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Oral Care and the Connection to Adverse Events in Dentistry

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This is to certify that the doctoral dissertation by

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Walden University
2018

Abstract

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by

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MA, Walden University, 2013

BS, William Paterson University, 1997

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

As the healthcare industry continues to change, dental providers are concerned about the different types of adverse events that can occur if systemic diseases are not well understood when treating patients. The purpose of this study was to explore the level of understanding among dental care providers of the relationship between oral care and systemic diseases and how these are linked to adverse events. The theoretical foundation that was used for this study was the Swiss cheese model. The research questions were designed to address the level of understanding among dental care providers of the link between oral care and systemic diseases as well as their perceptions of adverse events in dentistry and why they occur. Using a qualitative phenomenological approach, interviews were conducted with 10 dental care providers who practice in the New Jersey area. As I reviewed the field notes and listened to the audio recording, themes were developed to gain a deeper understanding of the research. The research findings revealed that dental providers have moderate knowledge of systemic disease and that some dentists had encountered an adverse event when providing oral care to patients; this experience led participants to look at patients' overall health instead of only oral care. Positive social change could result from improved training and education for dental providers to gain a better understanding of systemic diseases and systems such as the Swiss cheese model for preventing adverse events in patients with systemic diseases. Dental providers should be more involved with community services by providing health fairs to educate the public about why taking care of their oral health is as important as their physical health.

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Chapter 1: Introduction to the Study

Oral Care and the Connection to Adverse Events in Dentistry

Dental practitioners and dental institutions are committed to care that is safe, timely, efficient, effective, equitable, and patient centered (Kalenderian, Obadan, & Ramoni, 2015). An adverse event in dentistry is any unfavorable, undesired, and generally unforeseen incident caused by an error or omission during the dental treatment, which can have negative consequences for the patient's health (including physical or mental damage, and/or prolonged treatment time (Perea-Perez, Labajo-Gonzalez, Santiago-Saez, Albarran-Juan, & Villa-Vigil, 2014). Certain dental procedures and systemic diseases can lead to an adverse event.

A clear understanding of these systemic diseases, their pathologic basis, how they are managed, and what modifications are needed to provide dental care to medically-compromised dental patients are needed. As the age of the population increases, individuals are living longer, which can lead future dental professionals to view dental care from a different perspective. Noncommunicable chronic diseases are the major health challenge across the globe and account for the majority of deaths (Lamster, 2016). An estimated 90% of the world's population suffers from a form of oral disease at some point in their life course; oral disease is recognized as a major global health burden (Jin et al., 2016). Oral conditions have increased in prevalence because of significant population growth and aging (Southerland, Webster-Cyriaque, Bednarsh, & Mouton, 2016). Dental caries and periodontics are considered to be the causes of tooth loss, and these conditions can significantly affect an individual's quality of life (Jin et al., 2016). Periodontitis is a

chronic inflammatory condition following bacterial colonization of the gingiva that successively degrades the tissues attaching the teeth to the alveolar bone (Kjellstrom, Ryden, Klinger, & Norhammar, 2016). The U.S. Surgeon General called this disease a "silent epidemic" (Benjamin, 2010; U.S. Department of Health and Human Services, 2000) and yet it is the major cause of tooth loss in children and can have serious health consequences, such as odontogenic infection and even mortality (Jin et al., 2016).

An individual's oral health care can change from simple to complex issues. There are some who believe it is inevitable that dentists will put their own interest before those of patients (Holden, 2016). The planning of change in the dental industry must link to the philosophy of care by meeting the expectations of the society and individual's behavior. As the dental industry continues to change, providers have to change their mindset on how they view procedures and how procedures are conducted. This will involve understanding systemic disease demography to provide care as well as implementing healthcare models to help address adverse events from continuously occurring.

My goal with this research study was to gain a better understanding of oral care, how systemic diseases are linked, and how systemic diseases can cause an adverse event in dental care. Systemic disease is not the only concern for dental providers; there is also fatigue, inexperience, understaffing, and vague organizational policies (Kalenderian et al., 2015). Even though errors will occur, when they do, instead of asking whom, it should be asked how, or the system may become ineffective (Yanik & Cetin, 2014). The potential positive social change that can result from this study is the development of treatment strategies for oral care and systemic diseases and a dental home model that

represents innovation and an opportunity to not only positively affect healing outcomes but also incorporate oral health into collaborative interdisciplinary practice (Southerland et al., 2016). The major sections of this chapter will include the background, problem statement, theoretical framework, purpose of the study, research questions, nature of the study, assumptions, and limitations.

Background

Adverse events in dentistry can take place in many different types of procedure settings. Examples can include placement of a tooth restoration with a piece of the material swallowed or aspirated by the patient or incorrect placement of the rubber dam during an endodontic procedure resulting in the patient swallowing the liquid used to irrigate the tooth (Silva, Martins, Prado, Junior, & Junior, 2011). Another example is the endodontic file slipping out of the provider's hands and becoming lodged in the patient throat (Silva et al., 2011). Other types of adverse events that can occur during dental procedures are respiratory complications, prolonged sedation, cardiac arrhythmias, brain injuries, and/or death.

Some adults and patients with disabilities require sedation or general anesthesia to complete a thorough oral examination and subsequent care because of behavioral, communicative, or medical problems (Stillwell & Anderson, 2013). Yanik and Centin (2014) conducted a study to determine the levels of patient safety and adverse event assessment among healthcare employees working at oral and dental health centers based on six factors: hospital safety, team work, security gap, system quality, adverse event assessment, and management assistance. They found that there was still a risk of harming

patients even though adverse events took place in an environment considered to be safe. The occurrence of adverse events continues to challenge health service providers.

One type of adverse event is prolonged QT syndrome; a condition that can potentially cause fast chaotic heartbeats that can cause sudden death (Mikesell, Atkinson, & Rachman, 2011). Providers need to be aware of this condition before inducing sedation because many patients go undiagnosed (Mikesell et al., 2011). There was a case of a 4-year-old girl who was diagnosed with prolonged QT syndrome when she was admitted to the hospital because of a fall that led her to have an emergency root canal done in the operating room (Mikesell et al., 2011). As the operating room staff was preparing the 4-year old girl for the procedure, medication was administered to her at a high volume that caused her to have a wide complex heart dysrhythmia of variable rate (Mikesell et al., 2011). With fast action, the clinical staff in the operating room was able to get the heartbeat under control before it turned into an adverse event (Mikesell et al., 2011).

In one hospital, a corrected site surgery checklist known as *time out* was introduced to reduce adverse events before procedures, and this checklist became part of hospital policy. During the period from 2009 to 2012, five cases of wrong tooth extraction occurred at the hospital (Tickle, Campbell, & O'Malley, 2015). Removal of the wrong tooth can cause appreciable morbidity and leaves the surgeon and organization liable for litigation and scrutiny by regulatory bodies (Kenpil, Harvey, & Beevj, 2012).

Many adverse events are preventable. In a case of a man who accidently swallowed an endodontic file during a procedure, if a checklist had been used the adverse event may have been avoided. The passage of foreign objects through the oropharynx

during endodontic treatment constitutes a totally predictable and avoidable accident, and it is the responsibility of the dentist to prevent its occurrence by using a rubber dam in all cases (Silva, Martins, Prado, Junior, & Junior, 2011). Rotary equipment is also known to be a threat to patients; a spinning burr can easily cut tissue outside of the surgical site if allowed to rotate while inserting or removing the drill from the site (Hupp, 2015). An increase of adverse events has become a main focal point for dental providers; consequently, a goal of dental care is to avoid preventable adverse events to the greatest extent possible and to limit the negative consequences of those adverse events, which are unpreventable.

Dental implant treatment, endodontic treatment, and oral surgery display the highest frequencies of adverse events (Perea-Perez et al., 2014). When a patient is scheduled for a cardiac operation, the patient must be cleared by a dentist to make sure there is no dental infection which could result in cardiac infection.. Patients with decompensated and untreated heart disease scheduled for cardiac operation, in particular, are at substantial risk for adverse outcomes when subjected to surgical stress (Smith et al., 2013).

Pediatric dental sedation has been associated with patient death in children that were younger than 5 years old. Lee, Milgrom, Starks, and Burke (2013) conducted a study of 44 patients and the circumstance surrounding their deaths; half of the patients were female and younger than 5-years old. Three of the children in their study had preexisting conditions: a 10-year old with Treacher Collins syndrome (autosomal dominant congenital disorder/craniofacial deformities) and a history of a tracheostomy, a

2-year old with congenital pulmonary stenosis, and a 13-month old who died on induction of general anesthesia.

Inadequate sterilization is another major issue that dental providers also need to be aware of in their practices. Cross contamination is common when equipment is not maintained or monthly cleanings are not completed (Green, 2013). Instruments that are used on patients can become cross contaminated and a patient could acquire a disease they never had before coming into contact with the instrument (Green, 2013). As an example, a Tulsa, Oklahoma patient tested positive for HIV and hepatitis C, and the source of how the patient became positive was traced back to an oral surgery procedure (Green, 2013). As the case was being investigated, it was found that the autoclave machine had not been tested in 6 years for cross contamination after discovering two sets of instruments was placed in the autoclave of one patient that have infectious diseases (Green, 2013).

Healthcare workers are at risk of sustaining a percutaneous injury with a contaminated sharp object every year (Prabhu et al., 2014). Prabhu et al. (2014) conducted a study in Tamilnadu, India of dental nurses and needle safety because there is no training for nurses who practice dentistry in India. The results of the study reflected that 34 dental nurses reported being stuck by a needle. Cross contamination also occurs when working with patients who may have a disease and the staff member is stuck by the needle that was used to treat a patient (Green, 2013). Needle stick injury poses an occupational hazard for transmission of blood-borne infections such as hepatitis B virus (HBV), hepatitis C virus (HCV), and HIV (Prabhu et al., 2104). The errors in dental care

may be of a human origin (in which a professional reaches an erroneous decision or provides a deficient treatment), but in most cases the occurrence of errors are to a great degree dependent upon many contributing factors related to the systems, which can lead to a chain of errors and end up causing harm to the patient (Perea-Perez et al., 2011).

Several studies have emphasized the importance of monitoring for prevention of adverse outcomes; inadequate monitoring could reflect problems with staff training or inadequate equipment resulting in an inability to recognize and respond appropriately to an adverse event (Lee, Milgrom, Starks, & Burke, 2013). There is insufficient data regarding adverse events in regular dental practice, which makes it difficult to obtain reliable data due to the dispersion of sources, and secrecy, which tend to surround these types of incidents (Perea-Perez et al., 2012). Although research about patient safety training has been conducted, a gap in the literature exists because research on adverse events in dentistry has not been well studied since 1970 (Yanik & Cetin, 2014).

Problem Statement

Buhrow and Buhrow (2013) reported that in the United States, more than 40,000 patients in general are injured each day. The lack of supervision, training, teamwork, and technical skills leads to problems with transition of care, communication barriers, poor information exchange, and interruptions, which are consistently cited as major causes of error among dental professionals (Kalenderian, Obadan, & Ramoni, 2015). In healthcare, research shows that most adverse events are caused by prescriptions and administration of drugs (Perea-Perez, Santiago-Saez, Garcia-Marin, Labajo-Gonzalez & Villa-Vigil,

2011). If a dentist is not aware of a patient's systemic disease and a drug prescription is written for that patient, this can cause a negative outcome.

The notion that oral or periodontal infection can influence systemic health is not new to dentistry and has been proposed at various times throughout the centuries (Shwetha et al., 2016). There are individuals who do not find oral care to be a priority. When patients do not address their oral care, this can lead to many health issues. Periodontal disease is one of the leading diseases in dental patients. Periodontal disease is composed of a group of chronic inflammatory conditions affecting tooth-supporting tissues with a global prevalence of severe periodontitis of 743 million people worldwide (Rebelo, DeCastro, Vieira, Robinson, & Vettore, 2016). Since periodontal disease and heart disease share common risk factors and both predict health-related psychosocial outcomes, it may be that their effects are cumulative (Rebelo et al., 2016).

In dentistry, behavior and risk of disease are part of the oral care dynamics. Patterns of behavior and risk of diseases are only one part of the picture in regards to dental care. A second major factor likely to be responsible for some of the changes in oral health status is the change that has occurred in how dentists diagnose and treat caries and periodontal disease (Watt et al., 2013). For many dental practitioners, patient safety is a concern and understanding the types and causes of errors could help decrease adverse events.

Adverse events can result from an error (failure in the care professional) or accident (an unexpected and unforeseeable event which arises throughout the course of a treatment or during the patient's stay at a healthcare center; Perea-Perez et al., 2014). In a

study conducted by Perea-Perez et al. (2014), they found that adverse events included one erroneous tooth extraction; four cases of retained roots following tooth extractions; eight cases relating to endodontic therapy (including fractured instruments, perforations, and leakage of sodium hypochlorite into the apical tissues); and two cases of crowns being swallowed by patients. A common incident for both general and specialty dentists are patients swallowing an object during a procedure; injuries can occur in dentistry regardless of the specialty.

There are many reasons why dentistry must become more cognizant of patient safety; handling potentially dangerous pharmaceuticals is one reason (Perez-Perez et al., 2011). Dental procedures are becoming more aggressive, particularly the surgical techniques related to implantology (Perea-Perez et. al., 2011). For dentists and their staff, handling technical instruments (e.g., ionizing radiation and lasers) can be harmful, and contact of instruments with blood and bodily fluids of patients are a potential source for the transmission of disease (Perea-Perez et al., 2011).

Numerous epidemiological studies have investigated the association between oral diseases and a myriad of systemic conditions, including cardiovascular diseases, diabetes, pneumonia, rheumatoid arthritis, and pregnancy outcomes (Song, O'Donnell, Bekhuis, & Spallek, 2013). The results of these studies reflected that there is a link between oral infection (periodontitis diseases) and systemic diseases. The results of Paquette, Madianos, Offenbacher Beck, and Williams's (1999) study provided overwhelming support that periodontitis may confer the independent risk of systemic conditions, in particular, cardiovascular diseases and preterm low birth weight.

Practicing dentists in the United States are noticing an increase in numbers of patients with systemic conditions with ill health and comorbidities that complicate care (Song et al., 2013). These patients are challenging to care for when the relationship between oral care and systemic disease is not well understood by the patient (Song et al., 2013). There is also an increase in the aging population with Down syndrome who has secondary disorders, such as Alzheimer's disease and diabetes mellitus, that are conditions that dental care providers need to recognize (Abanto et al., 2011). Dental providers must be aware of the medical conditions that may affect the delivery of oral health care for patients.

Patients who are diagnosed with thrombocytopenia, an inadequate platelet count to clot the blood, are at a high risk for hemorrhaging and bleeding complications when undergoing dental extraction (Fillmore, Leavitt, & Arce, 2013). At the discretion of an oral surgeon, they will determine if a patient can move forward with a dental extraction. A study was conducted that measured age, gender, platelet count, and transfusion of platelets before or during surgery (Fillmore et al., 2013). In this study, 68 patients underwent the extraction of 200 teeth while thrombocytopenic platelets were less than 100,000/ul. Five patients in the study had postoperative bleeding as a complication due to low platelets. After the procedure, patients were seen in a follow up; all the patients in the study were seen except two who expired from their disease. Two surgical site infections occurred with patients who suffered from myeloid leukemia (Fillmore, Leavitt, & Arce, 2013).

Oral health is frequently affected on a daily basis by various forms of oral disease, mainly dental caries, periodontal disease, and orofacial pain clefts (Lamster, Pitts, & Warnakulasuriya, 2015). Systemic diseases were a previous concern, but providers did not address the issue until some patients started to develop various conditions and the care for these patients became more complicated. There is a need for more research on the connection between oral care and systemic diseases to develop actionable clinical guidelines to improve care and to avoid adverse events from occurring.

Purpose of the Study

The purpose of this qualitative, phenomenological narrative study was to explore the level of understanding among dental care providers of the relationship between oral care and systemic diseases and how these were connected to adverse events. Narrative studies were also influenced by the emphasis of phenomenology on understanding lived experience and perceptions of experience (Patton, 2002). In this study, I explored dental care providers' perceptions of adverse events and why they occurred. I conducted this qualitative study to gain a deeper understanding of oral care, systemic diseases, and the occurrence of adverse events in the field of dentistry.

Research Questions

I developed the following research questions to guide this study:

RQ1: Among dental care providers, what is the level of understanding of the relationship between oral care and systemic diseases and how these can lead to an adverse event?

RQ2: Among dental care providers, what are the perceptions about adverse events in dentistry and why they occur?

Conceptual Framework

There are several reasons why adverse events could occur in dentistry. Several theories have been formulated to explain the mechanism of errors and how unchecked, latent systemic factors; threats; or failure can lead to the occurrence of adverse events (Kalenderian et al., 2015). Patients can be injured during dental treatment; one of the common incidents for both general dentists and specialists occurs when a patient swallows an object (The Dental Insurance Company Risk Management Staff, 2015). According to the Oral and Maxillofacial Surgeons National Insurance Company, approximately 1,200 wrong site extractions have occurred since 1988 (Buhrow & Buhrow, 2013).

One human factors model, well known in healthcare, is the Swiss cheese model, where each layer of defense (e.g., surgical checklists), latent conditions such as poor design, and lack of training create holes in these layers as they occur in succession and lead to adverse events (McKernon, Taylor, Reid, & Balmer, 2016). The Swiss cheese model attempts to identify system failures with each layer acting as a defense against potential error influencing the outcome. Reason (1990) introduced the Swiss cheese model to describe this phenomenon; errors made by individuals result in disastrous consequences due to flawed systems (i.e., the holes in the cheese; Agency for Healthcare Research and Quality, 2015). The Swiss cheese model is designed for clinicians to receive feedback and make changes to improve care by noticing an adverse event

repeating itself and stopping it from moving forward. Dental procedures are becoming more aggressive particularly with respect to surgical techniques; the function of the Swiss cheese model is to address adverse event occurrence for a length of time.

Authors of later works have modified the Swiss cheese model to address specific healthcare-related safety incidents. Sanders and Cook (2007) modified the Swiss cheese model to make it specific to a primary care dentistry setting when an adverse event occurs due to holes in the protective layers. In their study, an adverse event occurred when a new provider for a dental practice did not get the full orientation to the protocol of the practice in regards to the consent form policy. The authors provided this scenario to reflect how the Swiss cheese model was used to identify the adverse event. In the scenario, the patient came to the dental practice to have the removal of both maxillary first premolars. The new dentist had a short orientation and was also working with a nurse who was in training and really did not speak up when she saw a procedure being done wrong. The nurse felt that she did not have the right to question the dentist's work. Because the new dentist was running late from another procedure, he had only glanced at the recommendation from the orthodontist to remove the first molars. The new dentist proceeded to remove the second molars instead of the first molars, even though the nurse noticed he was removing the wrong teeth and remained quiet. After the procedure was completed, the dentist dismissed the patient. The patient returned to the orthodontist's office and the orthodontist noticed the wrong teeth were removed and immediately called the dentist and informed him of the error. Holes in a single layer of the cheese will not necessarily lead to an error, this only occurs when all of the holes are lined up in a

trajectory of both active and latent failure; an error in this case was the wrong tooth being extracted (Bailey et al., 2014).

The terms *sharp end* and *blunt end* correspond to actual error and potential error (AHRQ, 2015). Personnel at the sharp end may be holding a scalpel when the error is committed (e.g. extraction of a wrong tooth) or figuratively be administering any treatment (AHRQ, 2015). When a procedure goes wrong, a patient may develop a negative feeling about that facility and share negative experiences with others. Creating a culture of safety in which reporting of active errors is encouraged, analysis of errors to identify latent causes is standard, and frontline workers are not punished for committing slips is also essential for finding and fixing systematic flaws in health care systems (AHRQ, 2015).

With the Swiss cheese model, there is usually a series of apparent errors that can be identified (Buist & Middleton, 2016). The Swiss cheese model explains the failure of numerous system barriers or safeguards to block errors, each represented by a slice of cheese. The defects in these processes are signified by holes in cheese slices that allow errors to pass through and harm to reach the patient (Stein & Heiss, 2015). Applying the Swiss cheese model may help with the reduction of adverse events in dentistry and the growing population of patients with systemic diseases.

Nature of the Study

In this study, I used a qualitative methodology to help understand the link between oral care and systemic diseases and how these can lead to an adverse event. A qualitative approach was the most appropriate method because it allowed me to carry out

a process of inquiry to understand the research problem within the natural surroundings of the topic being researched. The approach for this study also allowed me to identify how the individuals involved perceived events. Qualitative research methods are known to explore human experiences.

In this study, I used the research design of phenomenology along with a narrative research approach. Phenomenology has roots in philosophy, focusing on the lived experience of individuals (Patton, 2002). The narrative research method was used to gain a clear analysis of the stories told by the participants. Narrative research allows the collection of an oral history and consists of gathering the personal reflections of events and their causes and effects from one individual or several individuals (Creswell, 2013; Plummer, 1983). The participants I selected had similar stories and life experiences to tell, and this is why narrative research was a suitable approach to gather the data I needed.

In interviews, I asked study participants to give a detailed account of their understanding and perceptions of oral care and systemic disease. Also, this approach allowed researchers to immerse themselves in the setting and obtained an in-depth understanding of the phenomenon being studied (Janesick, 2011). The participants for this research study were dental care providers from private practices to hospital dental centers. Data were collected from recorded interview sessions.

Definitions

Systemic diseases: Diseases such as diabetes, periodontal, heart, osteoporosis, respiratory, and cancer (American Academy of Periodontology, 2016).

Adverse event: Any unfavorable, undesired omission during the dental treatment, which has negative consequences for the patient's health (including physical or mental damage and or prolonging the treatment time; Perea-Perez et al., 2014).

Assumptions

The assumptions I made about this study were:

1. Dental providers offer risk communication with their patients. Generally, risk communication is considered to be a cognitive process that is primarily going to have an impact on patients' understanding of treatment choices (Asimakopoulou, Rhodes, & Daly, 2016).
2. Fear may exist that reporting adverse events might have some repercussion on the commercial profits of dental clinics (Perea-Perez et al., 2011).
3. Dentists may deem nonlife-threatening errors to be insignificant, and hence, not important to report (Thusu, Panesar, & Bedi, 2012).
4. Dentists will be truthful in their responses during the interviews conducted as part of this study.

Even though dentistry is a business and individuals may be unwilling to report incidents, patients will likely be the first to speak of their negative experience. Dentists do not expect to cause harm to patients during a procedure, but harm may still happen.

Scope and Delimitations

Patient safety in oral care has not been well studied. In this study, I focused on dental providers who had experienced treating individuals who have systemic disease. These groups of patients presented the greatest challenge for dental providers. I did not

focus on adverse events that occurred in nonsystemic disease individuals because there was less concern that an adverse event would occur. A patient with a nonsystemic disease is less likely to have an adverse event than a patient who has pneumonia, due to aspiration of oral pathogens in the respiratory tract of susceptible host (CITE). It is important to continue to focus on individuals who have systemic disease in order to increase knowledge on how to treat them orally. In this phenomenological, qualitative research study, I focused on adverse events and the link with oral care and systemic diseases in dental patients. The strategies that could be used to provide oral care to these particular patients could also be used for nonsystemic diseases patients as well.

The concept of the medical and dental model expands the scope and places more emphasis on adults with chronic conditions in collaborating with the medical practices (Southerland, Webster & Bednarsh, 2016). As with the collaborative model, this model involves patient-centered care as well as community-based preventative intervention and includes oral health to increase access to care, improved health outcomes, and reduce burden of diseases (Southerland et al., 2016). Among chronic diseases that impact health outcomes, oral infection and inflammation were often overlooked events though dental caries and periodontitis represent the first and sixth most prevalent global diseases (Southerland et al., 2016). Oral conditions have increased in prevalence because of significant population growth and aging (Southerland et al., 2016). Even though this model could have also been beneficial to this study, I recommend the Swiss cheese model because it gives a more detailed step-by-step view of how adverse events occur.

Limitations

The main limitation of this study was due to dental care providers not willing to report adverse events because of the negative impact it may have on their practice and their professional capacity. Dental care is fundamentally private, and a fear may exist that reporting adverse events might have some repercussion on the commercial profits of clinics (Perea-Perez et al., 2011). Providers may hesitate to share an experience of an adverse event that occurred because they may fear being looked upon as a provider who is not professionally competent. A provider may also lack an understanding of systemic diseases and how it can affect oral care. Another limitation was that there is a lack of studies on adverse events in dentistry, which made it difficult to obtain reliable data due to the dispersion and confidentiality surrounding these incidents.

Depending on the geographic location, research bias may be present. This may be influenced by the socio-economic status of the patients who present to a practice. An example would be a patient who lived in the Summit, NJ area compared to a patient who lived in Newark, NJ. A provider may be reluctant to perform a certain procedure due to economic status of the patient and the patient's ability to pay for the procedure. Conducting structured interview sessions with dental providers who had been practicing dentistry for several years helped me to collect reliable data.

Significance

Dentists in the United States see an increasing number of patients with systemic conditions and should be knowledgeable about the different types of systemic diseases

that are linked to oral care. Poor oral hygiene is a primary cause of periodontal disease (Mosley, Offenbacher, Phillips, Granger, & Wilder, 2014). Periodontal disease has been reported to result in approximately a 24% to 35% increased risk for coronary heart disease (Mosley et al., 2014). Poor oral health (e.g., periodontal diseases and dental caries) has been shown to be associated with increased risk of atherosclerotic-cardiovascular disease (Joshy, Arora, Korda, Chalmers, & Banks, 2016).

Dental providers can improve their care for patients with systemic diseases by increasing their medical training, especially for individuals who live in low and middle-income areas. The training will allow dentists to implement new policies in treating these particular patients. This can avoid delaying treatment because dentists are fearful of an adverse event that may occur. An in-depth questionnaire to ask the patients about their current health condition should also be a part of this policy.

Demographic location can also affect social change in dentistry because many patients are not in compliance with their healthcare. When treating these patients orally, there is a high chance of an adverse event occurring. It is important for dental professionals to have the appropriate clinical skills to meet the changing oral health needs of the adult population (Watt et al., 2013).

For many dental practitioners, patient safety is a concern and understanding the types and causes of errors could help decrease adverse events; even though recommendations are given out, safety issues are at a high level (Perez-Perez et al., 2011). Delayed treatment, unnecessary treatment, or disease progression after misdiagnosis were the largest types of harm reported (Kalenderian et al.,). Of the 182

publications Kalenderian et al., (2015) reviewed that contained 270 cases, 24.4% of those cases involved an adverse event where patients experienced permanent harm. There are other reasons that have been formulated to explain why errors occur in the dentistry, including provider fatigue, inexperience, understaffing, poor supervision, faulty equipment, teamwork, vague organizational policies or procedures, or a poor safety culture (Kalenderian et al., 2015).

The results of this research study could advance knowledge in the discipline through development of a better understanding of systemic diseases and how oral care can be connected to systemic disease as well as how adverse events can result from the lack of understanding of care for patients with systemic diseases. Revamping current policies to address adverse events in dentistry and encouraging a work culture where there is sufficient staffing, fully functioning equipment, and adequate supervision could make a difference in how dental providers approach different situations. Positive social change can benefit many dental providers if the implementation of new systems is enforced in an effort to prevent adverse events in patients with systemic diseases. The dental industry continues to change procedural guidelines and dental providers need to be aware of the changes so that they can provide the most appropriate care for patients with systemic diseases. Providers can help people to improve their health by playing a role in community health promotion.

Summary

In this qualitative, phenomenological study, I explored the level of understanding that dental care providers had of the relationship between oral care and systemic diseases as well as their perceptions of adverse events and why they occur. When providing oral care, dental providers should be knowledgeable about different types of systemic diseases. When treating a patient with a systemic disease, dental providers should understand the correct way to provide oral care to help prevent an adverse event from occurring. As the healthcare industry continues to change, dental providers are concerned about treating patients with systemic diseases. Dental providers have a moderate knowledge of systemic disease and the population is living longer; their clients are the individuals who need oral care and have systemic diseases. Improving supervision, teamwork, training, and technical skills can decrease the transition of care to this particular patient population. In Chapter 2, I will discuss my literature search strategy, the theoretical framework for the study, and the literature related to my key concepts.

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Chapter 2: Literature Review

Introduction

Numerous epidemiological studies have investigated the association between oral diseases and myriad systemic conditions, including cardiovascular diseases, diabetes, pneumonia, rheumatoid arthritis, and pregnancy outcomes (Song et al., 2013). Practicing dentists in the United States see an increasing number of patients with systemic conditions in ill health with comorbidities that complicate care (Song et al., 2013). Because patients are aging and diseases, such as obesity and diabetes, may be more prevalent in the population, it can be challenging for dentists to care for these patients when the relationship between oral care and systemic disease is not well understood. In recent years, the relationship between oral care and systemic disease has become an important research topic (Song et al., 2013).

There is a need for more research on the connection between oral care and systemic diseases to develop actionable clinical guidelines to improve care and to avoid adverse events from occurring. Literature is available, but there is a gap in the literature as research on adverse events in dentistry has not been well studied since 1970 (Yanik & Cetin, 2014). The need to conduct research on adverse events in dentistry exists since it was last studied in the 1970s and advancements have taken place in the areas of medicine and dentistry since then. The occurrence of adverse events continues to challenge health service providers.

Dental procedures are becoming more aggressive, particularly the surgical techniques related to implantology (Perea-Perez et al., 2011). Handling technical

instruments (ionizing radiation, lasers, etc.) can be harmful to both the patient and provider, and contact between instruments and the blood and bodily fluids of patients are a potential source for the transmission of diseases (Perea-Perez et al., 2011). Even though recommendations are provided for both caregiver and patient safety, a significant number of adverse events still occur in dentistry (Perea-Perez et al., 2011). Supporting patient safety in dental practice relies on understanding the types and causes of errors, which have not been well studied (Kalenderian et al., 2015, para. 1).

The purpose of this phenomenological qualitative study was to explore the level of understanding among dental care providers of the relationship between oral care and systemic diseases and how these are linked to adverse events. I also explored dental care providers' perceptions of adverse events and why they occurred. I also conducted this study to gain a deeper understanding of oral care, systemic diseases, and the occurrence of adverse events in the field of dentistry. In Chapter 2, I will describe my literature search strategy and the theoretical framework as well as provide an overview of the existing literature related to oral care, systemic diseases, and adverse events in dentistry.

Literature Search Strategy

I conducted a literature search using different types of resources, including PubMed, MEDLINE, Walden Library, Morristown Memorial Hospital Research Library, books, personal communications, peer-reviewed articles, the AHRQ website, and Google search. Keyword search terms used were *patient safety, patient safety in dentistry, oral systemic diseases, staff development to improve care, Swiss Cheese model, adverse events in dentistry, oral health, case report, behavior change, social cognition model, dental*

public health, systemic diseases, evidence-based dentistry, accidental swallowing, dental instruments, endoscopy, sedation/adverse effects, prolonged QT syndrome, adverse event, medical care risk, dentistry, change management, patient feedback, patient satisfaction, quality improvement, adverse drug event, human error, airway management, dental prevention, anesthesia, emergencies in oral and maxillofacial surgery, dental education, health promotion, preventive dentistry, culture of safety, dental implants, surgical errors, safety checklist, wrong site surgery, medical errors, trigger tools, medical conditions, and *disabled patient*. I searched using these keywords both within the United States and internationally to gain a broader sense of how other countries compare to the United States in terms of improving safety in dentistry. The countries included in the research along with the number of articles found were Spain (three), Netherlands (two), England (nine), Turkey (one), Australia (two), Brazil (five), Greece (one), Ireland (one), Germany (one), Sweden (one), South Korea (1), and United States (26).

I conducted this literature review over a period of 2.5 years. The literature I searched for was published no more than 5 years ago and the articles retrieved were full text. The article publication dates range from 2011 to 2016. All literature included information on dental treatment, guidelines for dental safety, knowledge of oral care, airway management, systemic diseases that link to adverse events in oral care, and aging population and how it can influence care. Seminal work was conducted in early years and focused on the future dental workforce because dentists will need to be oral physicians as well as dental surgeons in order to treat patients. Other seminal literature included case

reports that reflected adverse events that had taken place in oral care. I retrieved a majority of the literature from the PubMed, Medline, and ProQuest databases.

Theoretical Foundation

The theoretical framework that guided this study was Reason's (1990) Swiss cheese model. This model attempts to identify system failures with each layer representing a defense against potential error having an effect on the outcome (Busit & Middleton, 2016). With the Swiss cheese model, there is usually a series of apparent errors that can be identified, and the use of this model allows preventative strategies to be implemented (Buist & Middleton, 2016). Reason (1990) introduced the Swiss cheese model to describe the phenomenon of errors made by individuals resulting in disastrous consequences due to flawed systems (i.e., the holes in the cheese; AHRQ, 2015).

Reason is known for helping organizations identify active failures and latent conditions (poor design). Reason is also known for safety culture and managing the risks of organizational accidents in different industries. When Reason worked for Royal Air Force Institute of Aviation Medical, the Swiss cheese model was developed with cat food in a teapot, which seems bizarre and random (Speers & McCulloch, 2014). The items were used to illustrate that there are many common elements in this example and all absent-minded slips where there are routine tasks, in this case, of making tea and feeding the cat. There are two tasks going on in parallel, which compete, for an individual's attention, and the elements of one task migrate into the other (Peltomaa, 2012).

Reason indicated that airlines and medical care organizations are examples of complex structures where the Swiss cheese model was used for analysis of risk

management of human systems (Speers & McCulloch, 2014). The four slices of cheese show how errors/adverse events can pass through from one slice to all remaining three slices (Speers & McCulloch, 2014). The Swiss cheese model was used in the airline industry when several airliners crashed in the 1970s due to communication failures, poor teamwork by crewmembers, interruptions of established protocols, and hierarchical airline culture (Speers & McCullock, 2014).

As a result of the pattern of discovery of medication errors in a tertiary hospital in Hong Kong, the hospital leadership used the Swiss cheese model to explain the interceptions targeting medication error (Samaranayake, Cheung, Chui, & Cheung, 2013). Another incident took place in a California hospital when a patient died because the medication was given intravenously instead of through a feeding tube (Escano, 2011). Represented as holes in the Swiss cheese model, these active failures are typically the last unsafe acts committed by caregivers (Escano, 2011).

Song et al. (2013) conducted a qualitative study to understand how much a dentist knows about systemic diseases and oral care and the proper way to treat patients without an adverse event occurring. Practicing dentists in the United States see an increasing number of patients with systemic conditions in ill health with comorbidities that complicate care (Song et al., 2013). The Swiss cheese model can be used to help identify where a failure occurred in treatment to avoid a repeat of an adverse event. Figure 1 is an example of how the model can be applied to dentistry.

Figure 1: Dental Procedure Started

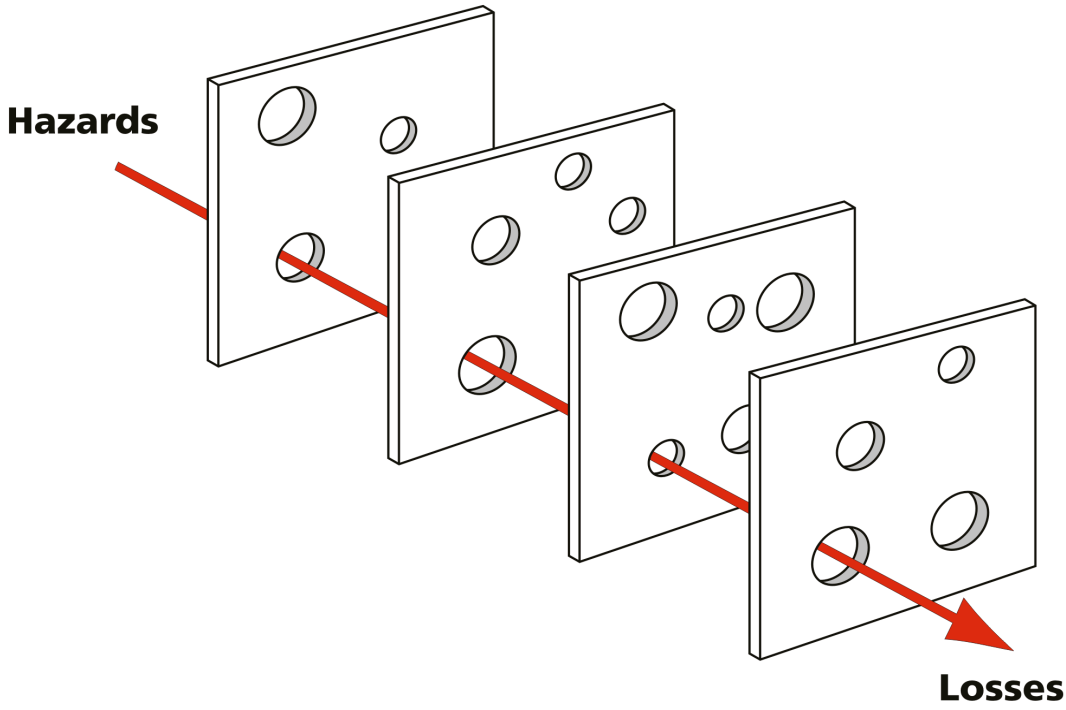

Figure 1. An example of Swiss cheese model used in a dental procedure and how an adverse event occurred (David-Rhoney, 2016). The defects in these processes are signified by holes in cheese slices that allow errors to pass through and harm to reach the patient (Stein & Heiss, 2015). Copyright 2016 by the Journal of Community Hospital Internal medicine Perspectives.

The following is an example of the Swiss cheese model in action with a hypothetical dental procedure and resulting adverse event: The first slice of cheese is the start of an endodontic procedure (in this case, a root canal), and the second slice of cheese is that no rubber dam was placed in the patient's mouth. The third slice of cheese is the endodontic file being swallowed by the patient due to no rubber dam being placed in their mouth. The fourth slice of cheese is the patient had to go to the emergency room to have the endodontic file removed. According to the Swiss cheese metaphor, the slices of cheese are layered, and each layer is a defense (e.g., the surgical safety checklist) against

the holes in the cheese, which represent a problem or error in the system (e.g., active and latent failures; Collins et al., 2013).

Another example of system failure is a case of a 71-year-old female patient who was hospitalized for uncontrolled hypertension and acute kidney injury (DaSilva & Krishnamurthy, 2016). The patient was given the prescription medication of amlodipine (Norvasc) 10mg, metoprolol 50 mg, doxazosin 2 mg, and torsemide 30 mg daily when she was discharged (DaSilva & Krishnamurthy, 2016). Over the course of 3 months, the patient's condition worsened, and she was readmitted to the hospital on multiple occasions (DaSliva & Krishnamurthy, 2016). Admission medication reconciliation revealed that the patient was taking metoprolol, doxazosin, alprazolam, citaloprag, and thiothixene (Navane) because the outpatient pharmacy accidentally dispensed Navane (an antipsychotic) instead of Norvasc (DaSliva & Krishnamurthy, 2016). The error was caused by multisystem fallout or failure.

There was another instance of a young Asian man whose parents only spoke Mandarin (Stein & Heiss, 2015). The child was examined, and it was determined that he needed surgery for an inguinal hernia on the left side, and a telephone translator communicator was used to communicate this with the parents (Stein & Heiss, 2015). On the day of the surgery, the dad who spoke some English was not present (Stein & Heiss, 2015). The patient was taken to the operating room and underwent a negative left groin exploration (Stein & Heiss, 2015). Giving too much sedation medication to a child who has QT syndrome, a heart rhythm condition that can potentially cause fast, chaotic heartbeats, can cause sudden death (Mikesell et al., 2011).

A 4-year-old girl was admitted to the hospital for a fall and fracture of a tooth root (Mikesell et al., 2011). The tooth needed to be removed and the patient was given sedation medication of 1 mg midazolam and 2 mg ketamine, and then a second dose with an equivalent to 0.9 mg lidocaine and 0.009 mg epinephrine was given to the patient (Mikesell et al., 2011). The child's heart rate became significantly faster than it should have been for a child of her age, and after the procedure, the child was transferred to the pediatric cardiac center to be monitored (Mikesell et al., 2011). Mistakes such as this can lead to an adverse event that can result in death.

In the cases described the breakdown of the Swiss cheese model's successive layers of defenses are noticeable and led to adverse events for these cases. The rationale for the use of the Swiss cheese model is to close the holes in oral care that leads to adverse events. The model can help identify failures of numerous systems. The defects in these processes are signified by holes in cheese slices that allow errors to pass through and harm to reach the patient (Stein & Heiss, 2015). Latent conditions (poor design) and lack of training create holes in these layers (Stein & Heiss, 2015).

The Swiss cheese model can be applied to adverse events in oral care by providing methods to plug in the holes. Possible methods could include:

1. Training – a culture that supports continued learning and training as a system safeguard to prevent errors.
2. Technology – automatic pop-ups to confirm or warn about allergies or drug interactions that can be unsafe.

3. Checklist – in a health care system that continues to evolve and be complex, the checklist provides another layer of protection against errors.
4. Policies and procedures – system level agreements designed to commit practitioners to safe, standardized and consistent care, and to avoid unwanted variations (Stein & Heiss, 2015).

The Swiss cheese model may be able to pinpoint errors and accidents that occur in oral care that lead to adverse events. Significant adverse outcomes occur with cardiac patients who have dental procedures before surgery. The result is 6% of cardiac patients die within 30 days after the operation, 3% percent before cardiac operation (Smith et al., 2013). This is a significant adverse event that providers monitor to avoid this type of adverse event from continuously occurring. Building on the Swiss cheese model, the research questions in this study I explored why certain dental procedures lead to adverse events for some patients, also understanding the different factors that can contribute to adverse events and what can be learned from them.

Review of Literature

Dentistry is a form of medicine that treats conditions of the oral cavity. There are several types of dentistry that are performed on individuals depending on their needs. Society has changed rapidly where individuals are living longer and systemic diseases that individuals have can make it difficult to provide oral care. The different types of dentists are: general dentist who performs a wide range of dental procedures, endodontist who focuses on root canals, oral and maxillofacial surgery, removal of teeth, implants and facial surgery, orthodontists who straighten teeth and modify the mandibular growth,

periodontitis who focus on the diseases of the gum, and prosthodontics who restore teeth through the use of implants, dentures, and bridges.

Dentistry and Models of Collaborative Practice

Oral health is identified as an important part of overall health (Southerland et al., 2016). Collaborative models have been created to improve care in patients and manage chronic disease but can also be applied in preventing adverse events in dentistry. Among chronic diseases that impact health outcomes, oral infection and inflammation are often overlooked because of the growing incidence of periodontitis in elderly patients; dental caries are the most widespread disease (Southerland et al., 2016).

Southerland et al. (2016) described several types of collaborative models that are used in chronic disease management:

- Established models of chronic disease management medicine – the intent was to transform the daily care for patients with chronic illnesses from acute and reactive to proactive, planned, and population based.
- Interdisciplinary collaborative model for chronic disease – to improve disease prevention, diagnosis, and treatment, particularly diseases that are multi morbid.
- Diabetes collaborative models – to provide guidance on management and treatment of diabetes.
- Cardiovascular collaborative models – an interdisciplinary team to address the care of patients over a range of practice settings, including inpatient, outpatient, inner city, rural, and suburban.

- Human immunodeficiency virus/acquired immunodeficiency syndrome collaborative models – widely adopted approach for ambulatory care improvement in the setting of chronic diseases like HIV.
- Mental health collaborative models – to provide and coordinate a variety of responses to individuals with complex health and social care needs.
- Medical and dental home models – offer an opportunity to not only positively impact health outcomes but to also incorporate oral health into collaborative interdisciplinary practice.

These collaborative models are designed to help individuals who suffer from the different types of systemic diseases. The advantage of these models is that they can be applied to oral care while managing systemic diseases. The medical and dental model is an interdisciplinary model that places more emphasis on adults with chronic conditions. The chronic disease can be, for example, mood disorders, diabetes, heart disease, asthma, and/or hypertension. The bidirectional impact of oral and systemic health has been extensively reported in the literature suggesting oral health has a significant influence on the quality of life and disease progression in those who are most vulnerable in the population (Southerland et al., 2016).

Oral Care and Systemic Disease

Oral care is a global burden that can lead to adverse events in patients, because it is one of the most common health issues with significant socio-economic impacts mainly dental caries, periodontal disease, and occasionally oral cancer; lesions in HIV/AIDS are chronic diseases in humankind with great impact (Jin et al., 2016). In 2000, the U.S.

Office of the Surgeon General released a report on the state of oral health and disparities in the nation (U. S. Department of Health, 2000). As such, numerous studies that have documented oral health disparities across life cycles and the connection between poor oral health and its progression of systemic disease have been documented (Southerland et al., 2016). Due to these recent findings, studies have reflected the relationship between periodontal disease, cardiovascular disease, end-stage renal disease, diabetes, pulmonary infections, and HIV/AIDS (Southerland et al., 2016).

Oral infection may affect the course and pathogenesis (development of disease) of a number of systemic diseases; this is the reason why cardiovascular disease, diabetes, obesity, periodontal disease, rheumatoid arthritis, hematologic abnormalities, pneumonia and pregnancy are the main focus of this study in regards to systemic diseases and providing care to patients in whom these diseases are more common. Bacteria that naturally attach to our teeth are displaced and passed into the bloodstream during a dental procedure, flossing, or even chewing food. These microbes while relatively harmless in the mouth have an affinity for damaged endothelial cells or blood clots in the heart, where they attach, multiply, and form larger bacterial colonies that trigger the endocarditis (Babu & Gomes, 2011).

Providers need to gain a clear understanding of systemic diseases to understand how to treat patients who need to receive oral care to reduce the potential for any adverse events. Systemic diseases are a concern when providing care for patients who need dental care. Systemic diseases affect some organs and tissues or affect the body as a whole and can range from cardiovascular, endocrine, and pulmonary diseases as well as other

conditions. When a patient is undergoing a dental procedure, the presence of systemic disease could lead to an adverse event.

When treating patients for oral care needs, there are other factors that may need to be taken into consideration as well. For example, an increasing number of aging population with down syndrome (DS) have secondary disorders, such as alzheimer's disease and diabetes mellitus, conditions that dental care providers need to be aware of (Abanto et al., 2011). Medical conditions that may affect the delivery of oral health care for patients with DS include immunologic abnormalities, hematologic abnormalities, esophageal cancer, respiratory infection, cardiovascular diseases, atlantoaxial instability, muscle hypotonia, Alzheimer's disease, seizure disorder, diabetes, and sleep apnea (Abanto et al., 2011).

Oral diseases have become a challenge for dental providers because they have become a health issue in society. Data that were collected in 2010 from Global Burden of Disease Study showed that for disability adjusted life years, the total for individuals with health conditions was 18,814.00; these people present with caries, periodontal disease, edentulism, oral cancer, and cleft palate. Unfortunately, the number of people with periodontal disease, oral cancer, and caries increased from 1990 to 2010 by 45.6% (Jin, 2016).

Cardiovascular Disease

In a recent study, Kjellstrom, Ryden, Klinger, and Norhammar (2016) found that DNA from oral bacteria has been identified in arterial plaques. This supports the link between the oral microflora and cardiovascular diseases. Poor oral health (periodontal

diseases and dental caries) has been shown to be associated with increased risk of atherosclerosis (Joshy, Arora, Korda, Chalmers, & Banks, 2016). Atherosclerosis is a condition that develops when plaque builds up in the walls of the arteries (American Heart Association, 2016).

There has been a concern of oral infections and general health; tooth loss has been related to systemic diseases. The principal causes of missing teeth are; apical periodontitis, deep caries and its sequelae, particularly root canal infection dispersed extraradicularly, marginal periodontitis, periodontal disease causing destruction of soft and hard tooth supporting tissues (Pussinen & Kononen, 2016). Marginal periodontitis and the risk of cardiovascular disease have been established although there is no causal data supporting the findings. Potentially the strongest confounding factors for the association between marginal periodontitis and cardiovascular diseases include age, smoking, and low socioeconomic status however diabetes, obesity, diet, metabolic syndrome, gender, microbiota, and unfavorable lipid profile may also play important roles (Pussinen & Kononen, 2016). In conclusion, the current evidence indicates that the number of missing teeth is linked to an increased risk for cardiovascular events and all-cause mortality (Pussinen & Kononen, 2016).

Periodontitis is an independent risk indicator for atherosclerotic (artery wall thickens as result of invasion and accumulation of white blood cells) cardiovascular diseases, a group of ischemic (inadequate blood supply to an organ) diseases that includes fatal and nonfatal coronary heart disease (Beukers, Van der Heijden, Wijk, & Loos, 2016). Beukers et al. (2016) confirmed that risk factors for cardiovascular diseases (age,

sex, smoking, diabetes, hypertension, hypercholesterolaemia, and social economic status) and observed periodontitis are significantly associated with cardiovascular diseases.

Diabetes

Diabetes is a chronic disease that occurs when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin that it produces (Velasco-Ortega, Delgado-Ruiz, & Lopez-Lopez, 2016). In the United States, the prevalence of diabetes in 2012 was more than 29 million (Izuora et al., 2016). Tooth loss can be associated with individuals who have diabetes due to periodontal diseases and dental caries. Bacterial growth in periodontal plaque causes bone loss. Izuora et al.'s (2016) study revealed that there is a high prevalence of tooth loss and periodontal disease among patients with diabetes.

Periodontal disease is a major risk factor for tooth loss being more prevalent and more severe in patients with diabetes. Velasco-Ortega et al.'s (2016) study on the influence of diabetes in oral diseases showed patients with diabetes have increased frequency of periodontitis tooth loss, and xerostomia. Diabetes has been considered a risk condition for oral surgery and dental implants due to delayed wound healing, prevalence of microvascular disease, and impaired response to infection (Velasco-Ortega et al., 2016).

Obesity

Obesity is a global issue among lower socio-economic groups (Kumar, Tadakamadla, Tibdewal, Duraiswamy, & Kulkarni, 2012). Systemic medical conditions associated with an increase in body weight and specifically adiposity is now well

recognized. These conditions include Type 2 (formerly called late onset) diabetes, cardiovascular disease, and osteoarthritis (Levine, 2012).

As dentists become more aware of systemic health diseases, they can adapt themselves to care for these patients. However, with the rise of obesity within populations, these problems extend from the impact of obesity both directly on dental disease together with medical conditions influencing the development and treatment of dental disease, to the practicality of treating the obese in a conventional dental primary care setting (Levine, 2012). Recent research found that one possible factor, inflammation, might be the common factor between obesity and poor dental outcomes, such as periodontitis resulting in tooth loss (Ostber, Bengtsson, Lissner, & Hakeberg, 2012).

Periodontal Disease

Recent research has established that periodontal infection is a likely risk factor for cardiovascular disease including atherosclerosis, myocardial infarction, and stroke (Shwetha et al., 2016). A periodontal disease is a group of chronic inflammatory conditions affecting tooth-supporting tissues with the global prevalence of severe periodontitis of 743 million people worldwide (Rebelo et al., 2016). Periodontal disease can be linked to many systemic diseases. Individuals need to understand how serious periodontal disease is when it relates to oral care and if their systemic disease is not clearly understood, how it could lead to an adverse event when receiving dental care.

A general dentist or periodontist clinically diagnoses periodontal disease using variables such as tooth loss, clinical attachment loss, periodontal pocket depth, tooth mobility, and radiographic evidence of bone loss. Factors such as smoking, Type I and II

diabetes, cardiovascular disease, and obesity have also been linked to the risk associated with developing periodontal disease (Mosley, Offenbacher, Phillips, Granger, & Wilder, 2014). Therefore, it could be concluded that poor dental hygiene linked with host resistance is the primary cause of periodontal disease, which can be linked to systemic diseases.

Rheumatoid Arthritis

Rheumatoid arthritis is a chronic inflammatory musculoskeletal disease with considerable morbidity and mortality and may present with extra-articular manifestations including involvement of exocrine lacrimal and salivary glands (Zalewska, Waszkiewicz, Darlusz-Szajad, & Waszkiel, 2011). Zalewska et al. (2011) found that hyposalivation (HS) is associated with a decrease of saliva produced that has a deleterious effect on many aspects of oral function and general well being. This is significant because saliva acts as the first defense against infection and numerous oral bacteria and fungi (Zalewska et al., 2011)

Eriksson et al. (2016) suggested that the prevalence of RA is higher in patients with periodontitis than in patients without periodontitis. This indicates that patients with RA might have an increased frequency of periodontitis as compared to control groups. Because of bone destruction, patients with RA have a higher potential for tooth loss. Even though previous studies indicated a potential association between RA and periodontitis, some of the data is unclear due to the population base. Further research is warranted to clarify the relationship between RA and periodontitis.

Hematologic Abnormalities

Leukemia is characterized by a high incidence of oral complications at the time of diagnosis and during treatment (Abanto et al., 2011). Oral complications can be divided into different types of lesions: primary, secondary, and tertiary lesions. Understanding the type of lesions that appear in patients who have leukemia makes it safer to treat the patient lessening the potential for an adverse event.

Patients with thrombocytopenia who undergo dental extraction are at a high risk of having an adverse event. The thrombocytopenic patient undergoing dental extraction may have increased episodes of postoperative bleeding. The frequency of bleeding episodes is associated with the degree of thrombocytopenia (Fillmore et al., 2013).

The awareness of systemic diseases can decrease adverse events in patients with these conditions. Recent research has established that periodontal infection is a risk factor for cardiovascular disease, including atherosclerosis, myocardial infarction, and stroke (Shwetha et al., 2016). Preliminary research has shown that periodontitis may also contribute to adverse pregnancy outcomes (Shwetha et al., 2016).

Pneumonia

Pneumonia affects almost a million people in the general population per year in the United States (Doll, Kelly, Ratliff, & Carroll, 2016). Pneumonia is through to be due to aspiration of oral pathogens in the respiratory tract of the susceptible host (Doll et al., 2016). A growing body of evidence shows that poor oral hygiene and oral hygiene-related factors e.g. denture use (O'Donnell, 2016) and being edentulous (Abe, 2008) may

be additional risk factors for aspiration pneumonia among the elderly. These patients present with an increased rate of dental plaque colonization as a possible reservoir for pathogenic organisms associated with community-acquired pneumonia (CAP) or nursing home-acquired pneumonia (NHAP, Bassim, 2008; Janssens, 2005; Li et al., 2016; Scannapieco, 2003). Pneumonia can be a disease that leads to death. Having oral care protocols in place is important for individuals who are pre-disposed to aspiration. The potential for aspiration can be evaluated during routine dental check-ups.

Dental Care and Pregnancy

When providing dental care to pregnant women for periodontal disease or essential dental treatment, a question of concern by dental providers is what is a safe number of pregnancy weeks before a mother and child is at risk for preterm birth. Michalowicz et al. (2013) reported that providing periodontal treatment or essential dental treatment for pregnant women at 13 to 21 weeks' gestation was not associated with increased risk of experiencing serious medical adverse events or adverse pregnancy outcomes. Research concluded that women are safe to have dental treatment up to 21 weeks (Michalowicz et al., 2013). Women who are 24+ weeks with periodontal disease were more likely to develop preeclampsia (Soucy-Giguere et al., 2016). Periodontal disease has also been associated with adverse pregnancy outcome, including preterm birth and preeclampsia (Soucy-Giguere et al., 2016). Despite this evidence, many dentists are reluctant to care for pregnant women due to lack of preparation and the knowledge required. This may aggravate the oral condition of the patient and bring harm to both

mother and baby (Kloetzel et al., 2011; Silk et al., 2008; Vieira, De Oliveira, Lopes, DeFigueiredo, & Maia, 2015).

Patient Safety

Tools and Interventions in the Dental Care Setting

The concept of patient safety in dentistry is in its infancy, with little knowledge about the effectiveness of tools or interventions developed to improve patient safety or to minimize the occurrence of adverse events (Baily et al., 2015). Many specific techniques can be used to analyze errors, including retrospective methods such as root cause analysis (or the more generic term, systems analysis) and prospective methods such as failure modes effect analysis (PSNET). There are different types of practice that can be implemented to decrease an adverse event from occurring: Failure modes effect analysis (FMEA) attempts to prospectively identify error prone situations or failure modes with a particular process of care (PSNET). Surgical checklists – introduced to ensure that correct sites are marked. Since the surgical check-list was introduced and revised in 2012, the clinical staff is engaged in the process; no wrong tooth extractions have occurred in 24 months at the Central Manchester University Hospital dental division (Bailey et al., 2015).

System checklists are now being used in the dental setting to help office staff to think ahead before each case so they will be able to avoid and catch an error. A systematic review of patient safety finds that the only interventions in dentistry that reduce or minimize adverse events are surgical safety checklists (Baily et al., 2015). The World Health Organization Surgical Safety checklist was developed to decrease errors

and adverse events, and increase teamwork and communication in surgery (McKernon, Taylor, Reid, & Balmer, 2016).

Reporting system – A national dental reporting system was established in 1993 to gain an understanding of adverse events to a material, such as amalgam, that is known to cause adverse reactions. The reporting system serves as a registry to determine how many patients the material affects. Information collected by the registry can be used to help make decisions to discontinue materials that cause adverse events. The implementation of a safety reporting system (SRS) went into effect in April 2011; this system allows dental providers to report an adverse event for preventing similar events from occurring again (Yanik & Cetin, 2014). The SRS is a system formed to learn from events that occur in hospitals and to prevent similar events from happening again (Yanik & Cetin, 2014). The difference with this system as compared to previous systems is not to target individuals but the system itself. The SRS provides patient and employee safety, promotes the development of a safety culture within an institution, reduces errors, and increases efficiency (Yanik & Cetin, 2014).

Preventing Adverse Events in Dentistry

Patient safety is a concern in the dental field. It is a primary concern for everyone involved in health care. Concurrently, research regarding the adoption of a culture of patient safety and the implementation of patient safety measures in dental practice is also increasing (Yamalik & Perea-Perez, 2012). A goal of patient safety is to prevent adverse events such as accidents and errors from occurring and recurring. When an error takes place, the first action may be to blame someone instead of evaluating systems that are in

place. The culture of blame does not look for individuals on whom to lay blame but rather, it identifies the latent system mistakes that can lead to errors by the whole dental team (Yamalik & Perea-Perez, 2012).

As a profession, dentistry has been slower at joining medical colleagues in systematically considering how patient safety can be improved (Pemberton, 2014). Even though the morbidity is less than it is in the medical field, it still is important to prevent an adverse event from occurring. Data on surgical complications reflects nationally that the perioperative death rate lies between 0.4-0.8% (Perea-Perez, et al., 2011). Because of these findings, changes needed to be implemented to prevent infection of surgical wounds, provide safe anesthesia, and safe surgical equipment. There is a significant deficiency regarding patient safety within the realm of health care in general, and dental care in particular (Perea-Perez et al., 2011).

Adverse Events in Dentistry

Oral care and the connection to adverse events is a concern that can be due to lack of aptitude or attitude. Accidents can occur during dental treatment and several incidents can lead to adverse events in oral care. Swallowing or aspiration of small objects such as brackets, orthodontic wires, drills, amalgam fragments, pins, and metallic posts can occur (Silva et al., 2011). Bailey et al. (2015) analyzed over 1,000 records that consisted of 50 patients from 20 dental practices. Adverse events included one erroneous extraction, four cases of retained roots following tooth extractions, eight cases relating to endodontic therapy (including fractured instruments, perforations and leakage of sodium

hypochlorite into the apical tissues), and two cases of dental crowns being swallowed by patients.

Speers and McCulloch (2014) identified benefits learned from the airline industry, or an operating room, the lives and welfare of humans are the responsibility of the aircrew or the operating room team. Da Silva and Krishnamurthy (2016) acknowledged the advantage of the Swiss cheese model; for errors to occur there must be a failure at multiple levels. Having younger to older patients or even patients with special needs, there are adverse event risks associated with oral care for these patients, from sedation to dental procedures for cardiac clearance for heart surgery.

Some adverse events are preventable; future prospective studies are needed to determine optimal recommendations for dental extraction before planned cardiac surgery. When an adverse event occurs in a private dental setting, some providers learn from the situation while others try to forget about it. Providers may never report it, which makes it harder for others to learn from the occurrence of an adverse event. Several causative factors can to be considered when adverse events occur in oral care (Kalenderian et al., 2015). These factors include:

- Provider fatigue or inexperience – this is common with new dentists graduating and not being prepared to handle working in a fast paced dental environment such as a hospital or private practice.
- Understaffing – this applies to both the private and hospital setting, budget cuts and a decrease in patients affects cash flow which is needed to have adequate staff to operate efficiently.

- Inadequate supervision – sometimes supervisors work multiple positions causing responsibilities to suffer.
- Faulty equipment – keeping up with the changing dental equipment and avoiding the use of faulty equipment. Some providers hold onto defective equipment that is useful because to replace it is costly.
- Teamwork – this is an ongoing education process that has to be implemented. Stressing the need to work together as a team is the only way everyone can be productive.
- Vague organization policies or procedures – instead of updating the system every 3 to 4 years, things are continuously done the same.

Smith et al. (2013) released a table describing adverse events that occurred within 30 days of dental procedure (Appendix A). Death after postoperative day from dental extractions, a patient died from inpatient diuresis from congestive heart failure symptoms and suffered cardiac arrest. Another death occurred when a patient who had inoperable coronary artery disease, congestive heart failure, and an implanted cardiac defibrillator underwent dental extractions before left ventricular assist device operation; patient died in interim due to ventricular fibrillation arrest. The table in Appendix A describes other events that occurred with additional patients who presented with systemic conditions when treated for a dental procedure; this information may assist dental providers in avoidance of an adverse event. Information presented in Appendix A represents the largest case series evaluation of major adverse events after dental extraction before cardiac operation. Even though the American College of Cardiology (2007) considers

dental extraction to be minor, there is potential morbidity and mortality associated with the procedure.

Most deaths occurred among 2-5 year olds in an office setting and with a general/pediatric dentist as the anesthesia provider (Lee, Milgrom, Starks, & Burke, 2013). In the latter group, 17 of 25 deaths were linked with sedation (Lee et al., 2013). The concern is not only with providers and what is happening during a procedure, the question is if staff is receiving adequate training. Several studies have emphasized the importance of monitoring for preventing adverse outcomes (Lee et al., 2013). Inadequate control could reflect problems with staff training and inadequate equipment resulting in an adverse event (Lee et al., 2013).

In a case study of 270 cases age ranging from 25 to 64 years of age, slightly more of the adverse events were reported to have occurred in men compared to women (Kalenderian et al., 2015). The time has come for dentistry to commit to patient safety by systematically addressing adverse events and errors in dentistry. Dentists need to identify the threats to dental patient safety by identifying errors and causes of patient injury associated with the delivery of dental care (Kalenderian et al., 2015). There are degrees of harm after a patient has a dental procedure or after they have left the dental office and are hospitalized or at a dental clinic seeking medical attention.

Table 1

Degree of Harm and the Types of Harm after Dental Procedure

Different types of Harm	Percentage
Temporary harm with emergency department transfer or hospitalization or prolonged hospital stay	24.1
Temporary minimal harm with significant intervention	4.4
Permanent minimal harm with significant intervention	2.2
Patient death	11.1
Systemic complication, including adverse reactions to dental device material or procedure	21.1
Allergy and hypersensitivity reactions	10.7
Systemic infection	10.4
Aspiration of foreign body	4.1
Nerve damage or injury	4.1

Note. Degree of harm is shown with a dental adverse event severity scale. A dental patient safety case report characterized by degree of harm. By E. Obadan, R. Ramoni, E. Kalenderian, 2015 Lessons learned from dental patient safety case reports, JADA. Copyright 2015, American Dental Association.

Most adverse events in dentistry go unreported, and there are few published peer review articles related to this topic (Kalenderian et al., 2015). With the exception of a few pioneer efforts, the dental profession has essentially watched from the sidelines as medicine moved towards developing patient safety initiatives. Dental patient safety

events are a global phenomenon making it imperative that dental professionals worldwide acknowledge this reality to galvanize efforts to minimize patient harm (Kalenderian et al., 2015). The goal is not only to decrease the number of adverse events but also to provide dental providers with a standard way of communicating errors and not feel shameful or embarrassed. It is imperative for dental professionals to prevent errors from occurring, avoid errors before they lead to an adverse event, and mitigate their effects when the events become adverse events (Kalenderian et al., 2013).

Bailey et al. (2015) conducted an analysis of electronic records of patients that had a potential adverse event. For patients who part took in the study over a five year period, findings were that 18 adverse events occurred. These adverse events included one erroneous extraction, four cases of retained root following tooth extractions, eight cases relating to endodontic therapy (including fractured instruments, perforations, and leakage of sodium hypochlorite into the apical tissues), and two cases of crowns being swallowed by patients. After these incidents the checklist was introduced to the clinical staff. Clinical staff was engaged in the process of developing the policy and training on the use of the checklist was provided to all members. Importantly, no wrong tooth extractions have occurred in the 24 months since the checklist was introduced (Bailey et al., 2015).

Cochran (2011) investigated St. Louis VA Medical Center for improperly cleaning and sterilizing dental reusable medical equipment. A recent request was made by the members of Congress, calling for an inspection into reports that veterans in several states have been exposed to blood borne pathogens such as hepatitis B, hepatitis C and human immunodeficiency virus while receiving dental care at John Cochran Division

(JCD) of the St. Louis VA Medical Center (Cochran, 2011). Responsible managers did not verify the adequacy of reusable medical equipment reprocessing practices, nor did they assure that corrective actions were consistently implemented in response to Veterans health administration guidance and the infections disease program office report. Cross contamination is not uncommon in dentistry. Having a team leader in charge to make sure all staff members are following proper protocol will avoid cross contamination. The Clinical Risk Board concluded that a total of 1,812 patients were potentially affected by the dental instrument cleaning and sterilization issues; forty-three patients were since deceased (Cochran, 2011).

Fillmore, Leavitt, and Arce (2013) they found that thrombocytopenia is a concern for patients undergoing dental extraction. It is safe but can still lead to an adverse event. Patients eligible for study inclusion were those undergoing extraction of at least 1 tooth with a platelet count of 100,000/uL or lower at the time of extraction (Fillmore, Leavitt, & Arce 2013). Recent study results showed that 68 patients underwent extractions; five patients had postoperative bleeding as a complication, two patients died of their disease (Fillmore et al., 2013). Although there are different levels of transfusion protocols for extraction having adjunctive local and systemic treatments could improve outcome.

A 36-year-old male patient was receiving endodontic therapy (root canal), and after the dentist had been distracted from what he was doing, he noticed the file he was using to clean out the canal was missing (see Silva, Martins, Prado, Junior, & Junior, 2011). An x-ray showed that the patient had swallowed the file and it was located in the

thoracic region (chest). If a rubber dam was used in the procedure, this could have been avoided.

Most deaths occur between 2-5 years old when it relates to dental sedation and general anesthesia. The majority of deaths took place in dental office settings (70.5%). Lee et al. (2013) conducted a research study between January 1980 and May 2011 reflecting deaths associated with dental procedures. The results of the study indicated an association between mortality and pediatric dental procedures under sedation, particularly in an office setting (Lee et al., 2013). The data also showed that for procedures that were done in an office as compared to a hospital or surgery center the age of a child at which they were given anesthesia can lead to an adverse event. Most dentists who provide anesthesia do not have an anesthesiologist available in private offices (Lee et al., 2013). Anesthesiologists may be called in when a patient needs to be sedated. Unless staff training is done on a regular basis the risk of adverse events while giving anesthesia is high (Lee et al., 2013).

Incorrect tooth extraction is increasing among dental care providers. Data from the Dental Defence Union (DDU), which represents a third of all United Kingdom practicing dental professionals, disclosed 1-2 cases of wrong site tooth extraction are reported by their members in a primary care setting each week (McKernon et al., 2016). In the dental field, procedures that gave rise to the occurrence of adverse events are listed by specialty in Table 2. There was permanent damage to the inferior dental nerve (13.5%), significant bone loss (10.4%), chronic sinus damage (9.2%), and death (2.7%). There were infectious processes after the dental treatment (1.2%), a drug given (0.5%),

anaphylactic reaction to latex (0.2%, some patients do not know they are allergic to latex until they are touched with the glove by a clinician), or reaction to anesthetic injection (0.2%).

Table 2
Adverse events by Dental Specialty Areas

Specialty	Number of cases/Frequency
Implantology	N: 106 25.54%
Endodontics	N: 86 20.72%
Oral Surgery	N: 84 20.24%
Prosthodontics	N:52 12.53%
Orthodontics	N: 37 8.91%
Conservative odontology	N: 19 4.57%
Bucco-dental anesthesia	N:17 4.09%
Prescription of drugs	N: 5 1.20%
Pediatric dentistry	N: 5 1.20%
Problems related with instrument sterilization	N: 2 0.48%
Periodontics	N: 2 0.48%

Notes: Analysis of 415 adverse events in dental practice in Spain from 2000 to 2010. By B. Perea-Perez, E. Labajo-Gonzalez, A. Santiago-Saez, E. Albarrah-Juan, & A. Villa-Vigil, 2013 Journal section Oral Surgery. Copyright 2014 by Medicine Oral Patologia Oral Cirugia Bucal.

Morbidity and mortality of patients who had a dental procedure before cardiac operation requires further investigation. For patients with adverse events, outcomes appeared to be strongly related to a combination of factors relating to the dental extraction procedure, the anesthetic, or a combination of factors related to both anesthesia

and operation (Smith et al., 2014). Cardiac patients are known to be at higher risk for adverse events after dental extractions (Smith et al., 2013). Significant adverse outcomes within 30 days of dental extraction, but prior to cardiac operation, occurred in 16/205 patients (8%) (Smith et al., 2014). Patients may have been missed if they underwent dental extraction at another institution before planned cardiac operation. Making an accurate assessment of complications after hospital discharge and finding the root cause can be difficult.

Death associated with pediatric dental sedation and general anesthesia among 2-5 years olds led to providers' anesthesia training; it was unclear whether this referred to a trained pediatric dentist or a general dentist whose practice catered to children (Lee et al., 2013). Most of the deaths occurred in dental office settings, which can lead to a negative impact on the clinician's practice along with mass media reporting regarding the use of anesthesia.

Several studies have emphasized the importance of monitoring for preventing adverse outcomes; inadequate control could reflect problems with staff training and inadequate equipment resulting in an inability to recognize and respond appropriately to an adverse event (Lee et al., 2013). In 2005 a system site marking was introduced to reduce errors. Root cause analyses were performed on cases of wrong site tooth extraction; the most common causes include cognitive failure and miscommunication (McKernon et al., 2016). Even though errors can still occur, it is important to have procedures in place. These factors refer to error-prone situations rather than error-prone

people. The human condition cannot be changed, but the conditions under which people work can be modified (Peltomaa, 2012).

Related Studies

Practicing dentists in the United States are seeing an increasing number of patients in ill health with comorbidities that complicate care (Song et al., 2013). Women's health can be complex particularly when it is related to oral care and systemic diseases. With an increased understanding of the complexity of diseases in women, particularly those associated with oral-systemic etiologies, the Office of Research on Women's Health (ORWH) has identified oral systemic health issues as a priority area for research (Daley, DeBate, Vamos, Thompson, & O'Connell, 2013). Daley et al. (2013) conducted a study that focused on HPV infection and oral-systemic autoimmune diseases and oral human papillomavirus (HPV) to identify emerging issues related to women's oral systemic health.

The goal of the Office of Research on Women's Health study was to gain an understanding of the complexity of diseases in women, address selected issues on oral human papillomavirus, oral systemic autoimmune conditions as well as the impact of the Affordable Care Act on women oral systemic health, moving from research based findings to practice based discussions. The objective was to promote recognition and understanding of women's health among future health professionals and scientists by informing the design of curricula with up to date research findings for use in educational materials for medical, dental, nursing, and other professional training (Daley et al., 2013).

A study was conducted on children who have congenital heart diseases to determine the developmental enamel defects and dental treatment (Cantekin, Gumus, Torun, & Sahin, 2015). Seventy-two children were included in the group ranging from age 3-14 years old. (Cantekin et al., 2015). These children are expected to have dental problems. In the first few years of their lives, children with congenital heart disease are generally hospitalized for short or long periods of time, which is why it is common to see dental problems in these children that can be difficult to treat. Heart disease can cause a delay in dental maturation (Cantekin et al., 2015). When comparing the children who have congenital heart disease to children who do not have congenital heart disease, the children with heart disease had a high percentage of untreated dental caries (Cantekin et al., 2015). Previous studies have shown that children with congenital heart disease have higher caries prevalence than healthy children (Cantekin et al., 2015). For children who stay at hospitals for a length of time oral care can be neglected which can also affect their general health.

The results of an online qualitative study showed that 450 participants commented on the connection between oral care and systemic diseases and their experiences (Song et al., 2013). Dentists in the United States continue to see an increased number of patients with systemic conditions, which can make it difficult to treat these particular patients. Practicing dentists are seeing an increased number of patients with ill health and comorbidities that complicate care (Song et al., 2013). Comorbidities occur, in part, because patients are aging and diseases epidemics, such as obesity and diabetes, are

worsening, which makes it challenging to care for patients when the relationship between oral and systemic disease is not well understood (Song et al., 2013)

Many are aware of the outcome but some find that sometimes it is out of their control. When the population learns of a patient who had a myocardial infarction that completely blocked a major coronary artery and died, they are often unaware that periodontal disease or other dental issues may have caused an adverse event that led to death (Song et al., 2013).

Summary

Based on the information in the literature review related to systemic diseases and dental care, the relationship between oral care and systemic disease is not well understood. Patients are living longer and systemic diseases are common in patients. The literature related to dental adverse events reflects the need for more research on how to avoid a repeat of events by encouraging providers to report incidents. Patient safety is a concern, and the dental field can be considered immature in comparison with those in the medicine (Yamalik & Perea-Perez, 2012). Understanding the needs of the aging population can influence the future of the dental profession and dental providers' need to have a working knowledge of systemic diseases. Providers need to gain a clearer understanding of systemic diseases to understand how to treat patients who need to receive oral care to reduce the potential for an adverse event. In Chapter 3, I will discuss information about the research methods used for this qualitative study and identify the design and rationale of the research from the formulation of the research questions that

defines the phenomenon of the study. I will also explain my role as a researcher, describe the participants, and discuss ethical considerations.

Chapter 3: Research Method

Introduction

The purpose of this research study was to gain a better understanding of oral care, how systemic diseases are linked, and how systemic diseases can cause an adverse event in dental care. In Chapter 3, I will discuss the methodology that was used in this study and define the role of the researcher. I will also describe the research design, instruments used, data collection, data analysis, trustworthiness, and ethical considerations related to the study.

Research Design and Rationale

The research questions that guided this study were as follows:

RQ1: Among dental care providers, what is the level of understanding of the relationship between oral care and systemic diseases and how these can lead to an adverse event?

RQ2: Among dental care providers, what are the perceptions of adverse events in dentistry and why they occur?

In this qualitative study, I used a phenomenological approach. The phenomena I studied are the links between oral care and systemic disease and perceptions of adverse events in dentistry. I chose to use a phenomenology approach because it allowed me gather the lived experience of the phenomenon that the selected dentists experienced while providing care. Patton (2015) stated how various phenomenological approaches share a common focus on exploring how human beings make sense of experience and transform experience into consciousness, both individually and as shared meaning. The

narrative approach of the study also allowed me to focus on the stories that were told by the participants, this give a clear understanding of their experience of an adverse event.

Role of the Researcher

The participants for this research study were dental care providers from both private dental practices and hospital dental centers in the New Jersey area. I contacted potential participants by phone, gave them a brief description of the study, obtained their e-mail information, and sent them a consent form. If they agreed to take part in the study I moved forward with set up an interview session. I also asked them for referrals of other dentists they might know who may be willing to participate.

For this qualitative phenomenological study, I used semistructured interview sessions with dental providers from small and large private dental practices as well as surrounding hospitals. As the researcher, my role was to be a full participant where the researcher is fully engaged with the people he or she is observing (see Creswell, 2013). The field notes I took during the interview sessions provided the data used to the answer the research questions. The participants were asked about their experiences as a dental provider in order to explore their level of understanding of the relationship between oral care and systemic diseases and their perceptions of adverse events and why they occur.

Research Biases

The qualitative emphasis on striving for depth of understanding in context includes capturing personal perspectives (Patton, 2015). I have worked in the field of dentistry for over 14 years in both the private practice and hospital setting, so as the researcher, it was important for me to be detached from the participants to avoid research

bias and not to influence participants' perspectives/perceptions. I achieved this as I asked direct questions to avoid inaccurate responses, asked open-ended questions, staying focused on the subject matter, and made sure participants responded to the questions. In the interview sessions, I also made sure to not interpret the evidence or data in such a way that supported my research expectations. As data were collected, it was important to collect all information to avoid misrepresentation and conclusion. Once I was finished collecting data, it was sorted by location and type. I had a fellow researcher or mentor who was not familiar with the study read through information and report any potential bias.

Ethical Issues

Regardless of the approach to qualitative inquiry, a qualitative researcher faces many ethical issues that surface during data collection in the field and analysis and dissemination of qualitative reports (Creswell, 2013). All the participants in the interview session were honest and open about their experiences, and it was reinsured that the information that was shared will be kept confidential by signing the consent form. Some of the interview sessions were conducted in the participant's work environment or a private conference room. Conducting the interviews in either setting allowed the participants to choose and feel more comfortable sharing their experience of an adverse event and gain clarity on their level of understanding of oral care and systemic diseases.

Ethical issues can be a concern in data collection. An informed consent form (Appendix A) was available for participants to sign as I explained the study in detail. I ensured that information was kept confidential and not shared. I communicated with

participants in clear straightforward language and avoided siding with the participant's method of oral care.

Participants shared sensitive experiences, so I clarified the purpose of the study before the interview started. Participants had the option to decline the interview session or leave at any time. I also advised the participants that the information they chose to share would be kept on a secure, password-protected laptop for a period of 5 years before being destroyed.

Methodology

Participation Selection Logic

The participants for this study were dentists from the New Jersey area. I selected these specific individuals because of their years of experience in the field of dentistry. Participants also had experience working with a diverse group of patients. Participant specialties included:

- General dentistry where adverse events such as sedation and general anesthesia complications can occur. Local anesthetics can produce direct toxicity to nerve trunks, leading to persistent paresthesias (Becker, 2014).
- Dental practices that treated patients that had thrombocytopenia after oral or maxillofacial surgery.
- Periodontitis who can provide insight as to how periodontal disease can be linked to cardiovascular disease, which contributed to almost half of all deaths in Europe (Kjellstrom et al., 2016).

- Pediatric dentists who provide sedation to children, between the ages of 2-5 years of age; a high number of deaths occur among this age group. In this latter group, 17 of 25 deaths were linked with sedation anesthetic (Lee et al., 2013).
- Orthodontists whose treatment may be associated with some adverse effects, such as root restoration, pain, pulpal changes, periodontal disease, and temporomandibular dysfunction (Talic, 2011).
- Prosthodontists because they are part of a specialty area that has gained the reputation of being highly litigious. Procedures are more labor-intensive, require multiple appointments, and thus may be more vulnerable to mistakes (Rosen, Sunshine, & Glazer, 2013).

I reached out to the participants and invited them to participate in the research study and also asked for referrals of others who will be willing to help in the study.

The participants had a minimum of 5 years working experience. The total number of participants was 10 dental providers from different dental specialties. I contacted the participants by phone and asked if they were willing to participant in the research study. Once the individual agreed to participate, a consent form was e-mailed to them. Once the consent form was reviewed and signed, I scheduled a date and time and met them for an interview. Participants were only identified by their location, specialty, and years of experience. Names were kept confidential to protect their privacy.

Sampling Strategy

I used purposeful sampling to select participants for this study. I selected 10 individuals for this study who provided an understanding of the research problem and central phenomenon in the study (see Creswell, 2013). The sample size for this qualitative study was smaller than a quantitative sample size. Because qualitative research is very labor intensive, analyzing a large sample can be time consuming and often simply impractical (Mason, 2010). Once I received approval from the Walden University Institutional Review Board (IRB), I interviewed the 10 participants to gather enough data to reach data saturation and answer the research questions. In qualitative research, information is collected and patterns are developed and examined as the fieldwork proceeds (CITE). Data saturation is achieved once nothing new is being learned from the interviews (Patterns, 2015).

Instrumentation

For this qualitative study, I conducted separate, in-depth, audiotaped interview sessions with 10 participating dentists. The audiotape was used to ensure that no information was missing from the data collection report. The interview questions were designed to help answer the research questions. Participants were selected from the New Jersey area from different practices that perform certain dental procedures. The interview questions helped me collect information to understand how different specialties' experiences can have an impact on treating patients who have a systemic disease and to

develop an understanding of the participants' perceptions about adverse events in dentistry and why they occur.

After the participants agreed to take part in the study, I scheduled a meeting with them in a quiet setting, in their place of operation, a meeting facility, or a different mutually convenient location. As the researcher, I collected all data and protected the privacy of the participants by using a digital tape recorder and a notebook to take notes. The interviews took place only once, the duration of all interview sessions were between 1 to 2 hours. If for any reason there would have not been enough participants to take part in the study of the selected area of New Jersey, then I would have expanded the area for recruitment. If the participants had found it difficult to provide 1 to 2 hours of their time, then I would have moved on to the next potential participant. After the interview session, I gave each participant a $5 gift card to Starbucks as an appreciation for their time and for sharing their personal experiences in providing oral care to patients.

After the interview sessions, I reviewed the information provided by the participants and gave participants the opportunity to correct errors or incorrect interpretations I may have made about the information provided. The participants were also invited to volunteer additional information they felt would be helpful for the research. Most of the additional information the participants volunteered were personal experiences they had with patients, the outcome, and how they were able to handle the situation. This step allowed me to summarize preliminary findings and verify the information.

Data Analysis Plan

Data analysis involves collecting open-ended data, based on asking general questions and developing an analysis of the information supplied by participants (Creswell, 2009). The data that I collected from the interview sessions were geared towards answering the two research questions to gain an understanding of the phenomenon studied. The interview questions that I asked participants in order to answer RQ1 and RQ2 were:

RQ1: Among dental care providers, what is the level of understanding of the relationship between oral care and systemic diseases and how these can lead to an adverse event?

RQ1 Interview Questions:

- What is your specialty and years of experience?
- What is your definition of oral care?
- What is your level of understanding of systemic diseases?
- Have you experienced treating patients with a systemic disease that had a negative adverse event outcome?

RQ2: Among dental care providers, what are the perceptions of adverse events in dentistry and why they occur?

RQ2 Interview Questions:

- What is your knowledge of adverse events in dentistry?

- Have you experienced an adverse event in your practice? If so, why do you think the adverse event occurred?
- If yes, did you report the incident to the National Report Center and what could you have done differently?
- Do you read case studies on adverse events to avoid repeating the same error?
- Are you familiar with the author, James Reason, who is the creator of the Swiss cheese model? He defines error as the human error problem that can be viewed in two ways: the person approach and the system approach. In dentistry, the layers can be policies/procedural, professional, team, individual, environmental, and equipment. Your thoughts?

The information was coded by using NVivo10 for Mac software that is recommended for qualitative research to collect, organize, and analyze content from interview sessions. When working with qualitative data, it is recommended to use NVivo 10, since the work could be more time consuming and challenging to manage. The NVivo10 for Mac software allowed me to work more efficiently, save time, quickly organize, store, retrieve data, and back up my findings. The NVivo 10 software allowed me to keep the information I gathered in a note section that will break the information down into several themes. It also let me store the bibliographical and demographical information of the participants. Without using the NVivo10 software, it may have been difficult to find similarity between two or more facts. The color-coding system aided with any discrepant cases.

Issues of Trustworthiness

To ensure validity of the findings, the audio recording of the interview session proved that the information was accurate. I included triangulation of data sources and analytical perspectives to increase the accuracy and credibility of findings (Patton, 2002). Triangulation allowed for the use of multiple methods or data sources. This was done by asking the same questions to a particular group of providers, such as general dentists, getting a different answer but the same result for treatment. The goal was not to weaken the evidence but to confirm the findings are accurate.

The interview session with the selected participants also provided credibility, transferability, dependability, and confirmability from their shared experiences.

- Credibility: An in-depth interview was conducted with participants who provided their view on oral care and systemic diseases. Many of the participants saw similar incident differently. The participants shared their experiences on how they handled certain incidents that took place in their practice and how they were able to avoid an adverse event. They also shared their knowledge on systemic diseases. This insured my findings were robust because it linked with the reality of the participants' experiences.
- Transferability: Adverse events continue to occur as a result of patient, providers, and procedural factors in a manner that is either predictable or unpredictable (Reuter et al., 2016). Applying models like the Swiss cheese model could help with the reduction of adverse events and apply to other

situations in dental care. The Swiss cheese model could allow providers to determine where the adverse event occurred and what could have been done differently. The benefit of this is to avoid other procedures from having a negative outcome.

- Dependability: Is associated with the consistency of findings. To ensure dependability is to have an independent auditor to review the information to see if any mistakes exist in the data collection. After the interview sessions I had two dependent auditors; one was my chair that reviewed my information and the other was a non-participant who reviewed the information I collected. The non-participant auditor has many years of dental experience.
- Confirmability: Adverse events continue to be a growing concern for dental care providers. Each specialty in dentistry will have had some experience with adverse events. Implementing the Swiss cheese model to identify where the adverse event took place could help with the reduction of errors. Many providers are not familiar with this model. As providers have a clear understanding of oral care and the connection to systemic disease they may start to use different models that may help prevent adverse events from occurring.

In the interview session, I reviewed literature that was found in regards to oral care and systemic diseases. The participants determined if they agreed with the current information that was published, discussed and then elaborate on their understanding of the findings. I provided a clear, honest narrative of the results to avoid bias in the study.

Ethical Procedures

Before data collection was started, I obtained approval from the Walden University IRB (Approval # 09-05-17-0280490). Once IRB approval was obtained, I reached out to a list of participants who I felt would be good candidates for the study. The participants did not have any conflict of interest; they were very excited to take part in the research study, and all stressed the need for additional research in dentistry. Participants signed a consent form before participation. There was only one participant who was approached and did not participate in the research study; she made it very clear she was biased towards the research topic and was the only one who declined to take part. Participants were offered a $5 gift card as a token of appreciation for their time. Even though each participant read and signed the consent form and were aware of the incentives that would be given for sharing their knowledge, they did not wish to accept the incentive. They were happy that I asked them to be a part of the study. As the researcher, I had no conflicts of interests to declare.

I was the only person collecting the data and analyzing it. Participant names were kept confidential. All data collected were stored using the NVivo10 software on the Mac laptop, which is password protected. Data will be maintained for 5 years and then destroyed.

Summary

Oral health care providers must have a practical, working knowledge of systemic diseases, understand their pathologic basis, how they are managed, and what

modifications to dental care may be required (Lamster, 2016). In this qualitative study, I used a phenomenological approach to reflect lived experiences of dental providers by exploring their level of understanding of the relationship between oral care and systemic diseases. The aging population can influence the future of the dental profession because an increased number of older adults are retaining teeth. This raises the concern for oral care for seniors with noncommunicable chronic diseases that occur with this population.

In Chapter 3, I explained the research design and rationale of the study to understand the link between oral care and systemic diseases and also explained my role as a researcher. Participants were dentists from the surrounding New Jersey and New York area that work in private practice and hospital settings. Chapter 3 also provided detail about any potential research bias, data analysis, instrumentation, trustworthiness, and ethical procedures. In Chapter 4, I included the results of the interview sessions conducted with the selected participants and presented any discrepancies from the research plan, demographics of the sample who were participants, and research results.

Chapter 4: Results

Introduction

The purpose of this qualitative narrative phenomenological study was to explore the level of understanding among dental care providers of the relationship between oral care and systemic diseases and how these are connected to adverse events. I also conducted this study to explore dental care providers' perceptions of adverse events and why they occur. Another goal of this qualitative study was to gain a deeper understanding of oral care, systemic diseases, and the occurrence of adverse events in the field of dentistry.

I designed the following research and interview questions to gain an understanding of the phenomenon studied and capture the scope of inquiry:

RQ1**:** Among dental care providers, what is the level of understanding of the relationship between oral care and systemic diseases and how these can lead to an adverse event?

Interview Questions:

- What is your specialty and years of experience?
- Describe your definition of oral care?
- What is your level of understanding of systemic diseases?
- Have you experienced treating patients with a systemic disease that had a negative adverse event outcome?

RQ2: Among dental care providers, what are the perceptions of adverse events in dentistry and why they occur?

Interview Questions:

- What is your knowledge of adverse events in dentistry?
- Have you experienced an adverse event in your practice? If so, why do you think the adverse event occurred?
- If yes, did you report the incident to the National Report Center and what could you have done differently?
- Do you read case studies on adverse events to avoid repeating the same error?
- Are you familiar with the author, James Reason, who is the creator of the Swiss cheese model? He defines error as the human error problem that can be viewed in two ways: the person approach and the system approach. In dentistry, the layers can be policies/procedural, professional, team, individual, environmental, and equipment. Your thoughts?

In Chapter 4, I described the demographics of the participants, data collection, and the results and findings of this study.

Demographics

The participants consisted of an even number of five females and five males. The geographic locations of the participants were New Jersey and New York. The years of experience of participants ranged from 10 to 40 years. The specialties of the participants were general practice (six), orthodontics (one), general practice-special needs (one), general practice-pediatrics (one), and oral facial and maxillary surgery (one).

Table 3

Demographics of Participants

Participant number	Gender	Specialty	Years of experience
1	Female	General practice	14
2	Male	Orthodontic	38
3	Female	General practice-Special needs	18
4	Female	General practice	13
5	Female	General practice	38
6	Male	General practice-Pediatric	10
7	Male	Oral facial & Maxillary surgery	28
8	Male	General practice	38
9	Female	General Practice	13
10	Male	General	30

Data Collection

I completed all interview sessions with the participants within a 1 to 2-hour timeframe. Each session was recorded using a Sony handheld recorder and field notes were also taken. In Chapter 3, I mentioned that the participants were selected from the surrounding New Jersey area, but I also selected two individuals who practiced in the New York area as well to get a sense of practice approach to oral care. There were no unusual circumstances encountered in the data collection process.

Stage 1: Participants, Consent Forms

In this qualitative study, I carried out the data collection in two stages. First, defining what geographic location I wanted to have the participants from and second, by specialty. Once the location was finalized, I reached out by phone to the selected participants and explained the reason for my phone call. I asked if they would be willing to participate in a research study about oral care and the connection with systemic diseases and how it is becoming a concern to provide dental care to these patients. If the participants agreed, I e-mailed the consent form to them and the next day followed up with a call to see if they would like to move forward. Once they agreed, I scheduled a day and time for their interview.

Stage 2: Interview Sessions with Participants

All participants were licensed dentists who had been practicing for at least 5 years or more. There were a total of 10 dentists (five male dentists and five female dentists). After an interview date was scheduled, I interviewed a total of six participants during Weeks 1 and 2 and interviewed the last four participants during Week 3. All interview

sessions were in the evening and each lasted for approximately an hour. I took field notes of the interview sessions along with making an audio recording of the interviews. The interview sessions were semistructured, and the participants were able to explain their level of understanding of the relationship between oral care and systemic diseases and what their perceptions were about adverse events and why they may occur.

Data Analysis

I conducted this qualitative, phenomenological, narrative study to analyze the level of understanding of oral care and systemic diseases among dental care providers. The findings supported the lack of understanding in regards to systemic diseases by the participants. In this section, I present data with research questions and the corresponding interview questions that the participants were asked. As I reviewed the field notes and listened to the audio recording, themes were developed to gain a deeper understanding of the research.

Research Question 1

The first interview question related to RQ1 was: What is your specialty and years of experience? The years of experience of the total of five female dentists and five male dentists ranged from 10 to 38 years of experiences.

The interview participants gave the following responses to the second interview question of: What is your definition of oral care?:

- "Caring of the head and neck area, the dentation and support oral structure soft and hard tissues."(Participants 2, 3, 7 & 8)

- "Providing the best recommendation of oral care, also looking for any type of tissue discoloration." (Participant 1)
- "Evaluating the structure in the mouth and the head and neck area also looking for any oral diseases." (Participants 2 & 7)
- "Providing a treatment plan for the best possible restoration." (Participant 5)
- Educating patients on how to care for their teeth at home and explain to them your nutrient diet makes a difference on your oral health." (Participants 1, 7)
- "Oral care, where the patient takes an deliberate attempt to care for their own teeth, as the professional the maintenance of the dentitions and gums." (Participants 1, 2, 6, & 7)
- "Focusing on the hard and soft tissues along with the head and neck". "Looking for potential diseases that can be found in the oral cavity, before treating a patient." (Participants 2, 3, 7 & 8)

These responses indicated dental care providers had a similar definition of oral care by supporting the head and neck along with the dentation of soft and hard tissues. Participants agreed that providing the best recommendation of treatment and educating patients will improve proper home care. It did not matter what the specialty was, the participants all had the same understanding of dental care.

The third interview question was: What is your level of understanding of systemic diseases and the participants' responses were spread from four at low (40%) to three at medium (30%) and three at high (30%).

During the interview, participants gave the following responses:

- "Practitioners need to be more aware or have more of awareness for patients with systemic disease how it can have a negative outcome especially when it comes to periodontal disease." (Participants 7 & 10)
- "Even though there are some levels of understanding of systemic diseases but not to the extent as a physician's knowledge, it is the same way a physician will have a limited understanding of oral care." (Participant 2)

These answers depended on whether a participant completed a residency program in a hospital where they were exposed to all aspects of the medical side because they had to do rotations on different floors to get an idea of how to treat the patients. In conclusion, the results reflected that the level of understanding of systemic disease is low among dental care providers overall.

Next, I asked the participants the fourth interview question: Have you experienced treating patients with a systemic disease? Seven participants responded yes (70%) and three responded no (30%).

They also responded that patients were not aware how periodontal diseases can increase risk for cardiovascular disease. During the interview, participants also gave the following responses:

- "As an oral surgeon I see all types of patients with a lot of medical complications." (Participant 7)
- "Yes, a 45-year-old patient marked no on his medical history. After reviewing the documents I started the treatment and in the middle of the treatment the patient started to developed chest pain. We called 911; the patient was having

a heart attack. He has not had any recent physical exam with this doctor. He felt because he worked out and healthy he did not need to see a doctor so he was not aware of any health changes in his body." (Participant 1)

- "I treat many patients with systemic diseases like GERD (gastroesophageal reflux disease), hypokalemia (low potassium), macrocytosis (enlarge blood cell), diabetes (blood glucose level is too high), cerebral palsy (affects body movements and muscle coordination), and seizures (excessive and abnormal brain cell activity). Because of their health issues it can be difficult treating these patients. Depending on the severity of the systemic disease I will schedule them to go to the operating room to avoid any adverse event."
- "Some reaction to an injection of local anesthetic, that had the patient going into cardiac arrest." (Participant 3)

The interview responses indicated that dental care providers have some knowledge of systemic diseases, there are many complications with patients with systemic diseases, and dental care providers do not have sufficient medical knowledge to treat patients. Patients' health conditions are more complicated than before.

With the last interview question corresponding to RQ1, I asked participants: Did you have a negative adverse event outcome?

Six of the participants responded yes (60%), while four answered no (40%). During the interview, participants gave the following responses to the question:

- "There was a patient who came into the office complaining about a tooth that hurts. We took an x-ray and removed the tooth, after she said that we remove

the wrong tooth. I explained to her that the tooth next to the tooth we removed also need to be removed. I should have handed a mirror to the patient and have her point to the tooth, this would have avoided any miscommunication." (Participant 9)

- "Sometimes patients refuse to have an x-ray taken, you will review the medical history and discuss their concern. You can only diagnose a problem from the surface without any x-rays. After listing to the patient, I diagnosed her treatment. As a dentist you block out what you know what you need to do to accommodate the patient, because of my neglect to do my normal protocol I diagnosed the patient incorrectly." (Participant 1)

Interview responses reflected that the negative adverse event outcome is high. Due to simple protocol not being followed human error can occur. It is important that the systems that are in place be followed at all times, this can help avoid an adverse event from occurring.

Research Question 2

What is your knowledge of adverse events in dentistry? Five of the participants responded they were knowledgeable (50%), while five answered somewhat knowledgeable (50%). This result allowed me to understand how much these dentists thought they really knew about adverse events. Their responses reflect personal experiences and experiences shared by their colleagues.

Have you experienced an adverse event in your practice? Six of the participants responded yes (60%), while four answered no (40%). An adverse event can occur when

treating patients with systemic disease, but having a better understanding of systemic diseases can reduce adverse event in dentistry. During the interview participants gave the following responses:

> My experience when a patient was referred to me for a facial swollen and he was pointing to different areas of his mouth. Yes, the tooth was boomed out and need to be removed. The patient did not know and I did not know he had a pre-existence cardiac condition. I started to give him local anesthetic but I was not getting the response I expected. Removed the tooth and we gave him a little sedation to help relax and calm him down. After we took him home because the wife was having trouble getting him and he only lived down the street. Four or five days later I open the newspaper and read that he died. I called the wife right away and asked what happen and she said that he died in his sleep. Come to find out that he has a history of his father dying at the age of 45 and younger brother dying at the age of 45, this guy had a long history of drinking and smoking and was 47 years old. (Participant 7)

The interview responses indicate that dental care providers have to look at the overall physical health of the patient not only the oral care aspect. Dental providers are trained to care for patients orally and changes need to be made in the universities where dental care providers have more training on the medical side.

If so, why do you think the adverse event occurred? Six of the participants responded yes (60%), while four answered no (40%). During the interview participants gave following responses:

- "When I spoke about the foresight when things are not going the way they usually do, you should take a step back and look at his whole history of the patient". (Participant 7)
  - "Dentist focuses on the teeth, but when it is in regards to a patient with a systemic disease you have to take a look at the whole picture". Participants 1,4 &7)
  - The interview responses reflect a lack of training for dental care providers related to medical knowledge.

If yes, did you report the incident to the National Report Center and what could you have done differently? All of the participants responded no (100%). The National Report Center is designed for dentists to obtain information on incidents and also to report an incident they may have encountered. It is important to encourage dentists to report incidents because others can learn from it.

Do you read case studies on adverse events to avoid repeating the same error? All of the participants responded yes (100%). Case studies are important to read, because it is helpful in treating patients when a provider is not certain about treating a patient. During the interview participants gave the following responses:

- "We get case study articles about once a month and it is always informative". (All Participant)
- "It is important to be a part of a study group, we get together each month and discuss cases and what others have experienced we do keep patient name private". (Participants 1, 4, 7 & 9)

- "Our malpractice insurance company sends literature each month to keep up aware of what have recently taken place" (All participants)
- "Because of the case studies I am very cautious on how I treat patients" (Participant 1, 7 & 9)
- "I read case studies all the time because dentistry is always changing" (All participants)

Are you familiar with the author James Reason who is the creator of the Swiss cheese model? He defines error as the human error problem that can be viewed in two ways: the person approach and the system approach. In dentistry, the layers can be policies/procedural, professional, team, individual, environmental and equipment. Your thoughts? All of the participants responded no (100%). Since participants were not familiar with this model or its author, I explained to participants that James Reason is known for publishing books on the subjects of motion sickness, absentmindedness, human error, human factors safety culture, and managing the risks of organizational accidents in different industries.

Participants expressed their concerns;

- "If possible having a nurse in a dental practice can make a big difference in treating patients". (Participant 2)
- "Many practitioners do not take the proper precaution". (Participant 2 & 7)
- "Always revisit the patient's medical history because it changes frequently". (Participant 2, 6, 7 & 9)

- "We are seeing more sicker patients in the dental offices, we have to take a step back and look at a patient as whole not just their teeth". (Participant 7)

Themes

After coding the interview material, I generated seven themes. The NVivo10 software program was helpful when it came to the coding process of the research study. Following is a breakdown of the themes showing the similarities of the participants' responses.

Theme one – Patient safety literacy: *What is your level of understanding of adverse events?* The question helped determine how much participants knew about adverse events and how systemic diseases can be a linked to adverse event in oral care. It was important to find out what the participants' levels of understanding were because they all practice differently and have different specialties. Most of the participant's views were similar and they also had some ideas of systemic diseases. One participant stated, "That every patient has a systemic disease, the question is what problem they are having". The participant who responded high in their level of understanding of adverse events stated, "Lack of preparation with a patient with a systemic disease is the issue". Another participant stated, "I have some understanding, am not a medical doctor so I do not have the same level of understanding, the same way a medical doctor are not cognizant of oral diseases". They also expressed learning more about systemic diseases because they noticed they were having patients with issues they did not to manage before.

Theme two – Experiences with patients with systemic diseases: *Have you experienced treating patients with a systemic disease?* Some participants did treat patients with a systemic disease, but they were not aware of the systemic disease because it was not disclosed before the procedure, which resolved to negative outcome.

> One participant explained "a gentlemen 45 years of age came in for an oral surgery procedure, on the medical form he marked everything NO. I gave him anesthesia, he started to become uncomfortable, sweating, and dizziness in the middle of the procedure he started to developed chest pains, we stopped and called 911, he was having a heart attack. Come to find out he has not had a physical in a while, because he feels that he exercises and nothing hurts, he did not need to see a doctor for a regular check up". (Participant 1)
>
> Not having the full medical condition of the patient makes a difference in providing care. Many did not think to revisit their medical history because they only saw them a few months ago.

Theme three – Experiencing a negative outcome: *Did you have a negative outcome?* This theme was developed because it was discovered that many of the participants had a negative outcome with a patient with systemic diseases. This was a key issue for understanding the complexity in providing oral care.

> Reaction to an injection of local anesthetic that resulted in a negative outcome in the middle of the procedure". "Patient did not know and I did not know of a pre-existent cardiac condition. Patient was referred to me for a boomed out tooth and he was complaining of pain all over beside the area where the tooth needed to be

> removed. He was swollen and face was all red. Gave the patient local anesthetic and a sedation medication to relax him, but I was not getting the results I expected. Removed the tooth had him stay for a while and we took the patient home. Four to five days later opened the papers and saw his obituary, I called the wife right away and she explained he died in his sleep. Come to find out that he has a history of drinking and smoking and his dad and brother died at a young age for the same reason. This is what I mean when I say lack of preparation and foresight. (Participant 7)

Theme four – Level of understanding: *Do you feel that you are knowledgeable enough to treat a patient orally and not have an adverse event?* Having a clear understanding of how knowledgeable a participant is about an adverse event will provide a clear finding of how the participant can provide care to the these particular individuals. Fifty percent of the participants had an understanding of adverse event, and another fifty percent did not have an understanding of adverse event. Some participants were extremely careful before moving forward with treating patients with systemic diseases because of the lack of understanding and the concern of an adverse event occurring.

Theme five – Reporting incidents: *Did you report any adverse incident to the National Reporting Center?* The participants did not report any of their incidents because they felt that it was not a major adverse event to report. “It was not a requirement to report to the National Reporting Center”. “Adverse outcome happened days after so it was not reported” (Participant 10). As individual’s health conditions have changed, many of the participants were inclined to report incidents so others can learn as they did.

Theme six – Case studies: *Do you read case studies, to avoid repeating the same error?* All of the participants stressed the fact of how important it was to read case studies. Some read them on a weekly basis or monthly. The case studies can teach dentists to avoid the same error or have them consider a different approach of treatment. "The case studies are helpful when you are at a loss on a procedure". (Participant 2, 9 & 10)

Theme seven – Limited awareness of models: *Are you familiar with the Arthur James Reason and the Swiss Cheese Model?* None of the participants were familiar with the author James Reason or the Swiss cheese model that was developed by him. As I explained how the model works and the purpose of the model, participants wanted to learn more and see how they can implement the model into their practice.

In this research I was able to learn more about how oral care and systemic diseases can be linked to an adverse event in patients. Participants shared their views on oral care and their understanding of systemic diseases and adverse events. The research findings provide evidence that dentists do not fully understand systemic diseases because their knowledge is limited. Participants reflected that adverse events in dentistry continued to grow and were a concern. The Swiss cheese model is a model none of the participants knew about which can be helpful in identifying an adverse event and why it occurred. If dentists start to incorporate the Swiss cheese model they could decrease the chances of an adverse event from occurring when treating patients. The stories that were shared reflect a lack of preparation in handling patients with systemic diseases. There is a need to train dentists on the medical side of healthcare to be able to provide oral care for patients with systemic diseases. Dentistry will continue to change and it is important that

dentists pay close attention and incorporate different types of models that can benefit their practice as well as the patients.

Evidence of Trustworthiness

In this research study, I concluded that participants were truthful in their responses. In qualitative research there are four aspects of trustworthiness; credibility, transferability, dependability, and confirmability. The results of the study displayed all four areas of trustworthiness in the research.

Credibility: After the interview sessions I reviewed the information that was provided by the participants. I gave participants the opportunity to correct errors or wrong interpretations I may have had about the information provided. The participants were also invited to volunteer additional information they felt would be helpful for the research. Most of the additional information the participants volunteered was personal experiences they had with patients, the outcome, and how they were able to handle the situation. This step allowed me to summarize preliminary findings and verify the information.

Transferability: The method that was used to gather the data was a small recorder and field notes to assure validity. The information from the data can be generalized where the data can be used in other research studies to do a comparison. This data can be used in other dental settings such as oral surgery dentistry; oral surgery can have the highest adverse events, because the teeth shift and sometimes the wrong tooth is removed. Within the realm of health care, research demonstrates that the causes of the largest number of adverse events are the prescription and administration of drugs, as well as surgical activity (Perea-Perez et al., 2011).

Dependability: As I reviewed my notes, recordings, and NVivo data and I found consistency in my findings from the data I collected about dentist's knowledge of oral care and systemic disease.

Confirmability: Participants had unique stories to share about their experience about an adverse event. The information that was provided by the participants verifies that my findings are accurate. This was done by audit trail. A small recording device was used to confirm my write up of the results along with my field notes. This allowed me to merge codes together and explain what the themes mean.

Summary

During the interviews participants shared their thoughts and experiences in dentistry. The interview sessions were recorded, transcribed, coded with the NVivo 10 system, and analyzed from the data collected. Each session was recorded and field notes were taken as well to make sure I did not miss any important details. The data collection process was done in stages for accuracy of the data. After all the data were collected, it was imported into the NVivo 10 software program to create themes to show the level of understanding of each research questions. Based on the results of the study, it is clear that dental providers lack a substantial amount of knowledge in regards to systemic diseases and the best way to treat the patient without causing an adverse event. The research questions were designed to gain an understanding of the phenomenon of how systemic disease and oral care can lead to an adverse event. Participants have treated patients with systemic diseases before but not at this level of diseases. When dentists treat a patient there is a possibility that something can go wrong due to a patient's systemic issues.

Patients are living longer and many systemic diseases are now present in patients that dentists are treating. Participants expressed the importance of reading case studies as these have shown providers ways to avoid certain types of incidents. The participants that took part in the study have never reported any incidents of adverse event, just the information of a patient who may be HIV positive. The participants shared their personal stories and experiences of how they provided care to their patients who had a systemic disease and the adverse event they encountered. The participants who shared their stories expressed their concern for treating these patients and started looking at the whole person instead of focusing only on the mouth. As dental care providers assume new responsibilities regarding their patient's oral health, health outcomes may improve. In Chapter 5, I present an interpretation of the research findings, limitations of the study, recommendations for future research, and implications for social change.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

Adverse events in dentistry continue to occur as a result of patient, provider, and procedural factors in a manner that is either predictable or unpredictable (Reuter et al., 2016). The purpose of this research study was to gain a better understanding of oral care, how systemic diseases are linked, and how systemic diseases can cause an adverse event in dental care. The nature of the study was phenomenological to aid in my understanding of the link between oral care and systemic diseases and how these can lead to an adverse event.

Following the interview sessions and the collection and analysis of data from 10 participants, my key findings were that the knowledge that these dentists have about systemic diseases is minimal. I concluded this from the participant responses to my interview questions. From the responses of the 10 dental participants, I gathered that they believed the majority of their colleagues' level of understanding of systemic diseases would be the same. The systemic diseases the participants were aware of were periodontal disease, diabetes, and HIV. My findings also confirmed that dentists do not report incidents to the National Reporting Center. Dentists are concerned though that they are seeing more patients with a systemic disease and have some concerns on how to treat them without causing an adverse event. In Chapter 5, I will review the interpretation of the findings, limitations of the study, recommendations, and implications for social change.

Interpretation of the Findings

Dentists in the United States see an increasing number of patients with systemic diseases and should be knowledgeable about the different types of systemic diseases that are linked to oral care. The research findings confirmed that dental providers often risk communicating with their patient because of the concern how it may impact their treatment choice due to their systemic conditions that already exist. In terms of patient understanding, there is the potential for information overload and the dentist needs to find a way to identify and to communicate the risks that are of most relevance to the individual patient (Asimakopoulou et al., 2015). This may also be due to the fact that oral care and systemic disease is not well understood among dental care providers. Patients are having systemic diseases that were not known before and when they return for treatment their health status may have changed which makes them more complicated to treat. Therefore, it is important for providers to ask dental patients detailed questions about their health because patients may minimize the seriousness of their medical condition (CITE). A participant indicated that dentists are seeing more sick patients and patients are living longer. The world's population is aging. In 2010, the estimated number of people 65 years of age and older were 524 million (CITE). As a result, current and future generations of older adults will require more dental care than in the past (Lamster, 2016).

An adverse event in dentistry is any unfavorable, undesired, and generally unforeseen incident caused by an error or omission during the dental treatment, which can have negative consequences for a patient's health (including physical or mental

damage, and/or prolonged treatment time; Perea-Perez et al., 2014). Buhrow and Buhrow (2013) noted that in the United States, more than 40,000 patients in general are injured each day. The lack of supervision, training, teamwork, and technical skills leads to problems with transition of care, communication barriers, poor information exchange, and interruptions, which are consistently, cited as major causes of error (Kalenderian et al., 2015). There are several reasons why adverse events could occur in dentistry. Several theories have been formulated to explain the mechanism of errors and how unchecked, latent systemic factors, threats, or failure can lead to the occurrence of adverse events (Kalenderian et al., 2015). Adverse events in dentistry have not been well studied since 1970 (Yanik & Cetin, 2014). According to the data I collected in this research study, participants who had experienced an adverse event reported the need to revisit the systems they had in place along with a coming to a better understanding of their patient's changing medical condition. Some participants expressed the need for continued education sessions and to start including medical information to help with effectively providing dental care to the patients.

With some of the errors that occur with dentists, if they do not find them life threatening, they may not report the incidents. Dental care is fundamentally private, and the fear may exist that reporting adverse events might have some repercussion on the commercial profits of clinics (Perea-Perez et al., 2011). The participants in this study shared their experiences of incidents and gave examples what they could have done differently in the situation.

The conceptual framework for this research was the Swiss cheese model. In the interview sessions, I asked the question if participants were familiar with the author, James Reason, who created the model, to which they replied they were not. Reason (1990) introduced the Swiss cheese model to describe the phenomenon of errors made by individuals resulting in disastrous consequences due to flawed systems, explained in the model as the holes in the cheese (AHRQ, 2015). After explaining and showing examples of the Swiss cheese model and how it is used in the medical and aviation industry, the participants indicated they were willing to apply the model into their daily operations. Participants felt it was a good model to have to avoid any adverse event from occurring again.

In conclusion, the literature reflected how the safety of patients have become a focal point of patient care. There is a fear of an adverse event occurring when treating patients with systemic diseases have dentists concerned because many of the patients do not inform the dentist of any health changes (CITE). There is a need for studies to assess these factors to better understand the risks involved in the provision of dental care (Reuter et al., 2016).

Limitations of the Study

There is a lack of studies on adverse events in dentistry, which makes it difficult to obtain reliable data due to the dispersion and confidentiality surrounding adverse incidents. Encouraging dental providers to report adverse incidents, no matter how small, could benefit others by example so they do not make the same error. One of the main limitations of this study was that dental care providers are not willing to report adverse

events because of the negative impact it may have on their practice and their professional capacity. Such practices are run as businesses, and therefore, dentists may be reluctant to disclose incidents because of the perceived risk of damage to their reputation and livelihood (Thusu et al., 2012). As a consequence, the low data reported on dental specialties is a reflection of this limitation. Dentists may also deem nonlife-threatening errors to be insignificant, and hence, choose not to report them (Thusu et al., 2012).

Dental adverse events are a global phenomenon, making it imperative that dental professionals worldwide acknowledge this reality to galvanize efforts to minimize patient harm (Kalenderian et al., 2015). Unfortunately, there are no known studies on adverse events in regular dental practices (Perea-Perez et al., 2013). Dental providers need to share their stories so others can learn and not be afraid to report the adverse events they have experienced. Learning this lesson will help improve on their practice of oral care. Providing continuing education courses on systemic diseases for dental providers could help with the understanding of some of their patients' health statuses. Procedural factors can be either predictable or unpredictable; there is a need for studies to assess these factors to better understand the risks involved in the provision of dental care (Reuter et al., 2016).

Dentists in the United States see an increasing number of patients with systemic conditions and should be knowledgeable about the different types of systemic diseases that are linked to oral care. These patients are challenging to care for when the relationship between oral and systemic disease is not well understood (Song et al., 2013). Providers are lacking in an understanding of systemic diseases and how these can affect

oral care. I determined from my research findings that out of the 10 participants, the range of understanding systemic disease is 40% low, 30% medium, and 30% high. It is evident that dental care providers need to be more aware of patients with systemic diseases. Poor oral hygiene is a primary cause of periodontal disease (Mosley et al., 2014).

Additional limitations of this qualitative study could be that the findings cannot be generalized to a larger population because of the small number of participants. There could also be ambiguities in language taken from interviews. It may not be possible to verify any of the scenarios the participants described.

Recommendation

Initiatives in the dental field can be considered as quite immature in comparison with those in medicine, and some specific features of dentistry may be responsible for the situation (Yamalik & Perea-Perez, 2012). There is a need for more research on the connection between oral care and systemic diseases to develop actionable clinical guidelines to improve care and to avoid adverse events from occurring. Literature is available, but there is a gap in the literature as research on adverse events in dentistry has not been well studied since 1970 (Yanik & Cetin, 2014). In a culture of blame, it does not look for individuals on whom to lay blame, but rather, it identifies the latent system mistakes that can lead to errors by the whole dental team (Yamalik & Perez-Perez, 2012).

There is a need to increase the knowledge of dental students about medical conditions that can impact dentistry. Universities that offer a dental program should consider revisiting their curriculum to incorporate more medical courses to educate

students about systemic conditions. For example, the University of Temple dentistry program in Philadelphia, Pennsylvania offers Human Systems and Disease I and II for one semester (CITE). Universities could implement more case studies for teaching purposes as well and develop a postgraduate training to understand systemic diseases. Dental residents should have a longer residency program, so they can learn more about treating patients with systemic diseases.

Dentists should question the patient at every visit about their health and health status to identify any changes and should not only look at the patient orally but look at the entire physical body to get a clear understanding of what has changed before treating the patient. Dentists should also consider creating guidelines for patients who have systemic diseases in an effort to decrease adverse events.

Additional research studies that could be conducted are:

- A qualitative study about general dentists providing dental care to patients with systemic disease.
- A qualitative study with oral surgeons who have patients with systemic disease as they see more patients with these conditions.
- Studies on the growing number of systemic diseases that is making it difficult to provide oral care.

Implications

Positive social change could result from the findings of this study at both the individual and community level. The demographics of an area will determine what services dentists will be able to provide for their patients. Dental providers need to have

the ability to educate their patients on recommended care because patients will want to know what treatment options are available. As patients are living longer, dental providers will need to be more skilled to cope with the patient population and their health conditions.

Dental providers need skills to manage the increased number of patients with systemic diseases. Training could allow dentists to implement new policies in treating these particular patients and not delay treatment. It is important for dental professionals to have the appropriate clinical skills to meet the changing oral health needs of the adult population (Watt et al., 2013). The dental industry will continue to change and organizations will have to revisit the policies to continuously update them as the technology and patient population changes. Patients may start to put a demand on dental care providers to help them with their oral care because they are paying for the services. Organizations will have to start attracting and retaining individuals best suited for the dental workforce in order to keep up with the needs of the older population. In the developed world, the focus on prevention of oral diseases has led to an increase in the number and percentage of older adults who are retaining teeth for a lifetime (Lamster, 2016). SRSs enhance patient and employee safety, promote the development of a safety culture within an institution, reduce errors, increase efficiency, and decrease mortality and morbidity (Yanik & Cetin, 2014).

Conclusion

The information learned from this research study could advance knowledge in the dental discipline through development of a better understanding of systemic diseases and

how oral care can be connected to systemic disease as well as how adverse events can result from the lack of understanding to care for patient with systemic diseases. Implementing the Swiss cheese model as an added policy to the organization can also benefit dentists in finding an error that occurred in their practice. Universities should consider reviewing their current curriculum to reflect more medical information to help current and future dentists handle patients with systemic diseases. The oral cavity might well be thought of as the window of the body as oral manifestations accompany many systemic diseases. With recent research it may be said that the oral cavity has opened a door to the understanding of many systemic diseases (Babu & Gomes, 2011). Future research could focus on the dental curriculum in universities to reflect more medically-oriented courses to allow future and current dentists to learn more about systemic diseases and how to treat patients with these conditions.

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Appendix A: Major adverse outcomes within 30 days of dental extraction

Table 4. Major Adverse Outcomes Within 30 days of Dental Extraction But Before Cardiac Operation

Patient No.	Age, years	Sex	Major Adverse Outcome	Preoperative ACS Within 30 Days	Cardiac Diagnosis	Cardiovascular Procedure	NYHA Heart Failure Classification/ LVEF	Details
#1	62	F	Death POD 2	No	AV stenosis MV stenosis	Valvular[a,b]	IV 50%	Inpatient diuresis for CHF symptoms, and suffered cardiac arrest
#2	82	M[c]	Post-op ACS Death POD 1	No	CAD AV stenosis	Valvular[a,b] CABG	N/A 42%	Postextraction ACS/sepsis/atrial fibrillation/oral hemorrhage leading to inability to secure airway
#3	43	M[c]	Renal failure Death POD 10	No	Prosthetic PV stenosis Prosthetic TV stenosis	Valvular[a,b]	IV 55%	GI bleed/acute renal failure POD 6 with severe decompensation
#4	65	M	Death POD 3	No	CAD Ventricular failure	LVAD[b]	IV 33%	Inoperable CAD, CHF/VF with ICD firings, underwent dental extractions before LVAD operation. Pt died in interim of VF arrest
#5	77	M	Death POD 20	No	CAD AV stenosis	Valvular[a,b]	IV 50%	Anticoagulation for atrial fibrillation, developed spontaneous retroperitoneal hemorrhage, and died of related complications
#6	77	F	Death POD 12	No	Prosthetic MV stenosis Endocarditis	Valvular[a,b]	III 47%	Endocarditis, pancytopenia, and DIC preoperatively and developed postextraction TRALI
#7	58	F	Post-op ACS	No	Prosthetic PV stenosis	Valvular[b]	II 55%	Delay per request of patient after extraction, with subsequent ACS necessitating PCI, in-stent restenosis with additional PCI
#8	55	F	Post-op ACS	Yes	CAD MV regurgitation	Vavlular[b] CABG	II 35%	NSTEMI 7 days before extraction, unstable angina POD 1 from extraction necessitating IABP
#9	67	M	Post-op ACS	No	CAD	CABG	I 42%	Additional operation on POD 2 (Mahurkar catheter placement for stem cell harvest due to multiple myeloma before CABG). Pt developed ACS POD 1 Mahurkar, POD 3 dental extraction
#10	67	M	Aspiration MVMP	Yes	CAD	CABG	N/A 30%	Aspiration on induction of anesthesia for dental extraction requiring mechanical ventilation × 24 hours
#11	49	M	CVA	No	CAD Ventricular failure	Heart transplantation	IV 10% (BIVAD)	BIVAD patient awaiting transplantation, with brainstem CVA on POD 10
#12	65	M	CVA	No	MV regurgitation Endocarditis	Valvular[b]	N/A 60%	Posterior CVA on POD 7
#13	50	M	CVA	No	MV regurgitation AV regurgitation Endocarditis	Valvular[b]	III 20%	Brainstem CVA on POD 21
#14	59	M	CVA	No	Atrial fibrillation MV regurgitation Endocarditis	Atrial fibrillation ablation Valvular[b]	N/A 63%	Occipital lobe intraparenchymal hemorrhage POD 3 in setting of anticoagulation for atrial fibrillation
#15	79	M	Renal failure	No	AV stenosis MV regurgitation Endocarditis	Valvular[b]	IV 35%	ATN secondary to gentamycin requiring dialysis POD 1
#16	46	M	Renal failure	Yes	CAD	CABG	IV 30% (IABP)	NSTEMI requiring IABP. Cardiorenal syndrome present before extraction requiring dialysis on POD 7

[a] Cardiac operation was planned but not performed due to patient death. [b] valve replacement or repair. [c] patient with >1 adverse outcome, this was counted as 1 total adverse outcome.

ACS = acute coronary syndrome; ATN = acute tubular necrosis; AV = aortic valve; BIVAD = biventricular assist devices; CABG = coronary artery bypass grafting; CAD = coronary artery disease; CHF = congestive heart failure; CVA = cerebrovascular accident; DIC = disseminated intravascular coagulation; F = female; GI = gastrointestinal; IABP = intraaortic balloon pump; ICD = implantable cardioverter-defibrillator; LVAD = left ventricular assist device; LVEF = left ventricular ejection fraction; M = male; MV = mitral valve; MVMP = mechanical ventilation maintained postoperatively; N/A = not available; NSTEMI = non-ST elevation myocardial infarction; NYHA = New York Heat Association; PCI = percutaneous coronary intervention; POD = postoperative day from dental extraction; Pt = Patient; PV = pulmonary valve; TRALI = transfusion-related acute lung injury; TV = tricuspid valve; VF = ventricular fibrillation.

Note: Dental extraction before cardiac operation. Table reflects major adverse outcome within 30 days of dental extraction but before cardiac operation. By Smith, M.M.,