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Dental Education in Wyoming Schools

A dentist's office is notorious for frightening many individuals; few patients are eager to sit in the dental chair. However, my experience in dentistry has been positive due to the education, personal experience as a patient, and working experience I have obtained. My passion for oral health originated while employed as a dental assistant. Seeing patients smile at the end of an appointment inspired my desire to pursue a degree in dental hygiene with intent to eventually obtain a Doctorate of Dental Medicine degree. However, prior to this work experience, I was first introduced to a dental office at 3 years of age. As such, I became acclimated to the dental office environment, including the hygienists, chairs, and high-pitched sounds. Then, in primary school the classes would gather, and we would learn about teeth, "sugar bugs", and proper ways to brush and floss. We had dental screenings from the school based dental hygienists and would go home to tell our parents about our experience. While for me this was not the first time talking about oral health, for many of my peers it was. Today children in Wyoming do not have that benefit, and many students continue throughout school with little education about proper oral hygiene techniques.

Why should we care? The mouth is a critical organ in the human body and integral component of health. It allows individuals to eat nutrients to fuel the mind and body and provides an avenue to speak with clarity. It also provides confidence for individuals communicating with their colleagues, teachers and family. These aspects are fundamental for future quality of life for students. Dental caries (cavities) are preventable, yet dental caries is

the most common disease in children (Reddy, 2018). By providing educational tools, and collaborating with local dentists and schools, the goal to create a comprehensive oral health program for schools to utilize in the years to come is feasible.

Healthy and Unhealthy Mouths

Teeth

Teeth are instrumental for biting, chewing, smiling and talking. To understand the benefits of a healthy mouth, one must recognize the anatomy and distinctive function of the layers respectively. The tooth is divided into two sections: the crown and root. The crown of the tooth can be seen when someone smiles. It consists of hard tissue: enamel, dentin and cementum. Pitt et al. (2017) Enamel is the outer most layer and is made up of hydroxyapatite ($\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$). This mineralized material is the hardest substance in the body and covers the dentin, only on the crown of the tooth. As seen in Figure 1 below, the cementum and dentin extend to the root and shield the root canal. Encapsulated by the cementum, the dentin is protected. The cementum is composed of collagen and minerals which resembles bone; however, it is avascular. The duty of cementum is to anchor teeth to the periodontal ligament (PDL). Figure 1 also shows the internal layers, which include the pulp, root canal, nerves, and blood vessels. The pulp consists of soft connective tissue, nerves, and blood vessels – these extend from the crown to the tip of the root where the connection of the nerve and blood supply to the mouth meet.

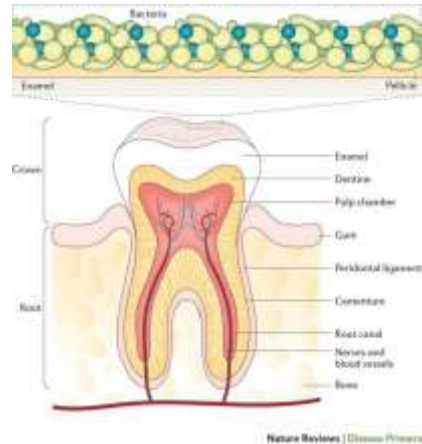


Figure 1. Tooth anatomy and dental biofilm developing.

Note. From “Dental Caries”, by Nigel B. Pitts et al., 2017, Nature Research Journal, 3.

When individuals brush their teeth, a protective acquired pellicle layer covers the tooth surface. The pellicle layer consists of glycoproteins and creates a sticky surface for bacteria to attach. Within hours, other bacteria attach, leading to the formation of microcolonies; each microcolony is comprised of millions of diverse bacteria. The microcolonies grow and other microcolonies form, resulting in the biofilm formation. If the biofilm is undisturbed it can lead to yellowing of teeth, bad breath, tooth decay and gum disease. According to Robinson (2000), dental caries (cavities) result from the acidic destruction of the tooth created in the biofilms. The bacteria in the plaque use the sugars in food to produce acids. The destruction is caused by the tooth demineralizing from the acids; repeated occurrences result in the enamel demineralizing, then the dentin and finally the pulp. This creates a hole in the tooth and a cavity has formed.

However, the tooth surface has alternating intervals of demineralization and remineralization. The consistent habits of an individual, over extended periods of time, determine if the tooth is in a net demineralizing or remineralizing interval. According to Pitt et al. (2017), remineralization factors include healthy habits such as, consistent brushing with

fluoride, healthy diet, and receiving professional sealants and fluoride treatments. These factors result in a low risk of dental caries (cavities). However, if an individual frequently consumes sugars without brushing, or does not receive adequate fluoride to the teeth, these factors result in demineralization. Once teeth have been demineralized, they are increasingly susceptible to dental caries (cavities). For children, these habits are learned and start at a young age. The habituation could be an influence on dental caries being the most common disease among children. The National Health and Nutrition Examination Survey (NHANES) found that 23% of children (ages 2-5 years) from the U.S. had dental caries on primary teeth. Of those children, 10% had untreated dental caries (Dye et al., 2015). Meaning that those children will likely have dental implications later in life, due to untreated dental caries.

Dental caries also impacts infants. A study conducted by David Isaacs (2018) found that prolonged breastfeeding can increase the prevalence of caries. Breastfeeding longer than 2 years of age results in twice the risk of severe caries than those infants that breastfed less than 2 years. This emphasizes the impact dental caries has from infancy to adulthood and the importance of beginning good oral hygiene habits as a child.

Gingiva

Gingiva (gums) also hold a critical function for a healthy mouth. Gums hold teeth in place, bind to the underlying bone, and create a seal around the crown to prevent bacteria from reaching the root structure of the tooth. However, unlike other tissue, gum tissue does not regenerate. Once receded, there is no regrowth. This creates a dilemma for individuals that brush too hard, or those that do not perform healthy oral hygiene techniques (brushing &

flossing consistently). Without proper brushing and flossing, dental caries can affect gingival health as well. Mentioned by Kinane et al. (2017), plaque that is not removed will harden and become calculus (tartar). The calculus will accumulate at the gum line, if proper flossing and brushing does not occur. This will cause the gums to become inflamed and bleed; this is termed as gingivitis. At this stage, the teeth remain firmly in the sockets, and there is no tissue or bone loss; gingivitis is reversible with proper oral hygiene and professional guidance. Untreated, gingivitis can lead to periodontitis. Periodontitis is also gum disease; it is more severe, causing the gums to pull away from the teeth due to bone loss. This condition affects the gingiva, bone and periodontal ligament (PDL) resulting in decreased tooth support. Without the support, tooth loss can occur. Below, in Figure 2, a patient had aggressive periodontitis. One can note the plaque and calculus buildup, as well as the receding gum line and bone loss.

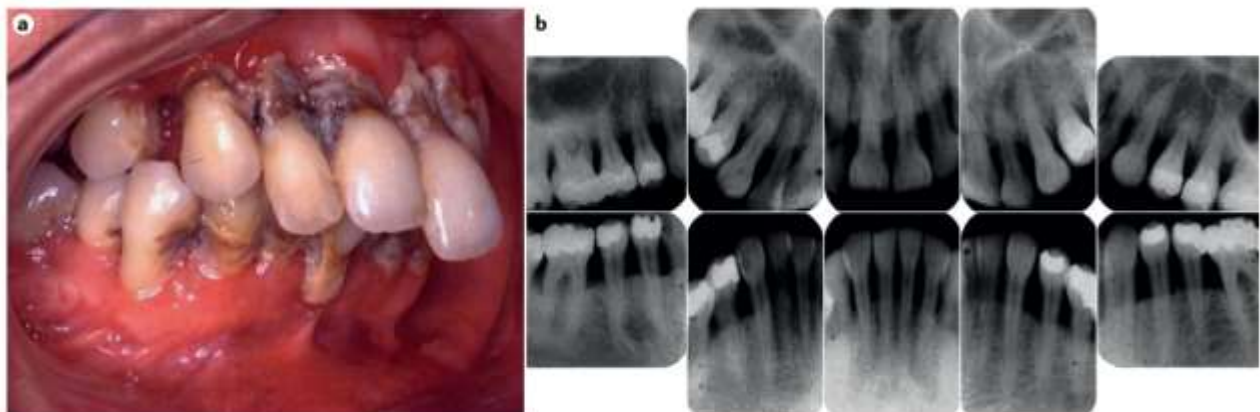


Figure 2. Patient with aggressive periodontitis, resulting in extractions.

Note. From “Periodontal Diseases”, by Denis F. Kinane, Panagiota G. Stathopoulou and Panos N. Papapanou, 2017, Nature Reviews-Disease Primers, 3, 17038.

Causes of Poor Oral Health

Poor oral health is influenced by social, behavioral, biological, and psychological factors in adults and children. A central behavior influencing poor oral health includes consumption of added sugars. These sugars can be consumed in food or drink form. According to Pitts et al. (2017), dental caries should be considered a dietary microbial disease because it would not occur in the absence of carbohydrates (free sugars). Past research has been disputed in regard to whether increased sugar intake correlated with increased dental caries. However, a longitudinal study conducted by Peres et al. (2016) found that children ranging from the ages 6 to 18 years old had a consistent association between sugar consumption and caries. These individuals also drank fluoridated water and utilized other forms of fluoridation (i.e. toothpaste); this should have skewed the data but did not. Dental caries occurrences differed in the amount of sugar consumed; the high consumers of sugar had a greater prevalence of caries than the lower consumers. However, the low consumers also reported a high prevalence of caries later in life. This study suggests that sugar is affecting teeth negatively in all amounts of consumption.

As mentioned previously, fluoride has a protective factor in reducing decay. Dental professionals and researchers agree that the benefits of fluoride are significant. Fluoride can be delivered in a variety of ways: communally by water or by agents such as toothpaste, varnish, rinse, etc. Highly concentrated fluoride applied topically can penetrate the biofilm and deliver fluoride directly to the tooth surface; this method provides the enamel with extended fluoride release and helps repair microscopic lesions. These lesions are caused by the demineralization of the tooth structure. The fluoride filters into the incipient lesions, on the tooth surface (Pitts

et al., 2017) and begins the remineralization process. To assist in the extended release, it is recommended to avoid hot drinks and hard foods, as these will remove the fluoride. As cited in “3M Vanish 5% Sodium Fluoride White Varnish”, fluoride reacts with calcium and phosphate to produce a stronger mineral. With the addition of fluoride, fluorapatite is formed and creates an acid resistant mineral. Without fluoride, the hydroxyapatite (calcium and phosphate), occurring naturally in saliva, is not as acid resistant. Acid resistance is influential in the tooth’s remineralizing process. Figure 3 provides a depiction of the chemical structures of hydroxyapatite and fluorapatite.

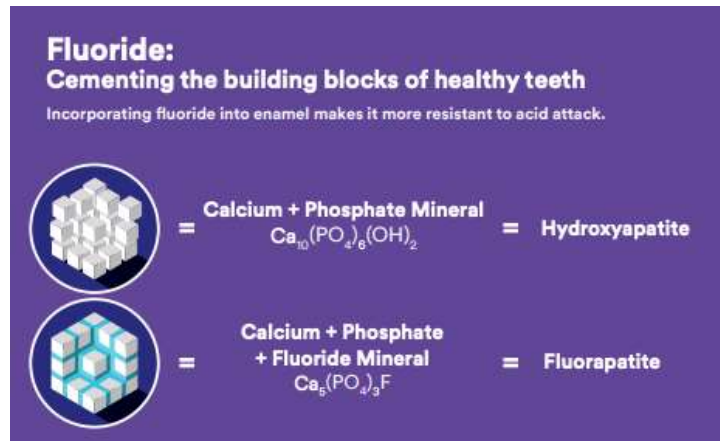


Figure 3. Calcium, phosphate, and fluoride chemical structures relating to acid resistance.

Note. From “3M™ Vanish™ 5% Sodium Fluoride White Varnish”, by 3M Preventative Care, 2019.

Community water fluoridation also influences dental caries significantly. In Brazil, exposure to fluoridated water and additional forms of fluoride resulted in lower numbers of decayed, missing and filled teeth (DMFT) (Cruz, 2018). One study group was exposed to community water fluoridation while the other was not for a 5-year span. The results showed

that there was increased DMFT values in the group not exposed to fluoride. Over the 5-year span, it was found that exposure to water fluoridation resulted in lower values of DMFT.

The Centers for Disease Control and Prevention (CDC) developed a program called “My Water’s Fluoride” (MWF). MWF provides fluoride data for community water systems across the United States, however, Wyoming is not participating in MWF. In a recent phone interview with an employee at Laramie Water Plant, it was found that Laramie’s community water system provides 0.4 mg/L of fluoride after treatment. When the water is retreated before filtration, the reported local fluoride levels are 0.5mg/L. Laramie uses 50:50 or a 60:40 ratio of well water to water-plant water. According to the CDC, the U.S Department of Health and Human Services recommend fluoride levels to remain at 0.7 mg/L for drinking water purposes. It is reported that this specific water fluoridation level enhances oral health and prevents tooth decay. As such, Laramie residents are receiving some water fluoridation in their drinking water, but not the recommended amount. The additional fluoride treatments, like toothpaste, can be utilized to compensate for the lower fluoridated levels in the local drinking water.

Lower socioeconomic living is another factor that influences oral health. A study conducted by Hong et al. (2018) investigated sugar consumption trend in the United Kingdom and United States. More explicitly, the effects this trend had on children. This experiment measured the number of DMFT in children between the ages of 12 and 15. They recorded each child’s social economic status, region they lived, tooth brushing habits, water intake, and dental professional guidance. Social factors were established in this study; they found that high added sugar consumption was associated with lower socioeconomic living, not attending the dentist, and low water intake. Individuals living in socially disadvantaged areas establish behaviors that

include high sugar intake, oral health inequalities, and may not have developed oral routines at home. A study conducted by Skeie and Klock (2018) researched immigrant populations, which are vulnerable to low income living, and found influences affecting oral health, specifically in children. Diet was a main explanation to poor oral health; high sugar foods are cheap and easy to access, resulting in plaque buildup. Conversely, healthier foods tend to be expensive and difficult to access. Additionally, parents in these communities tend to have low educational backgrounds which may contribute to the misinformed importance of a healthy mouth and negative perception of dental professionals. The cost of toothbrushes and toothpaste pose a potential barrier for families to maintain a regular brushing regimen. Another major factor in these communities was the cost of dental care also contributing to poor oral health.

Consumption, fluoridation, and low socioeconomic living contribute to and affect oral health. These influencers affect both children and adults. This research is addressing the importance of educating the youth about the risks of poor oral health so once they reach adulthood, they have the proper tools to continue proper, healthy oral health techniques.

Addressing Poor Oral Health

The main causes contributing to poor oral health are known; however, there are important ways in which to address these issues in order to provide a child with the proper tools and support. Parental input is found to be a major contributor for their children's oral health. Many parents have the common misconception that primary teeth (baby teeth) do not affect secondary teeth (adult teeth). This misconception has influenced parental guidance and the oral health of their children. Professional dental care is another factor influencing

individuals; many individuals have dental anxiety once they enter the dentist’s office. This results in decreased yearly oral checkups and professional guidance on how to maintain good oral health. The last major contributor to a child’s oral health is access to teach oral health education in schools. This has been found highly beneficial for children, yet there are implications that influence the logistics of this.

Parental Input

The factors that cause dental caries critically incorporate parental input. Primary teeth are the first teeth that erupt in a child’s mouth. This starts around the age of 6 months. One can note the eruption timeline of primary teeth in Figure 4. Permanent teeth erupt starting around the age of 6 years old.

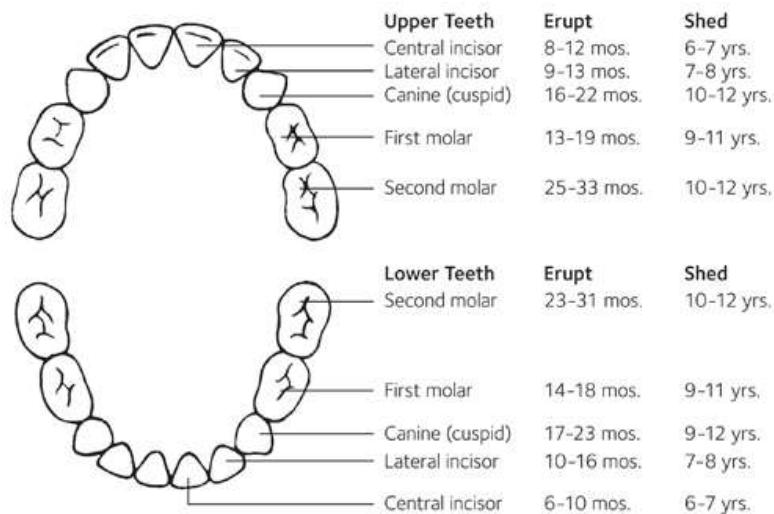


Figure 4. Eruption of primary teeth.

Note. From “Eruption Charts”, by Mouth Healthy, 2019, American Dental Association.

The inability to recognize the importance of primary teeth has been found to be associated with a lower likelihood of dental visits, decreased brushing frequency, and increased childhood caries, therefore resulting in dental caries in secondary teeth (Nelson et al., 2018); this study shows that it is the habituation, learned from the parents, that is influencing their children's oral hygiene behaviors. It was found that most parents respond to their child's oral health only if pain is involved or the cavity is visible, however caries can develop and remain unseen for many years. To help combat this parental trend, these scientists devised a model to help with the misconception of dental caries; it is called the Common Sense Model of Self-Regulation (CSM). This model describes how an adult can alter their health behavior for their children's oral health. As seen in Figure 5, the process framework can be noted. The scientists recognize that caries can be asymptomatic, so having other illness perception factors is important to change the parent's behavior regarding their child's oral health. These factors include understanding the consequences of not being proactive, as well as understanding the implications resulting from poor oral health techniques. It is necessary to change parent's perception of dental caries; it is a chronic disease rather than a symptomatic disease. This study suggests that the CSM model can influence parent's perception of primary teeth and will help increase healthy oral health strategies for their children. In doing so, this will influence the child's behavior and oral health in the future.

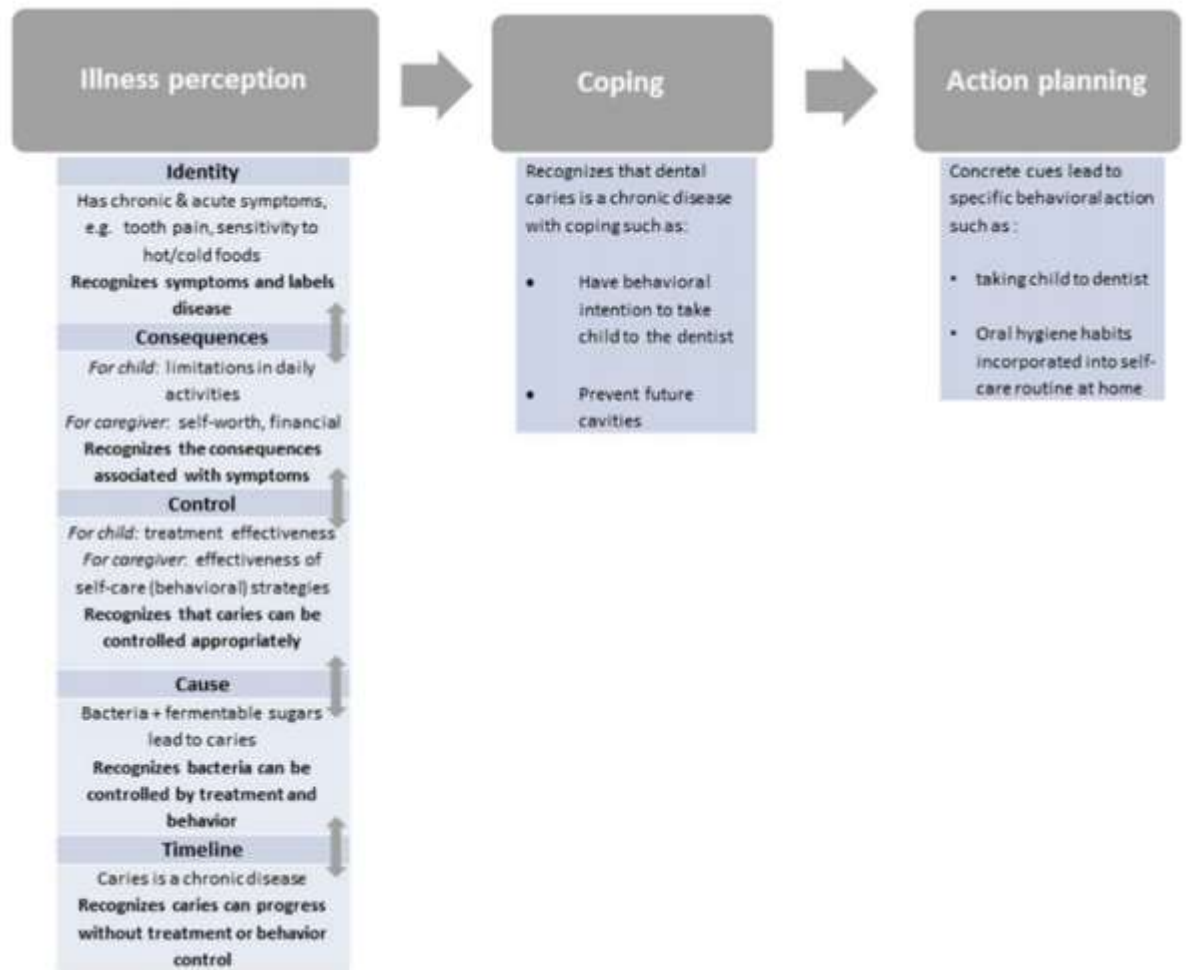


Figure 5. Theoretical framework of CSM for dental caries.

Note. From “Do baby teeth really matter? Changing parental perception...”, by Suchitra Nelson et al. 2017, Elsevier-Contemporary Clinical Trials, 59.

To support the influence of parental input, a study conducted by George et al. (2017), found that Australian Aboriginal children were at a higher risk for dental caries; if their parents were educated and concerned about oral health, the children had less time with bottle use and better oral health techniques. Conversely, the parents that were not educated about oral health increased bottle use time, did not utilize dental services, and were less concerned about the oral health of their children. One can note the trend in Figure 5, below. The significance

bottle use has on children's teeth is not recognized by many. Early childhood caries is associated with consumption of sugary fluids through a bottle. These fluids include juices, chocolate and vitamin D milk, and soft drinks. Unknowingly, parents providing sugary fluids to their children are heightening their child's likelihood of teeth complications into adulthood. The sugary substance sits on the newly developing teeth and without dental visits or proper brushing, the teeth develop caries. Some parents give their children a bottle before they go to bed and the sugar pools in the mouth throughout the night. This parental input then leads to habituating the child to continued bottle use. However, bottle use is not always classified negatively, regarding dental caries. Water consumption, through a bottle is beneficial for the child's teeth, flushing any previous sugars away from the tooth structure. This study provides additional support regarding the essential role parents have and the importance of educating parents about childhood dental caries. As seen in Figure 6, once the parents were educated about caries, bottle use decreased, and dental visits increased accordingly.

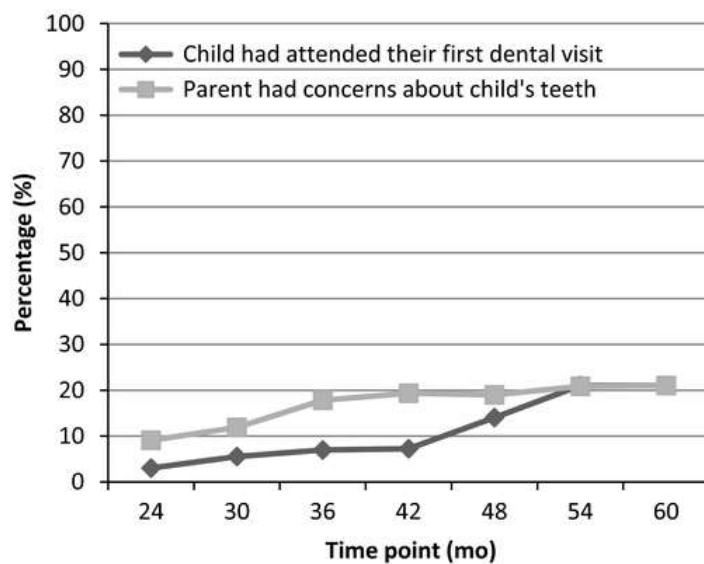


Figure 6. Parental concern about child's teeth and the child's attendance of dental visits.

Note. From “The oral health behaviours and fluid consumption...”, by Ajesh George BDS, MPH, PhD et al. 2017, Health Promotion Journal of Australia, Volume 29, Issue 1.

Improving Self Esteem

The effects of poor oral health, dental appearance, and social interactions influence self-esteem in a major way. As stated by Venete et al. (2017), “People’s self-image and perception of their dental aesthetics affect their social and psychological welfare, and this is reflected in their behavior and self-confidence” (p. e1454). An individual with low self-esteem may find it difficult to interact socially; participating in day-to-day functions may also prove to be challenging. Kaur et al. (2017) researched the impact of dental disorders and the influence that had on self-esteem; they found that once students reach adolescence their perceived dental aesthetics lead to an “inability to socialize, perform work and daily activities”. This is a result of aesthetics affecting the adolescents psychosocially, resulting in a reduced self-esteem. Although these subjects are adolescent, recognizing that childhood dental implications can later lead to decreased self-esteem and lower quality of life due to dental implications is significant. This provides additional support that poor oral health has lifelong complications and can affect the lives of many.

Reduce Dental Anxiety

Dental anxiety directly and indirectly affects oral health. The senses are over-stimulated: high-pitched drills provoke the auditory system, the olfactory system is overwhelmed by the smell of disinfecting products, the sharp objects stimulate the visual system, and personal space is intruded by an individual in a mask. Dental anxiety *directly* affects

oral health due to the anxiety triggers. These triggers may result in the patient leaving an appointment upon arrival or developing irregular attendance before arrival. Delaying treatment often leads to dental procedures that are more invasive; affecting oral health indirectly. Preventive procedures monitor the health of the mouth and are less invasive. Preventive appointments include consistent oral prophylaxis (cleanings) fluoride application, and placing sealants. The patients that wait until they have dental pain to make an appointment are likely to be diagnosed with a severe cavity or abscess, which could result in a root canal or a filling, requiring anesthetic. These procedures are more invasive. Dental anxiety is a major factor contributing to the prevalence of dental caries due to the inconsistent attendance. Causes of dental anxiety are disputed. It has been found that patients with dental phobias are reportedly more anxious from the sensory stimuli and loss of control rather than the injections of anesthetic (as cited in Seligman et al., 2017). However, according to The Diagnostic and Statistical Manual of Mental Disorders (5th ed.; DSM-5; American Psychiatric Association, 2013), there is a comorbidity of some blood-injection-phobias (BII) alongside dental phobia, resulting in fear of injections. While the causes are disputed, finding effective methods to combat dental anxiety is critical for educating the youth, parents and dental professionals.

Dental anxiety influences numerous individuals globally. 10-60% of the population experience dental anxiety (Wang et al., 2017). To explore the fear and anxiety of a dental patient one must understand the triggers. Wang and colleagues found triggers that lead patients to be anxious. The triggers were categorized into four themes that could be utilized to reduce the anxiety. The themes were preparedness, teamwork, reinforced trust, and a tailored treatment plan. For some patients, feeling prepared included knowing what the procedure

entailed before, so they could mentally prepare and visualize. For others, having the x-ray of the tooth caused anxiety. For those patients, preparedness entailed a cartoon or drawing of what the procedure consisted of. Teamwork involved the patient feeling involved in the decisions regarding their teeth and having options to pick from. Having the dental team collaborate with the patient was also included in teamwork. Reinforced trust included a trustworthy dentist-patient relationship, as well as giving the patient time to take a break any time during the procedure. A tailored treatment plan included the dentist informing the patient that their circumstance was common, but the treatment would be modified for each patient. Another tailored aspect was the personality of the dental professionals; these patients in the study wanted to be shown patience and sympathy. It was found that preparedness might require dental professionals to become psychologically trained to support the patients, due to contradicting needs throughout the study. However, trust, teamwork, and a tailored treatment plan could be utilized to help decrease dental anxiety. This information is critical in understanding what steps can be taken for dentally anxious individuals as well as dental professionals.

Dental fear in youth is normal. However, once fear develops into anxiety or phobia it can ultimately affect the oral health and quality of life of a child. It has been reported that children affected by dental anxiety will have a lower quality of life due to pain, social avoidance, and trouble eating (Seligman et al., 2017). A study conducted by Morgan et al. (2016) found that in the UK, dental anxiety affects 6-20% of children between the ages of 4-18 years old. Childhood dental anxiety is associated with increased decay, extractions, toothaches, and lower quality of life (oral health related). To understand prolonged dental anxiety in children, the Five

Areas Model was applied to help recognize how children interpret situational factors. They questioned children about their feelings, thoughts, symptoms, behaviors and triggers. Upon their initial findings, discovered that parents, the dental team, and specific dental equipment influenced situational factors. Two subthemes emerged from this, as seen in Figure 8. These include communication and information sharing, and potential frightening stimuli within the dental office. Some examples included parents not informing their child they had an appointment (information sharing) or seeing the syringe before the anesthetic was delivered (stimuli). Interestingly, a major influencer was the parental restriction. Although adults and children have similar dental anxieties, children do not make decisions, regarding appointments, on their own. Parents can avoid appointments, whereas children are forced to attend. This could result in an enhanced trigger for dental anxiety.

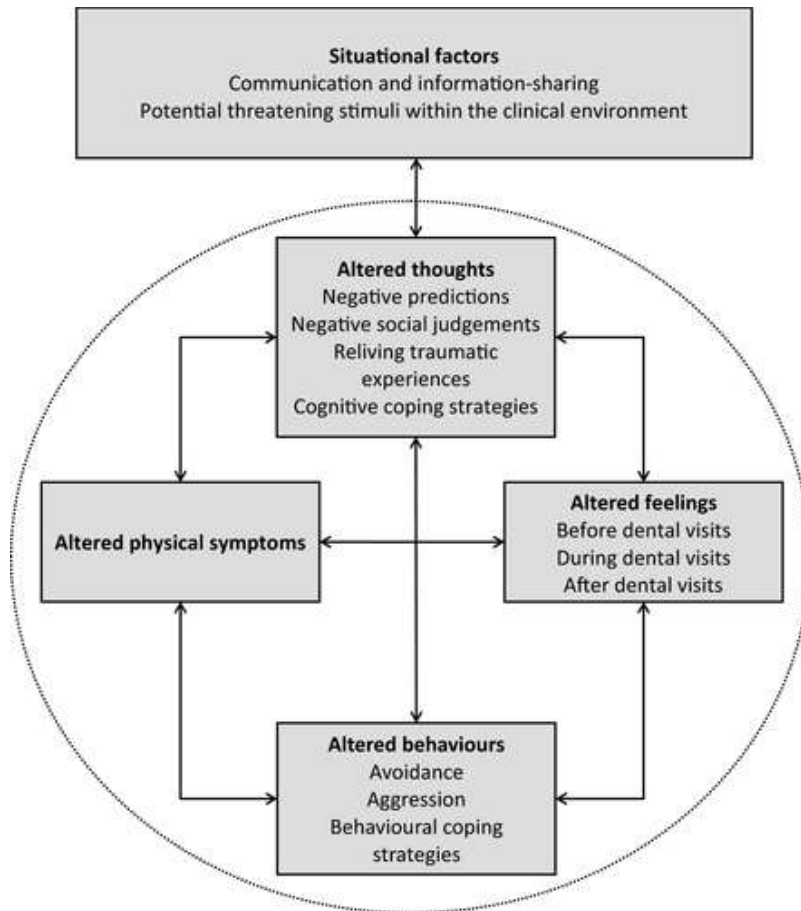


Figure 8. Five Areas Model for dental anxiety.

Note. From “Children’s experiences of dental anxiety”, by Annie G. Morgan et al. 2016, International Journal of Paediatric Dentistry, Volume 27, Issue 2.

Common themes that were noted in this study included negative predictions of events that could happen, reliving traumatic experiences, and avoiding dental care. Some patients would imagine the dentist making a mistake and consequentially getting severely injured. Other patients would continue to relive a painful dental experience and refuse another appointment. This study did not have patients with uniform needs or coping methods, as predicted. The Five Areas Model helped in making sense of each patient’s behavioral coping strategies. The dentist-patient relationship proved to be significant; if the dentist did not make the child feel safe or

did not meet the child's needs, then the dental anxiety increased. Criticism by the dental professions was also found to induce anxiety, even when the criticism was helpful; patients did not like that their mouths were perceived as unhealthy or that the dental team was judging their oral health. Overall, it was found that children preferred a professional, honest and friendly environment, including allocating time for children to ask questions. Children also wanted their parents to inform them of the appointment before arriving, reducing anxiety. This study provides an explanatory model for children's decisions and offers successful and unsuccessful strategies for dental professionals and parents to utilize.

Early and regular exposure to the dental office proves to be influential in the development of childhood dental anxiety. Examples of early exposure include preventative appointments (cleaning) or acclimating a child to the dentist's office early in development. In a study conducted by Seligman et al. (2017) individuals with non-painful and positive experiences, at their first appointments, were less likely to develop dental anxiety, compared to those that had initial painful experiences. If a parent waited to schedule an appointment when their child complained of dental pain, then the first dental experience could potentially result in a major surgery. This appointment might be negative and painful, developing in an increased risk of dental anxiety for that child.

Perception of oneself and familial/cultural factors also influences the development of dental anxiety. Dental anxiety-stricken individuals found themselves to have lower pain tolerance, resulting in more painful experiences than those with a higher tolerance. It was also found that parental anxiety does correlate with child anxiety. If the parent responded anxiously the child would likely mimic the response. Additionally, cultural influences affect attitudes

towards the dental experience. For example, African American and Latino adults have fewer affirmative views regarding preventive care (as cited in Seligman et al., 2017). As mentioned previously early preventive care is critical in dental anxiety development. These influences can be noted in Figure 7, below.

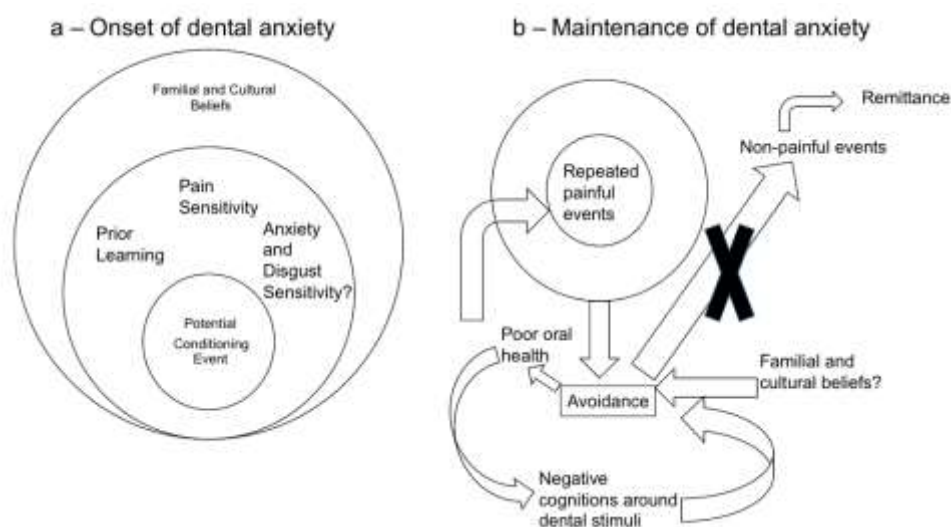


Figure 7. “The onset of dental anxiety begins with a conditioning event but whether a dental experience serves as a conditioning event is dependent on the context in which it occurs (panel a). The maintenance of dental anxiety is hypothesized to be influenced by a complex interplay of cognitive behavioral factors influenced by the child’s family and cultural beliefs (panel b)” (Seligman et al., 2017, p. 27).

Note. From “Dental anxiety: An understudied problem in youth”, by Laura Seligman et al. 2017, Elsevier-Clinical Psychology Review, 55, 25-40.

It is essential to have children experience dental care early to serve as an inhibitory system to dental anxiety. Positive patient-dentist relationships are also critical in subduing dental anxiety. There are familial and personal implications that affect development, assessment and maintenance of dental anxiety. With these tools, one can attempt to decrease dental anxiety for children.

Educate in Schools

There are many health barriers to learning, in the United States. When left untreated, they can interfere with education. There are 7 Health Barriers to Learning (HBL) which include “vision and hearing deficits, uncontrolled asthma, mental and behavioral problems, dental pain, persistent hunger, and effects of lead exposure (Gracy et al., 2018, p. 1). Of those 7 HBLs, no state in the United States requires all 7 to be screened during school. This study mentions that less than one half of the schools require and overall health exam, and of those schools only 12 states (with the addition of D.C.) require dental screenings, as seen below in Figure 9. While only 24% of the schools in America require dental screenings, there is a missed opportunity to help identify the children that need oral hygiene guidance (Reddy, 2018). Wyoming is a state that does not require dental screenings.

	Vision	Hearing	Dental	Asthma	Mental Health/ Behavior	Lead	Hunger
California	✓	✓	✓			✓	
Connecticut	✓	✓	✓	✓	✓	✓	
D.C.	✓	✓	✓	✓	✓	✓	
Georgia	✓	✓	✓				
Hawaii	✓	✓	✓	✓	✓		
Illinois	✓	✓	✓	✓	✓	✓	
Kansas	✓	✓	✓	✓	✓	✓	
Kentucky	✓	✓	✓		✓		
Maryland			✓	✓	✓	✓	
Massachusetts	✓	✓	✓	✓	✓	✓	
North Carolina	✓	✓	✓	✓	✓	✓	
Pennsylvania	✓	✓	✓	✓	✓		
Rhode Island	✓			✓	✓	✓	

<https://doi.org/10.1371/journal.pone.0190254.t002>

Figure 9. States that require overall health screening.

Note. From “Missed opportunities: Do states require screening of children for health...”, by Delaney Gracy et al. 2018, Public Library of Science (PLoS), Volume 13, 1-13.

Although dental screenings are not required in Wyoming, oral health education can be implemented to start the conversation. Oral health education can be delivered at multiple community locations, such as hospitals, primary care facilities, and at the local dentist. However, providing oral health education in schools has been found to be extremely beneficial for a vast majority of individuals, specifically children. Today 52.1 billion students are attending school worldwide (NCES, 2018). Due to the billions of students congregated at one location almost daily, school provides an ideal location to present this information. It was mentioned, in a study conducted by Haque et al. (2016), that 50 million school hours are lost in Bangladesh due to poor oral health. Poor oral health is affecting class attendance and possible long-term success in the future. As previously mentioned, some students may not have parental input guiding their oral health techniques, so providing this information to all school aged children will reach those with no oral health background. In this study, other global locations utilizing oral health education, provided in school, were examined. It has proven effective in China; school-aged children were exposed to a campaign called “Love Teeth Day”. Since this campaign launched, there was a decline in dental caries. There were similar findings with programs in Brazil, Madagascar and Indonesia. In rural Bangladesh, researchers found that oral health education provided in schools improved knowledge, attitude, and oral health practices, as well as decreased cavities. This mimicked the previous program’s findings. It was made clear that the success in this program was influenced by the dentist’s specific instructions during the sessions; the dentist recommended brushing with fluoridated toothpaste, having a consistent brushing regimen, and decreasing sugar consumption. Teacher contribution was also influential in the success of decreased caries; teachers were trained and helped the students stay

motivated and reinforced proper oral techniques. All factors influenced the decreased caries results and overall oral health of the students.

Dental information does not have to be given by a dental professional. A study conducted by Vangipuram et al. (2016) compared the effectiveness of dentist-led education sessions to peer-led education sessions. It was found that both leaders were successful in improving knowledge, attitude, and oral hygiene practices in student ages 12-15 years. The gingiva was reported to be healthier and there was decreased plaque on the teeth when compared to the student's mouths before the study. Interestingly, the peer-led sessions were more effective in influencing changed behavior and increased knowledge compared to the dentist-led sessions. The information given is effective and proves successful if presented by a professional or nonprofessional.

However, there are cons to teaching oral health in schools. One posed counterargument is that school time should be used for school-related topics. A study conducted by Reddy (2018) found that teachers faced challenges when trying to integrate oral health into the school day. Time was a major constraint; the teachers felt pressure to teach the curriculum and it was reported that there was not enough time to incorporate brushing teeth or educating their students. This resulted in another challenge, the teachers reported to already have a great workload so adding another school lesson seemed overwhelming. For this specific study, the teachers felt like there was not an accountable person to lead the program, so there was no consistent engagement with the students. The teachers also felt the resources given to them were limited, follow up practices were limited in the rural area of South Africa, and there were not enough funds to implement a consistent oral health program. This resembles the

circumstances in Laramie, due to the diminished oral health support state funding and rural location. By educating the teachers about the academic effects that poor oral health can have on their students will be beneficial. It's inevitable that some teachers will agree it's important while others will stick to their lesson plans.

The convenience of an oral health curriculum proves beneficial for teachers, their school districts, students, and their parents. To help alleviate teacher concern regarding time constraints and workload, a curriculum titled "Tooth Tutor" is currently utilized in Washington; Tooth Tutor provides a comprehensive guideline for educators teaching oral health in school (Pyatt et al., 2011). It offers teachers with descriptive unit plans that detail proper oral hygiene techniques and how to maintain a healthy mouth. There are ten units for each grade level, K-12. This resource also presents age-appropriate class activities, handouts, and template parent letters. The letters given to parents outline what their student learned, and how they can support their child's oral health habits. Additionally, Tooth Tutor provides supplemental background information that can be utilized by the teachers to answer questions their students may have. SEE ADDENDUM FOR DETAILS

An activity for second graders, regarding tooth decay prevention can be seen below in Figure 10. This specific activity discusses the importance of fluoride and how it prevents decay. It also outlines sources of fluoride; examples include toothpaste, varnish, or water intake. Tooth Tutor provides many hands-on activities that engage the students.

Second Grade: Preventing Tooth Decay – Fluoride, Sealants, Nutrition
Class Activity 1: Fluoride

Time Needed: 15–20 minutes

Materials Needed:

- Piece of celery with leaves
- Knife to cut celery lengthwise (*teacher may want to pre-cut the celery*)
- Food coloring (blue and red)
- 2–8 small glasses
- Parent/Caregiver Information Letter for each student
- Unit 4 Teacher Background Information

Objectives for Student Learning

- Understand how fluoride prevents decay
- Understand where we get fluoride

Essential Questions

Pre-assessment

Engage your students by assessing their general knowledge on the following question:

	Poor	Fair	Good
How does fluoride help fight decay?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Where do we get fluoride?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Procedure/Instruction

Review Unit 4 Teacher Background Information with students. Allow time for discussion.

Class Activity

- Students will conduct an experiment to show the action of fluoride on tooth enamel. You may choose to divide the class into 1–4 groups.
 - * Use a 10–12" piece of celery with leaves.
 - * Starting at the bottom of the stalk, cut a slit lengthwise, from the bottom to the middle of the stalk.
 - * Leave the top portion of the celery joined.
 - * Put 20 drops of red food coloring in one glass and 20 drops of blue food coloring in the second glass.
 - * Set the glasses side by side.
 - * Place one leg of the celery into the first glass and the other leg into the second glass.
 - * Set the celery aside for 5–24 hours.
 - * Discuss how teeth absorb fluoride from the inside out and how it is similar to the way celery absorbs the colored water.

Parent/Caregiver Information Letter

- Make copies of the Parent/Caregiver Information Letter for Unit 4 (Appendix C) to send home with each student. Please circle the subject(s) you covered in today's letter.

Figure 10. Tooth Tutor Activity for Second Grade

Note. From “Tooth Tutor- A simplified oral health curriculum for Pre-K to Grade 12”, by Pyatt et al. 2011, Washington State Department of Health, 1-188.

Local Project

Providing oral health education in schools has proven effective in other regions, however, there are other local setbacks that inhibit opportunities. In Wyoming, there is no longer funding for a public health oral health program, utilized in schools. To further investigate

the funding, an interview was conducted with Cassandra Walkama, MPH, RDH, CHES, CPM. Walkama is a registered dental hygienist, Program Manager for the Wyoming Cancer Program, and former Public Health Oral Health Program Manager. Walkama explained that prior to 2016, there were state-funded dental screenings, fluoride varnish applications, and oral health education provided to children in early childhood education through third grade.. The Public Health Oral Health Program was entirely general state funded and when the government was looking to cut funding, they considered how many individuals the Public Health Oral Health Program was serving and the types of services it was providing. This program did not serve as many individuals as other programs and the scope of the program was narrow, resulting in the program becoming eliminated.

In Laramie, Wyoming there was no evidence to suggest the school nurses or teachers were providing oral health education due to no standardized oral health curriculum available. Phone call interviews were conducted with the elementary school nurses to determine the stance and approach for oral health education provided in the schools. It was mentioned that most local educators and nurses want to provide oral health education, but there is no curriculum to follow, resulting in hesitation. Oral education is being taught by the teachers exclusively. If a student needs referred or has oral health needs, the teachers send them to the school nurse for further investigation. Once the student is referred, the nurses provide education, tools, and references for dental professionals locally. It was found that Centennial, Spring Creek and Indian Paintbrush Elementary schools have had a hygienist from Dental Arts of Laramie educate 3rd grade students about oral health. These schools have utilized this office for the past few years. While the other elementary schools have the teachers incorporate oral

health education throughout the school year. Velma Linford Elementary school utilizes a Colgate Kit that the teachers incorporate into the school day. The schools locally do not have a system or curriculum to follow, resulting in some students receiving essential information regarding oral health, while other students might not receive any. Through these interviews it was found that oral health education explicitly depends on the teacher or school they attend.

Due to the lower community water fluoridation levels in the local drinking water, the youth of Laramie are not receiving adequate fluoride to enhance oral health and prevent tooth decay. This provides another benefit to teaching students and their parents about the importance of oral health. With this information, parents can supplement with other fluoride options. Parents can buy toothpastes or rinses that offer additional fluoride at home. Clinically, children can take advantage of fluoride treatments, yearly or bi-annually, during scheduled cleanings at their local dentist office. Informing parents and their children about the local water fluoridation conditions and providing alternative methods to provide additional fluoride could benefit many.

Pilot Study

Introduction

Upon this investigation, the importance of healthy oral hygiene has been noted, as well as the consequences of poor oral hygiene. These are preventable diseases that can impact overall health, involving psychological and educational implications. Poor oral hygiene consequences affect individuals of all ages, however informing parents and their children about these consequences are essential to start a trend in low childhood dental caries and increased

healthy oral hygiene, explicitly in Laramie, Wyoming. Informing parents and their children about the development of dental anxiety and the steps to combat dental anxiety is important and may lead to more dental visits. A curriculum offered, like Tooth Tutor, provides a detailed unit plan for all ages (Pyatt et al., 2011). This resource helps combat teacher concerns regarding time constraints, heavy workload and feeling limited to sources. The handouts, activities and letters provide students with hands-on experience and gives helpful tips to parents. Teaching oral health education in schools is an effective and instrumental tool to reach all children and their parents. Schools around the globe have found great success in school educational sessions, resulting in decreased caries and increased understanding of proper oral health practices.

As of July 2016, the youth of Wyoming have not been regularly receiving oral health education. Considering the risks and suggesting proactive tips, in school, will should help to initiate preventive care. Therefore, the possible dental implications will likely decrease, leading to productive and healthy development. Wyoming youth need to be taught this at a young age to start or continue proper healthy habits.

Aim

This pilot study proposes input from a collection of individuals to help educate the youth of Laramie, Wyoming about the benefits of proper oral health techniques and how to prevent dental caries, gingivitis and periodontitis. Dental professionals, teachers and volunteers are

required, in this study, to help provide a successful program that influences students' decisions and understanding about oral health.

Materials and Methods

To narrow the sample size, Laramie elementary schools will be targeted. This age group provides students that understand basic concepts; most children's primary teeth are developed at this stage of oral development. As previously mentioned, habituation of oral hygiene techniques is learned at a young age, so informing students ages ranging from 5 years to 11 years will be beneficial to encourage proper hygiene techniques, if not already practicing.

Having a group of professionals collectively advocate for oral health education has limitations, due to other professional obligations. This project suggests that the role of a dental professional, hygienist or dentist, is needed to provide guidance to the volunteers and teachers. A short questionnaire will be given to local dentists, as well as local elementary school teachers. The dental professional survey will question volunteering time and their stance regarding oral health education, as well as the current oral health status of Laramie children. The dental professionals will provide guidance to Alpha Epsilon Delta (AED) members, as well as local teachers. The teacher survey will question what times would be suitable, if interested, and their stance regarding their students' oral health and oral health education. The volunteers described are AED members at the University of Wyoming, located in Laramie, WY. AED is a preprofessional health honor society that has requested volunteer time. The guidance will include materials and phrases to be used that are concise and engaging for local elementary students. It was found in the previous study, that specific instructions provided was important

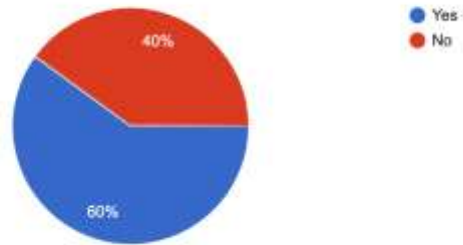
to the success in lowering dental caries and increasing healthy oral hygiene (Haque et al., 2016). However, this information does not necessarily require a dental professional to be successful (Vangipuram et al., 2016). For this project, AED students will volunteer alongside or on behalf of the dental professionals - depending on the dental professionals' request. Teacher input is also necessary for students to feel accountable. The teachers should be well informed of the basics of proper oral health education in order to answer questions the students may have. This will require the primary researcher and dental professionals to provide a resource for the teachers to apply. This resource may include Tooth Tutor, giving teachers grade specific guideline, activities, and parental letters.

Results

The surveys were created on Google Forms and were IRB approved on April 26, 2019. The surveys were sent April 26, 2019 to the elementary school nurses in Laramie, Wyoming. It was requested that the nurses forward the survey to the teachers (grades K-5) for completion. Ten teachers from the local schools have responded to the surveys, while there have been no results for the Dental Professionals survey. The questions and results for the teacher survey can be noted below.

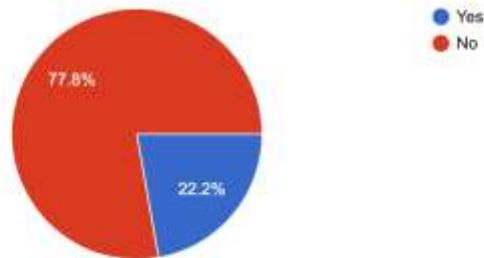
Do you teach your students about oral health/hygiene?

10 responses



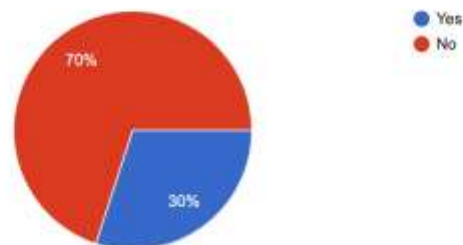
If so, do you find that you have enough time to teach about oral health?

9 responses



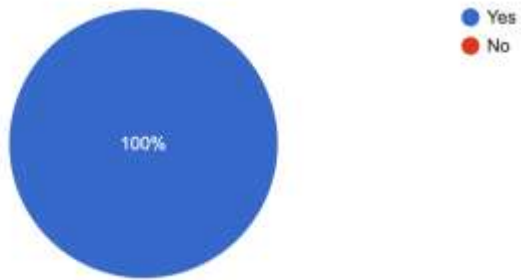
Do you find that you have enough time to teach about topics that are not tested on in your curriculum?

10 responses



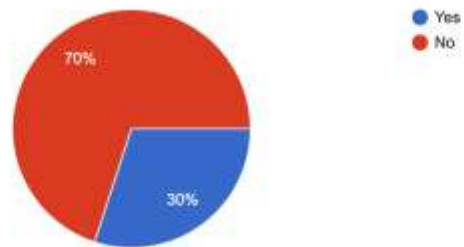
Do you find educating youth about oral health beneficial?

10 responses



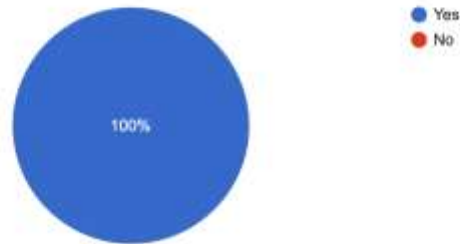
Do you think your students understand the importance of proper oral health techniques?

10 responses



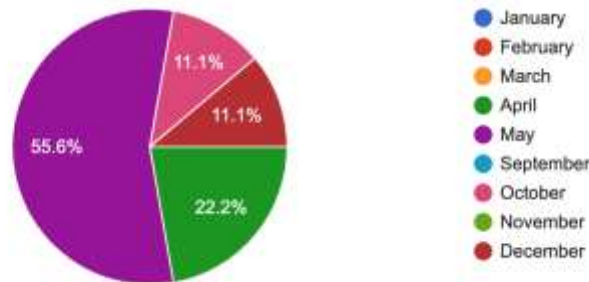
If available, would you allow a volunteer to teach your students about oral hygiene?

10 responses



Is there a certain month that would be free for this educational session?

9 responses



Conclusion

The primary goal of this study is to investigate the need for oral health education of elementary students in Laramie, Wyoming. Through the teacher survey, it can be noted that some Laramie Elementary Schools are providing oral health education, while others are not. Up to 70% of the teachers are restricted by time however, all teachers responded that teaching about oral health is important. 70% of the teachers thought that their students did not understand the importance of oral health. The teachers that completed the survey unanimously approved of having a volunteer teach their students regarding oral health. The secondary goal

is to reach all Wyoming students. Since there is no standardized curriculum regarding oral health and there is no funding for this program, it is necessary to recruit other local Laramie dental offices to volunteer time in hopes of recruiting other Wyoming dental offices. In order for this secondary goal to succeed, after a few years of oral education volunteering, the results will be presented at a regional dental conference. The conference will reach other dental offices around Wyoming. It is hoped that this will start a trend in advocating oral health education in schools.

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Addendum

Layout of Tooth Tutor (Pyatt et al., 2011)

Unit 1: Importance of a healthy mouth and the diseases related to poor oral health

Unit 2: Shape and function of teeth

Unit 3: Tooth decay process

Unit 4: Preventative measures students, and their parents, can take to maintain a healthy mouth

Unit 5: Proper tooth brushing and flossing techniques

Unit 6: Impacts of tobacco, alcohol, and illicit drugs regarding the mouth

Unit 7: Prevention related to injuries, such as sports and playground equipment

Unit 8: Teen oral health - trends and associations impacting oral health

-These include appearance, piercings, and eating disorders.

Unit 9: Critical role of the mouth involving the whole body

Unit 10: Typical dental visit and dental office

-This prepares students, presents expectations, and provides relief