information will increase our knowledge regarding how to manage oral hygiene in people with swallowing disorders.

The University of KwaZulu-Natal's Biomedical Research Ethics Committee (BREC) has granted me provisional approval (BREC reference number: 454/15) pending approval from the study participants and the institutional gatekeeper, viz.:
[REDACTED]

I request permission from you to screen all patients admitted to [REDACTED] over a period of six weeks. Patients who meet selection criteria will undergo the following two assessments:

1. An assessment of their swallowing, which will be completed by the principal investigator, who is a Speech-Language Therapist.
2. An oral health assessment which involves (i) inspection of the oral cavity and (ii) swabbing of the oral mucosa with a cotton tip for laboratory testing, to detect the possible presence of pathogenic oral bacteria. The presence of these bacteria in the oral cavity, plays an important role in the development of aspiration pneumonia. A qualified Oral Hygienist will conduct these assessments.

Both the participants and the hospital will not be liable for the costs of these assessments. Participants who present with severe or serious oral health concerns will be provided with referrals for dental management. It will be clearly noted in the consent form that follow-up management will not be provided as part of the study.

Ideally I would like data collection to commence the 1st of February 2016 over a period of six weeks, until the 7th of March 2016. Assessments will occur as new patients are admitted to [REDACTED] over this timeframe.


Please be advised that:

- I will ensure that participant rights and confidentiality is upheld by following the current UKZN Biomedical Research Ethics Committee Terms of reference and Standard operating procedures.

- I will ensure that participant rights and confidentiality is upheld by following the current UKZN Biomedical Research Ethics Committee Terms of reference and Standard operating procedures.
- I will endeavour to manage the data collection in such a way to keep the disruption of the working day to an absolute minimum.


I hope that you find the project of interest and that you will be keen in working with me on it. Please feel free to contact the researcher, Ms. Merryl Weimers if you have any queries. Alternatively, you may wish to contact my supervisor, Prof. Mershen Pillay, or the Biomedical Research Ethics Administration at the numbers provided below.

Thank you sincerely,
Kind regards,



Ms/ Merryl Weimers
Researcher
041 398 7735

19 . 01 . 16
Date



A/Prof. Mershen Pillay
Supervisor
031 260 8019/pillaym1@ukzn.ac.za

Date

Biomedical Research Ethics Administration
Research Office, Westville Campus
Govan Mbeki Building
University of KwaZulu-Natal
031 260 4769
marimuthu@ukzn.ac.za

Please sign and complete below if permission is granted.

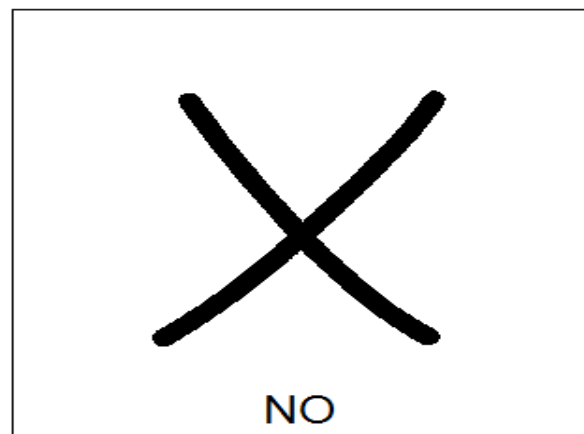
I Annette Krige, Hospital Manager of [REDACTED] tal, hereby grant permission for the study: *The oral hygiene status of people with dysphagia: a descriptive study*, to be conducted at Aurora Hospital. The nature and purpose of the study has been explained to me and I have had the opportunity to ask questions to gain more information.



Signature .....

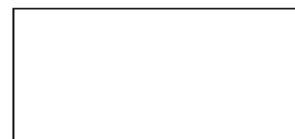
Date 18/01/16.....

APPENDIX J
PARTICIPANT CONSENT: ALTERNATIVE COMMUNICATION

My consent to participate in the study ~~yes~~ / ~~no~~ ?



If  yes provide  thumb print:



APPENDIX K
PROCESS OF OBTAINING INFORMED CONSENT FOR THE
STUDY “THE ORAL HYGIENE STATUS OF PEOPLE WITH
DYSPHAGIA: A DESCRIPTIVE STUDY.”

17.1 VULNERABLE POPULATIONS

17.1.1 Step 1: Invitation to participate in the current study.

On the day of admission it is hospital policy that all patients admitted undergo an informal screener of their swallow function to determine which diet level they will commence on. This screener is conducted by either the Speech-Language Therapist or hospital nursing staff. All patients commenced on a level 1, 2, 3t and 3 diet will be approached to become part of the research study.

During the process of obtaining consent, the researcher who is a qualified Speech-Language Therapists will be able to determine patient competency, regarding their ability to;

1. Understand what is expected from them.
2. Express their desire to become part of the study, using either verbal or non-verbal means.

17.1.2 Step 2: Identifying level of competency

The Declaration of Helsinki states that in order to make an informed decision about whether or not to participate in a research study, an individual must have sufficient intellectual/emotional capacity.

The Speech-Language Therapists approaching potential participants will inform the principal investigator regarding the competency of potential participants, based on:

- Auditory-verbal comprehension –understanding of spoken and written language;
- Fluency - verbal communication/expression;
- Alexia - loss of the ability to read following brain damage;
- Agrapha – loss of the ability to write, following brain damage.

The researcher has taken the decision to directly approach a proxy of potential participants, where the patient:

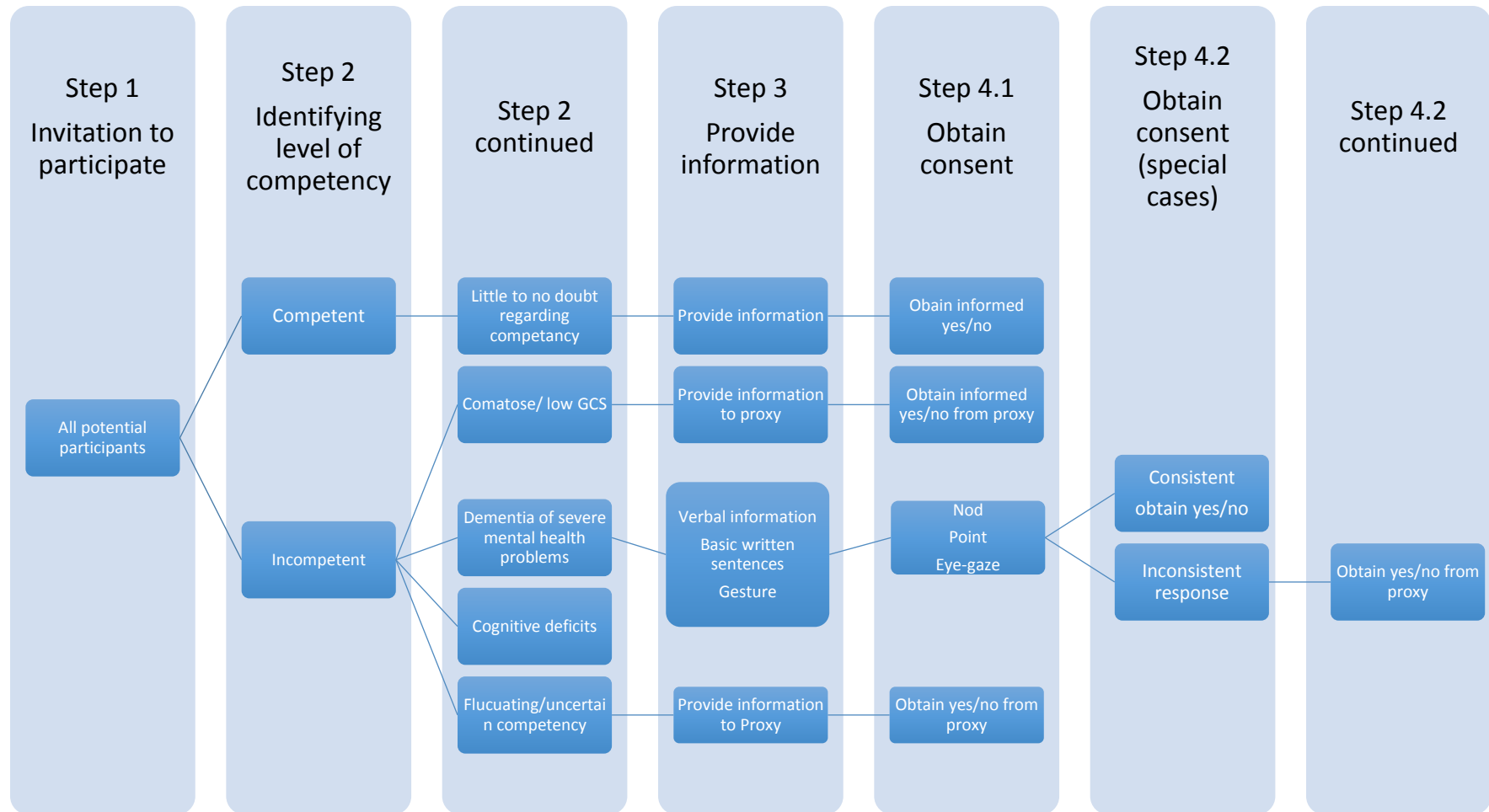
- Is in a comatose state;
- Is unable to comprehend verbal language;
- Is unable to comprehend gesture;
- Is unable to identify/comprehend pictures;
- Is unable to match/associate a picture with a certain activity, especially in cases where limited time is provided to learn to do so;
- Is too inconsistent in his/her use of a yes/no response either by the use of gesture, nodding, shaking of his/her head, pointing or eye-gaze.

17.1.3 Step 3: Provision of information

The principal investigator will approach potential participants who present with cognitive-linguistic difficulties, but which are mild enough for the participant to potentially understand information regarding the study, when short basic sentences are provided verbally, aided by the use of gesture or in written form.

APPENDIX K CONTINUED

INFORMED CONSENT PROCESS DEVELOPED FOR THE STUDY



APPENDIX L PARTICIPANT INFORMATION SHEET

Informed consent

INFORMATION SHEET AND CONSET TO PARTICIPATE IN RESEARCH STUDY

April 2016

Researcher Meryll Weimers
Department: Speech Therapy Department
Institution: University of Kwa-Zulu Natal
Contact details: 083 463 5131
Office number: (041) 368 7285
E-mail: Meryllw@[REDACTED].co.za

To the reader

Introduction:

You are being invited to consider participating in a research study. This form explains why I am conducting the study and how investigations/assessments may be different to the regular care you will receive whilst admitted in [REDACTED] Hospital. It tells you what will happen during the study, any inconveniences, discomforts/risks you may experience if you decide to become a participant. This information will help you decide whether you wish to become a participant.

What is the aim and purpose of the study?

The study involves investigating the potential difficulties your may have with your oral health/hygiene, especially if you have difficulties with swallowing.

The main reason for conducting this study is to answer the following questions:

- What is your current oral health like?
- What is your current swallow function?
- Do you have any difficulties with your swallowing and if so how severe is it and which processes are present to cause those difficulties?
- Does your current oral health status have the potential to make you sick, by giving you a chest infection, i.e. aspiration pneumonia?

The study will involve the following procedures:

The study consists of two parts:

1. A swallow evaluation by a qualified Speech-Language Therapist.

This evaluation will happen on either the day of your admission or on the day following admission. During this part of the study the researcher will administer a test called the MASA (Mann Assessment of Swallow Ability). This test will be used to assess the presence of feeding and swallowing difficulties, as well as how severe these difficulties may be.

2. Dental/oral evaluation

This evaluation will be conducted by a qualified oral hygienist. In this evaluation the oral hygienist will look into your mouth, while inspecting your teeth, roof of your mouth, and floor of your mouth, your tongue, inside the lips and cheeks and along your gum line. She will conduct this assessment to check for any abnormalities.

If you are currently wearing dentures she will remove these and inspect them for any loose or broken pieces.

3. Sample swab of the inside of your mouth

The process will be quick and painless; a cotton tip, sterile swab will be firmly rubbed over the inside of your cheek for about 20-30 seconds. To take a sample of the saliva inside your mouth to test for the presence of bacteria that could potentially make you sick.

Who can take part in the study?

Any adult, male or female over the age of 18 years, who is admitted to [REDACTED] Hospital and admitted to either the Physiological instability or Cognitive-physiological instability wards, is a potential candidate to participate in the current study. The study is expected to enrol 20-30 participants in total, all of whom will be sampled once they have been admitted to one of the target wards in [REDACTED] for rehabilitation. The duration of the study for participants will be 2-3 days as it only involves an initial

assessment of their swallow function by a Speech-Language Therapist and a dental assessment by an Oral Hygienist.

You cannot partake in the study if:

- You are admitted to the Residential Integration ward in [REDACTED]
- Younger than 18 years.
- Do not have a known or suspected swallowing difficulty.

What are the potential risks/discomforts the investigation used in the study may pose?

Your oral health will be evaluated by a qualified Oral Hygienist. These evaluations will include a routine investigation of your mouth, cheeks, lips, teeth and gums. The Oral Hygienist may have to employ the use of utensils, which may cause discomfort, but are not intended to cause you harm and will be similar to a routine evaluation you experience during a Dental exam done by your Dentist.

If you are found to have severe oral health issues, either with the oral assessment or bacterial swabbing, your ward doctor will be informed timeously. He/she will then refer you for further management.

Your ability to swallow safely and effectively will be evaluated. This includes an oral exam and the swallowing of different food consistencies (water, puree and solids). You may be found to have swallowing difficulties, which can potentially result in coughing; however, every care will be taken to ensure that you experience no harm.

If you are found to have a swallowing difficulty severe enough to negatively affect your health, the researcher may have to:

- Request that a feeding tube be placed to ensure you safely meet your nutritional requirements. In the event where these tubes are needed, options will be discussed with your caregivers and/or family members by your treating physician, before they are placed.
- Prescribe the use of Nutilis (this is a white odourless and tasteless powder that thickens your liquids and make it easier for you to swallow).
- Prescribe an adaptive diet, which may be easier for you to swallow. This will either be a level 2 (puree/sloppy diet) or a level 3 (soft) diet.

What are the potential costs involved?

If you agree to partake in the study, your oral health will be evaluated by a qualified Oral Hygienist.

If you are found to present with significant oral health issues which pose a possible risk to your health and/or your oral health in future, the oral hygienist will provide the doctor supervising your care while you are an in-patient at [REDACTED], with a summary of your results. These results will clearly document why you require follow-up care.

The doctor will provide you with a list of three dentists you can choose between, as to who you will consult for further management.

Please take note, that these appointments made will not be covered as part of the study and will be incurred at your own cost.

What benefits will the study create?

The study will provide no direct benefits to the participant. It will, however, provide the researcher with valuable information which will be used to help other people with similar conditions to yours and has the potential to reduce life threatening conditions such as pneumonia, if we know which oral hygiene factors play a role in making people sick.

Do I have to take part in the study?

You do not have to consent to taking part in the study if you do not feel comfortable or do not wish to do so. It is your right to decline participation; if you decide to become part of the study you have the right to withdraw your participation at any point without incurring any penalty and with no loss of treatment benefit. If you are uncertain about any of the information contained in this document, feel free to discuss it with the researcher.

How will my participation in the study be managed?

Your information will be dealt with in the strictest confidence and all information obtained will only be shared by the researcher, her supervisor who oversees the research project and the oral hygienist. Your results will be discussed and shared

with you and your family members, but not with others who do not have the right to this information.

It must be noted that if any abnormalities are identified it will be in your best interest for the information to be made available to your medical doctor.

How will I know what the outcomes of my assessments were?

You will be informed of the outcome of each of the two phases of the study.

Phase 1, The swallow assessment. Results or outcomes on this assessment will decide the diet level for each participant. Thus any difficulties observed during the assessment will be discussed with each patient, as it will influence the feeding plan, e.g. the need for thickener in their liquids or a modified diet. Those who present with no feeding and/or swallowing difficulties, will be informed and will commence a normal diet and thus not continue to phase 2 of the study, the oral health assessment.

Phase 2: Oral health assessment

The oral hygienist will discuss outcomes on this assessment with each participant. The detection of severe abnormalities will be discussed with the participants and their family members. Furthermore the oral hygienist will inform the managing doctor in the ward about these conditions, to allow the medical doctor to discuss further management and referrals (as outlined above).

For participants who present with mild-moderate cognitive-linguistic deficits (have difficulties with understanding or expressing themselves), verbal feedback, supported with the use of short basic sentences, gestures and pictures, contained in basic Alternative and Augmentative Communication (AAC) boards, will be used. These boards will make use of pictures and the most basic of sentences to assist the participant in understanding what his/her outcome on the test was.

In cases where the participant is not competent to understand research findings, due to severe cognitive-linguistic deficits, the proxy who was approached for consent will be provided with the research findings.

This study has been ethically reviewed and approved by the UKZN Biomedical research Ethics Committee (approval number BE454/15).

In the event of any problems or concerns/questions you may contact the researcher at (provide contact details) or the UKZN Biomedical Research Ethics Committee, contact details as follows:

BIOMEDICAL RESEARCH ETHICS ADMINISTRATION

**Research Office, Westville Campus
Govan Mbeki Building**

Private Bag X 54001
Durban
4000

KwaZulu-Natal, SOUTH AFRICA

Tel: 27 31 2604769 - Fax: 27 31 2604609

Email: BREC@ukzn.ac.za

DECLARATION OF CONSENT

I _____ have been informed about the study entitled *The oral hygiene status of people with dysphagia; a descriptive study*. by Merrill Weimers.

I understand the purpose and procedures of the study (add these again if appropriate).

I have been given an opportunity to answer questions about the study and have had answers to my satisfaction.

I declare that my participation in this study is entirely voluntary and that I may withdraw at any time without affecting any treatment or care that I would usually be entitled to.

I have been informed about the costs, which I may incur, if I am found to have any significant oral health issues, which pose a possible risk to my health and/or my oral health in future and thus require dental treatment. Any follow up dental treatment will not be covered by the study.

If I have any further questions/concerns or queries related to the study I understand that I may contact the researcher at:

██████████

Speech Therapy Department

(041) 368 7285

083 463 5131.

If I have any questions or concerns about my rights as a study participant, or if I am concerned about an aspect of the study or the researchers then I may contact:

BIOMEDICAL RESEARCH ETHICS ADMINISTRATION

**Research Office, Westville Campus
Govan Mbeki Building**

Private Bag X 54001

Durban

4000

KwaZulu-Natal, SOUTH AFRICA

Tel: 27 31 2604769 - Fax: 27 31 2604609

Email: BREC@ukzn.ac.za

APPENDIX M
THE STUDY ARTICLE TO BE SUBMITTED TO THE
INTERNATIONAL DENTAL JOURNAL FOR CONSIDERATION
FOR PUBLICATION. THE ARTICLE IS WRITTEN ACCORDING
TO THE SPECIFIC JOURNAL SPECIFICATIONS AND FOLLOWS
AMA REFERENCING STYLE.

The oral hygiene status of people with dysphagia; a descriptive study.

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Key words: Dysphagia, oral hygiene, swallowing function, aspiration pneumonia, oral bacteria

24.1 ABSTRACT

Aim: The aim of the study was to assess and describe the oral hygiene problems of adults admitted to a sub-acute rehabilitation hospital who presented with dysphagia. **Design:** A descriptive cross-sectional survey study design was followed. **Methods:** The 40 participants, 57.5% (n=23) male and 42.5% (n=17) female, underwent various assessments during the two phases of data collection. Phase I consisted of three steps: (1) assess the swallow function during a clinical swallow evaluation, (2) assess oral hygiene using an adapted version of the Oral Health Assessment Tool to identify any oral hygiene problems, and (3) sample the microbiota to detect bacteria not considered part of the normal oral flora. A high likelihood for aspiration (42.5%), was a common feature for most participants who presented with dysphagia. The main swallowing problems were related to lingual strength, the ability to manage saliva, bolus clearance and effectiveness of the cough. A high prevalence (62.5%) of deficient oral hygiene and oral colonization was found. The most commonly occurring bacteria groups and species were: (1) *Candida albicans* and (2) respiratory pathogens, e.g. *Klebsiella pneumoniae* and *Staphylococcus aureus* growth.

Conclusions: The oral hygiene status of people who presented with dysphagia shows that it increases the likelihood for poor oral hygiene, which creates favourable environments for bacteria to flourish. It also increases the prevalence of pathogenic oral bacteria, which is associated with the development of aspiration pneumonia. The management of oral health issues for persons with dysphagia should receive greater attention during hospitalisation.

Key words: Dysphagia, oral hygiene, swallowing function, aspiration pneumonia, oral bacterial colonisation

24.2 INTRODUCTION

The oral cavity of hospitalized and bedridden patients is often a reservoir for opportunistic respiratory pathogens^{1,2} and can thus serve as a source of infection for the lungs when aspirated. Many published articles have identified a significant correlation between the presence of pathogenic bacteria in the oral cavity and the occurrence of respiratory diseases, such as pneumonia, especially in people who present with dysphagia.³⁻⁷ Swallowing is a complex neuromuscular activity that consists of oral, pharyngeal and oesophageal phases, and involves the coordinated function of many muscles.⁸ Physiological deficits in any of the swallowing phases result in dysphagia⁹ and may affect swallow efficacy (deficits with mechanical clearance) and/or safety (subsequent aspirations). Impaired safety of the swallow not only increases the risk for aspiration and the uncontrolled introduction of pathogenic pathogens into the lower respiratory tract⁷ but has also been associated with the presence of gram-negative bacteria; dysphagia is thus an important risk factor for the development of aspiration pneumonia (AP).

The incidence of pneumonia caused by aspiration of pathogenic bacteria in dysphagic patients increases both the mortality and the need for acute care hospitalization,⁵ which in turn can impact on oral hygiene.¹⁰⁻¹² This is partly due to the fact that oral infections often remain asymptomatic and may still result in bacteraemia despite an absence of overt symptoms.¹³ Oral care practices are often an overlooked component in the care of hospitalized patients¹⁴ as poor oral hygiene is not a highly visible condition, and related concerns require closer inspection to be given to the mouth.³ Furthermore potentially pathogenic bacteria are frequently carried in the oral cavity and hospitalization appears to create conditions that favour oropharyngeal colonization.² The problem, however, is that there are numerous diseases that often require hospitalization, of which dysphagia is a common underlying symptom. The methods used to treat these medical conditions and the dysphagia often promote colonization of the oropharynx with bacterial pathogens.¹⁵

24.3 CLINICAL RELEVANCE

There is ample evidence to highlight that oral bacterial colonization due to poor oral hygiene is one of the important contributors in the pathophysiology of AP¹⁶ and that AP can be prevented with adequate identification and care of oral health and hygiene conditions. Despite this the composition of the oral flora of dysphagic patients is not well described in literature and oral bacterial colonization is not being properly screened for or managed during hospitalization.

While the aim should be to prevent AP, strategies are not entirely effective¹⁷⁻¹⁸ as is indicated by its frequent ongoing occurrence. The challenge for health care professionals who form part of the management team for hospitalized patients who present with dysphagia, specifically nursing staff, Speech-Language Therapists, medical doctors and dental professionals is to further reduce the occurrence of AP by adequately managing the risk factors and reducing the aspiration of bacteria-laden secretions. Preventing AP and reducing the associated risk factors are ongoing challenges as the oral hygiene status of acutely hospitalized patients, especially in relation to the clinical features of dysphagia, is largely unknown making it the focus of this study. Unless we increase our knowledge and strengthen our understanding of the risk posed by poor oral hygiene to individuals with dysphagia, opportunistic respiratory bacteria originating in the mouth have the potential to become the silent killer of our vulnerable hospitalized patients who present with dysphagia.

24.4 METHODS AND MATERIALS

24.4.1 Design

The aim of the study was to describe the oral hygiene status of persons who present with dysphagia. A descriptive cross-sectional study was conducted over an eight-week period from March to April 2016, at a sub-acute neuro-rehabilitation hospital, based in the private hospital sector in Port Elizabeth, the largest city in the Eastern Cape Province of South Africa.

24.4.2 Procedures

The study procedures consisted of two phases: Phase 1 entailed collecting data during a three step process, and its analysis took place in Phase 2.

Phase 1 consisted of the following procedures:

- **Step 1:** Clinical swallow evaluation (CSE) to profile the swallowing ability and possible dysphagic characteristics of each participant, which consisted of a) the Mann Assessment of Swallowing Ability test (MASA), augmented with the use of b) cervical auscultation (CA), and c) pulse oximetry (PO).
- **Step 2:** Screening of participants' oral health using a modified version of the d) Oral Health Assessment Tool (OHAT) to document the oral hygiene problems.
- **Step 3:** Collection of oral mucosa samples for microbial diagnostic testing using e) swabs to detect the presence of organisms not considered part of the normal oral flora.

Phase 2 of the study refers to the descriptive and statistical analysis of data to identify rough trends of the oral condition of patients who present with dysphagia.

24.4.3 Sample selection

All male or female patients, over the age of 18, who were admitted to one of the two high care wards of the hospital and placed on a dysphagia diet on the day of admission, indicating the presence of swallowing difficulties, or who had self-reported complaints or concerns regarding their swallow ability, were approached to become potential study participants. Patients were excluded if they did not meet the above criteria, e.g. they were minors, they were on a normal ward diet or if they, their family members or caregivers did not provide consent.

Participants for step 1 were selected using non-probability convenience sampling, and all individuals who most closely met the selected characteristics and attributes of the study population, as documented in the inclusion criteria, were approached to become part of the

study. Purposive sampling was used to recruit participants for step 2 and 3, as only those who were identified with swallowing difficulties and confirmed as having dysphagia, were included in step 2 and 3. A total of 40 participants met the inclusion criteria, all 40 consented to become part of the study and underwent step 1 of the study, during which all 40 were confirmed to present with dysphagia and consequently underwent the oral health assessment.

24.5 METHODS

24.5.1 Phase 1

24.5.1.1 Step 1: Clinical swallow evaluation

During Step 1, the CSE, the swallow function of each of the 40 participants recruited, was assessed using (a) the MASA to confirm the presence of dysphagia by testing the 24 skills pertaining to the oro-motor and sensory components of swallowing. (b) CA was used to listen to the sounds of swallowing using a paediatric stethoscope to differentiate between normal and impaired swallow sounds and (c) PO was used to obtain real time readouts on a participant oxygen saturation (SpO_2) during swallowing. For this study, pulse oximetry was used to confirm the association between swallowing abnormalities and oxygen desaturation, seen as the difference $\geq 3\%$ between baseline SpO_2 and SpO_2 after the swallow. CA and PO were included as adjuncts to the MASA to increase the sensitivity and specificity of the findings.

24.5.1.2 Step 2: Oral hygiene assessment

A qualified Oral Hygienist used an adapted version of the OHAT to visually assess and score a participant's oral hygiene according to the following eight categories: lips, tongue, gums and tissues, natural dentition, dentures, salivary flow, oral cleanliness and dental pain. An Oral Hygienist was used to ensure that the most accurate and reliable findings regarding each participant's oral hygiene were obtained. The OHAT was customized based on literature and the inputs of a Dentist, to meet the objectives of the current study, and while it maintained the eight categories of the original tool, more emphasis was placed on identifying and describing

specific issues rather than simply scoring the responses. This allowed for additional structured observations that were added under each category to give a richer description of each area assessed and the scoring system was altered from three possible scores (0: healthy, 1: some changes, 2: unhealthy) to a 0-5. The altered scoring represented additional oral health abnormalities observed according to severity under each sub-category, which enabled the responses to not only indicate severity but provide a descriptive result of the problem.

24.5.1.3 Step 3: Microbial testing

The Oral Hygienist then collected samples from the oral cavities of the participants using cotton tipped swabs. This was a once off assessment and the collected specimens were sent for microbiology testing at Ampath Laboratories, which provides diagnostic pathology services to medical practitioners and various institutions belonging to the National Pathology Group in South Africa.

24.5.2 Phase 2

24.5.2.1 Statistical analysis

During Phase 2, the clinical data from the MASA, the OHAT and the pathology swab results were analysed statistically. Statistical analyses of data included descriptive analysis, namely frequency distributions, mean, mode and median and standard deviation values and testing the relationship between the PO, CA and MASA scores. The statistical analysis software SPSSTM Version 24, was used to test the relationship between the independent variables PO and CA, with the MASA score using a test of independence, namely the Fischer's Exact Test. The relationship for each comparison: PO to MASA, and CA to MASA was analysed with a P value of ≤ 0.005 being considered significant.

24.6 ETHICAL CONSIDERATIONS

The Biomedical Research Ethics Committee (BREC) of the University of Kwa-Zulu Natal, South Africa, approved this study, ethics reference number: BE454/15. The process of

informed consent was specifically designed for the purpose of this study to respect participants' rights and ensure autonomy, such as using Augmentative Communication Charts (AAC) to indicate yes or no for those unable to speak, which was accepted as a form of consent. Furthermore, in cases where the participant was cognitively intact but unable to write or provide a signature, a thumbprint in the presence of a witness was used and considered as written consent. Only participants who provided written consent were included in the study.

24.7 RESULTS

24.7.1 Clinical swallow evaluation

The clinical signs of dysphagia and risk for AP, such as signs of impaired efficacy and safety of the swallow, were found in the majority of participants. Table 24.1 presents the degree of dysphagia participants presented with, results being augmented by CA and PO measures. Of the 40 participants identified as having dysphagia during sample selection, the CSE confirmed the presence of dysphagia in all selected participants, with 17 (42.5%) presenting with severe, seven (17.5%) with moderate and four (10.0%) with mild dysphagia. Twelve (30.0%) presented with little evidence of dysphagia (LED).

Table 24.1 Results Degree of dysphagia

Components of the CSE		No.	%
a. MASA Degree of dysphagia (n=40)	Severe	17	42.5%
	Moderate	7	17.5%
	Mild	4	10.0%
	Total	28	70.0%
	Little evidence of dysphagia (LED)	12	30%
b. Cervical auscultation (n=40)	Normal swallow sound	21	52.5%
	Abnormal swallow sound	19	47.5%
c. Pulse oximetry (n=40)	Decrease of $\geq 3\%$ oxygen saturation	19	47.5%
	Maintained baseline oxygen saturation	21	52.5%

Figure 24.1 shows that from this sample of participants who had confirmed dysphagia, the majority (70.0%) presented with a degree of risk for aspiration, ranging from a definite to possible risk. To test the relationship between PO and CA respectively as the independent variable and MASA scores, a cross tabulation between (a) MASA scores and PO and (b)

MASA scores and CA was done, using Fischer's Exact Test. A P-value of ≤ 0.005 was considered significant. This was done to confirm the findings on the MASA regarding the risk for aspiration. Performing a Fisher's Exact Test, between PO and the MASA score a p-value of < 0.005 was obtained, similarly the p-value for CA to MASA scores was 0.000. A significant correlation was found between both the PO and CA and the MASA scores, indicating that the two supplemental procedures had a high rate of agreement with the MASA findings.

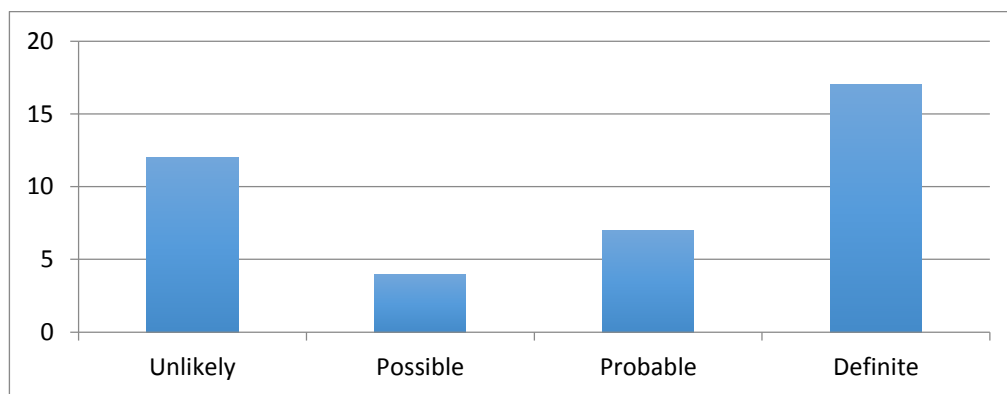


Figure 24.1 Frequency distribution for aspiration risk

24.7.2 Clinical signs of dysphagia

Only ten (25.0%) of the participants demonstrated no deficits with regard to the efficacy of the swallow, which revealed that the larger majority 30 (75.0%) did. Table 24.2 provides a summary of the five deficit areas relating to the efficacy of the swallow, each section being presented below.

Table 24.2 Predominant deficits affecting efficacy of the swallow.

Oral phase deficits		No.	%
Poor lip seal	Unable to assess	4	10.0%
	No closure	4	10.0%
	Incomplete seal	8	20.0%
	Unilaterally weak/poor maintenance	9	22.5%
	Mild impairment	6	15.0%
	Total	31	77.5%
	NAD	9	22.5%
ii. Reduced tongue strength	Gross weakness	20	50.0%
	Unilateral weakness	7	17.5%
	Minimal weakness	13	32.5%
iii. Poor tongue coordination	No movement	10	25.0%
	Gross incoordination	4	10.0%
	Mild incoordination	11	27.5%
	Total	25	62.5%
	NAD	15	37.5%
iv. Impaired oral transit	No movement observed	5	12.5%
	Delay >10 sec	6	15.0%
	Delay >5 sec	15	37.5%
	Delay > 1 sec	10	25.0%
	Total	36	90.0%
	NAD	4	10.0%
v. Ineffective bolus clearance	No clearance	8	20.0%
	Some clearance/residue	13	32.5%
	Significant clearance/minimal residue	16	40.0%
	Total	37	92.5%
	Fully cleared	3	7.5%

Most of the study participants (77.5%) demonstrated difficulties with lip closure, which was not experienced by nine (22.5%) participants. The most significant difficulties observed with regard to the lips were weakness 22.5%, inability to achieve closure 10.0%, resulting in an open mouth posture or achieving only an incomplete seal 20.0%. The reduction of tongue strength was observed globally, as all the participants presented with some degree of tongue weakness. Twenty of the participants presented with gross weakness of the tongue (50.0%), seven (17.5%) with unilateral weakness and 13 (32.5%) with minimal weakness. This was closely followed by difficulties with tongue coordination observed in 25 (62.5%) participants.

Difficulties with oral transit or mechanical clearance of the bolus was experienced by the majority, 36 (90%) of the participants, with only four (10%) not having any problems;

observed as a delay in the initiation of the swallow and ineffective clearance of the bolus, which resulted in residue remaining after the swallow observed in 37 (92.5%) of the participants.

Signs of impaired safety of the swallow (cough, voice change, impaired hyolaryngeal elevation, accompanied by oxygen desaturation and abnormal swallow sounds) were found, with 52.5% demonstrating some signs of penetration and/or aspiration while swallowing. Table 24.3 presents the predominant deficit areas relating to the pharyngeal phase. Signs of penetration were observed as gurgling during the swallow and coughing before, during or after swallowing which was detected in 12 (30.0%) and nine (22.5%) participants respectively. Twenty-six (65.0%) participants demonstrated difficulties with hyolaryngeal elevation.

Table 24.3 Predominant deficits affecting the safety of the swallow.

Pharyngeal phase deficits		No.	%
i. Impaired reflexive and voluntary cough	No reflexive cough observed	8	20.0%
	Weak reflexive cough	15	37.5%
	No attempt at voluntary cough	12	30.0%
	Voluntary cough inadequate	8	20.0%
	Voluntary cough bovine	8	20.0%
	NAD	12	
ii. Change in voicing	Aphonic/unable to assess	10	25.0%
	Wet/gurgly	9	22.5%
	Hoarse	4	10.0%
	Mild impairment	7	17.5%
	Total	30	75.0%
	NAD Reflexive	17	42.5%
	NAD Voluntary	12	30.0%
iii. Impaired hyo-laryngeal excursion	No swallow	1	2.5%
	Pooling/gurgling (laryngeal elevation incomplete)	12	30.0%
	Laryngeal elevation mildly restricted/slow/incomplete	13	32.5%
	Total	26	65.0%
	NAD	14	35.0%
iv. Ineffective bolus clearance	No clearance	8	20.0%
	Some clearance/residue	13	32.5%
	Significant clearance/minimal residue	16	40.0%
	Total	37	92.5%
	Fully cleared	3	7.5%

The most concerning finding relating to the safety of the swallow, was that 57.5% of the participants did not present with a voluntary cough effective enough to clear penetrated material, and 70.0% could either not cough on command, or presented with an inadequate or bovine cough attempt. The poor cough response was observed during the pharyngeal phase of the swallow, as 12 participants were not coping during the swallow, but only nine demonstrated a cough before, during or after the swallow.

After initiating the swallow, poor bolus clearance and management of saliva was observed in nine (22.5%) participants, and was observed as a change in vocal quality, namely gurgly and or wet vocal quality. Ten (25%) of the participants were aphonic or could not voice on

command; for those who were aphonic wet, gurgly or crackles were heard after the swallow during CA, which were absent in participants who were able to effectively clear the bolus.

24.7.3 Oral hygiene and oral bacteria

Oral hygiene status was found to be very poor among all participants, with a high prevalence of bacterial colonization. Table 24.4 indicates that each participant presented with at least a minimum of one oral hygiene issue at the time of assessment, with a mean of 4.25, a median of 4 and a maximum of 7.

Table 24.4 Central tendency and dispersion for the number of oral hygiene problems (N=40)

Mean	S.D.	Minimum	Quartile 1	Median	Quartile 3	Maximum
4.23	1.85	1.00	3.00	4.00	6.00	7.00

24.7.4 Oral findings

The most significant oral hygiene issues, as listed in Table 24.5 were related to the use of dentures, saliva, oral cleanliness and the tongue, with 80%, having hygiene related issues related to the latter. The most prevalent issue was related to white patches on the tongue, with 37.5% being affected, closely followed by the tongue having an abnormal coating, such as a hairy tongue or thick plaque, which was noted in 32.5% of the participants.

Table 24.5 Oral hygiene indicators relating to the most prevalent conditions of the oral cavity

Variable	Status	Oral hygiene indicators	Number	Percentage
i. Gums and tissues	Normal		19	47.5%
	Abnormal 21 (52.5%)	Dry/shiny	6	15.0%
		Red/white patches	2	5.0%
		Signs of inflammation	6	15.0%
		Oral mucosal lesions	6	15.0%
		Signs of possible fungal infection	1	2.0%
ii. Tongue	Normal		8	20.0%
	Abnormal 32 (80.0%)	Some white patches	15	37.5%
		Red	0	0%
		Ulcerated/swollen	3	7.5%
		Abnormal coating	13	32.5%
		Unable to view	1	2.5%
iii. Oral cleanliness	Normal		7	17.5%
	Abnormal 33 (82.5%)	Localized plaque	6	15.0%
		Generalized plaque	7	17.5%
		Tartar/calculus on teeth	3	7.5%
		Accumulated saliva	4	10.0%
		Food particles	13	32.5%
iv. Saliva	Normal		16	40.0%

Although natural dentition was in a good condition for most of the participants, 24, (60.0%), of the 25 who had dentures, a large majority (71.43%) experienced problems relating to their use. Of those who needed to wear dentures, nine (32.1%) did not have them, which was often due to family members not bringing them to the hospital for fear that they would go missing, or participants not wanting to wear them due to a poor fit. Of the 19 who had dentures with them, 21.43% had difficulties with the dentures being loose. When dentures were worn they were starting to cause pressure or broken areas in two (7.2%) participants, while three (10.7%) demonstrated the presence of tartar build-up, as seen in Table 24.6.

Table 24.6 Type and condition of dentures

Type of dentures	Number of participants	Percentage
None	15	38.46%
Upper only	5	12.82%
Lower only	0	0%
Upper and lower	19	48.72%
Condition of dentures		
No broken areas, regularly worn	8	28.57%
Broken areas	1	3.57%
Causing pressure areas	1	3.57%
Loose	6	21.43%
Tartar build-up	3	10.71%
Not available	9	32.14%

24.7.5 Oral bacteria

Oral cleanliness was poor in a large majority of participants; 33 (82.5%) in total related to the accumulation of plaque seen in 33 (32.5%), tartar/calculus observed in 3 (7.5%), food particles in 13 (32.5%), and four (10.0%) presented with accumulated saliva. Clearance of saliva was a problem for 10 (15.0%) participants, which resulted in the pooling of saliva in the oral cavity, sticky ropey secretion sticking on the tongue, palate or cheeks (7.5%), and discoloured secretions due to bleeding in one (2.5%) participant.

Eleven (27.5%) had dry/sticky tissues, while three (7.5%) presented with tissue that was parched and red. Only 15 (37.5%) participants presented with normal oral flora, which means that the majority (62.5%) had bacterial organisms that are not part of the resident oral flora. Seventeen (42.5%) had at least one bacteria strain present; seven (17.5%) had up to two strains and one (2.5%) participant had up to three bacterial strains present. Table 24.7 lists the most commonly occurring organisms isolated from the oral cavity of participants, these being (a) candida and various strains of the candida species (47.5%) and (b) opportunistic respiratory pathogens (37.5%). Twenty-two (47.5%) participants had only yeast; the remainder of the participants' cultures had single isolates of opportunistic respiratory pathogens or opportunistic respiratory pathogens co-occurring with yeast.

Table 24.7 Bacteria isolated and degree

Organism isolated	Normal		Scanty		Moderate		Profuse	
Candida/yeast								
Candida species growth	0	0%	0	0%	1	2.5%	0	0%
Candida albicans growth	0	0%	1	2.5%	8	20.0%	5	12.5%
Candida tropicalis growth	0	0%	0	0%	1	2.5%	0	0%
Candida glabrata growth	0	0%	0	0%	1	2,5%	2	5.0%
Gram-negative bacteria								
Staphylococcus aureus growth	0	0%	0	0%	1	2.5%	2	5.0%
Klebsiella pneumoniae growth	0	0%	0	0%	0	0%	4	10.0%
Enterococcus faecalis growth	0	0%	0	0%	0	0%	3	7.5%
Pseudomonas aeruginosa growth	0	0%	1	2.5%	0	0%	1	2.5%
Group B Streptococci growth	0	0%	0	0%	0	0%	2	5.0%
Stenotrophomonas maltophilia growth								
Normal oral flora	15	37.5%	0	0%	0	0%	0	0%

24.8 DISCUSSION

This study found that among hospitalized patients presenting with dysphagia, varying from LED to severe, oral hygiene status was found to be similar and very poor, with a high prevalence of bacterial colonization. The findings support those of previous studies, which report the prevalence of oral health problems among acutely hospitalized patients to be very high..^{10,12,19}

Signs of impaired efficacy and safety of the swallow were found in most of the study participants, including those who presented with LED. Results thus indicated a high prevalence of oropharyngeal dysphagia among hospitalized patients and found that patients with oropharyngeal dysphagia had severely impaired swallow and airway protection mechanisms, observed as problems with tongue strength and coordination, initiation of swallow, bolus clearance and impaired cough responses.

Studies have shown that effective salivary flow and swallowing is needed to clear bacteria laden secretions from the oral and pharyngeal cavities.^{20,21} Difficulties with saliva production and clearance were found in 60% of the participants, ranging from hyposalivation to pooling of saliva in the oral cavity due to poor clearance. Poor mechanical clearance of the bolus, which included the clearance of accumulated saliva, resulted in oropharyngeal residue. This was found to be an area of significant difficulty for most dysphagic participants in this study, particularly related to tongue weakness and difficulties with coordination. According to Palmer et al. (2001) the reduction in mechanical clearance of potential pulmonary and oropharyngeal pathogens may be the first step in the path that leads to oral pharyngeal colonization and pneumonia, as oropharyngeal residue which is not cleared promotes bacterial growth and invasion as it allows pathogens increased time in the mouth for proliferation. Reduction in mechanical clearance could also have accounted for the finding that all participants, 100% presented with deficient oral cleanliness related to the accumulation of plaque, saliva and debris e.g. food particles.

The motor function of the tongue is described to be related to its self-cleaning function,²² with reduced activity due to weakness possibly accounting for the finding that 80.0% of the study participants had oral hygiene related issues with regard to their tongue, more specifically tongue coating. What is concerning about this finding is that studies have identified the dorsum of the tongue as a major oral site of bacterial multiplication, as well as the major source for the bacteria found in saliva, thus, many salivary bacteria mirrors that coming from the flora of the dorsum of the tongue²²⁻²⁴ which could account for the high prevalence of pathogenic bacteria found in the oral cavities of participants with dysphagia.

A high prevalence (62.5%) of opportunistic bacteria was isolated from the oral cavities of participants who presented with dysphagia. A total of 42.5% of the participants had at least one bacteria strain present. In recent years the interaction between opportunistic respiratory pathogens and *Candida albicans* has been reported.²⁵ This finding was corroborated in the current study as the most commonly occurring bacteria in the oral cavity of participants were, (a) candida species and (b) opportunistic respiratory pathogens. In five (17.5%) participants *Candida albicans* was found to co-occur with an opportunistic respiratory pathogen.

Research states that as long as the microbial load is not too high, the harmony between pathogenic bacteria and oral resident flora will not be tilted toward infection.^{13,23} However, the results of this study indicate that when bacterial species were found in the oral cavities, the virulence was already quite high, suggesting the delicate oral homeostasis potentially having already been tipped toward infection and if not treated could potentially lead to systemic disease such as AP²⁶.

24.9 CONCLUSION

Due to the many oral hygiene issues in patients with dysphagia that could lead to a high prevalence of colonization of respiratory pathogens, the findings of this research study showed that the oral hygiene status of people with dysphagia is concerning. It is thus not surprising that the concept of oral health has become an emerging area of interest among medical professionals who treat individuals with dysphagia. Oral hygiene remains an unmanaged factor in the context of pneumonia management; therefore the following recommendations are drawn from the study:

- Oral hygiene should be screened for, particularly in patients who present with dysphagia to prevent complications.
- A multidisciplinary team approach to the management of dysphagia, which includes utilizing dental care professionals in mouth risk management, should be developed, implemented and supported in hospital care facilities.
- Future studies should focus on the effectiveness and use of oral hygiene screening tools used by Speech-Language Therapists during clinical swallow evaluations.
- Ongoing awareness and training should be provided regarding the importance and provision of oral healthcare, especially in the dysphagia population.

Obtaining and documenting clear, relevant data about the oral hygiene status of patients with dysphagia who are admitted to hospital facilities in South Africa is an essential first step in planning strategies to treat and prevent AP in hospital settings. This will have far reaching implications within the health care setting, as maintaining oral health to reduce the risk of

aspiration pneumonia is easier and less expensive than managing the disease once it occurs, and has implications for cost savings.

24.10 ACKNOWLEDGMENTS

A CHS Masters Scholarship, provided by the University of Kwa-Zulu Natal, Durban, South Africa, financially supported this study. The author thanks A. Krige, the hospital manager at the research site for allowing data collection to take place at the institution, and the participants and family members for their willingness to take part in the study. A special note of thanks is given to the Oral Hygienist, N. Grobler, for contributing her services during data collection, and Ampath Laboratories, Greenacres Hospital, Port Elizabeth and Dr. L. Nut for their contribution toward interpretation of results and Prof. M. Pillay for his guidance and supervision during the write up of the manuscript. The researcher declares no conflicts of interest.

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APPENDIX N
DEMOGRAPHIC DETAILS OF PARTICIPANTS

Table 25.1 Demographic details of participants who presented with dysphagia.

Variable	Characteristic	No.	%
Gender	Male	23	57.50%
	Female	17	42.50%
Age in years	20-59	13	32.50%
	60-99	27	67.50%
Diagnosis	Stroke	17	42.50%
	TBI	2	5.00%
	Anoxic brain damage	1	2.50%
	Haemorrhage	6	15.00%
	Cancer	3	7.50%
	Meningitis	2	5.00%
	Neurological conditions	3	7.50%
	Other conditions	5	15.50%
	No conditions	3	7.50%
Diet	PEG	13	32.50%
	NGT	4	10.00%
	Level 2 (Puree)	13	32.50%
	Level 3t (soft transitioning)	4	10.00%
	Level 3 (soft)	6	15.00%
Level of consciousness (Alertness)	No response	8	20.00%
	Difficult to rouse	1	2.50%
	Fluctuates	6	15.00%
	Alert	25	62.50%