ANALYSIS OF SEDGWICK COUNTY HEALTH DEPARTMENT SCHOOL DENTAL SCREENING DATA TO DETERMINE TARGET AREAS FOR INTERVENTION

by

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Abstract

Oral health is a critical aspect of child development, and dental decay is the most common chronic disease found in children. The goal of my capstone project with the Sedgwick County Health Department (SCHD) was to analyze school dental screening data from their Children's Dental Clinic to determine areas for targeted interventions. Data collected from school dental screenings during the 2012 and 2013 calendar years were analyzed for percent untreated decay, percent emergency dental visit needed, percent of sealants present, and percent of sealants needed (dental variables). Descriptive variables were also created to further describe the study population (school district (USD), school level, location, predominant race, and percent of students who receive free lunch). The schools were ranked based on the ten highest and ten lowest schools for the dental variables. Following these rankings, logistic regression analysis was conducted to determine the associations between high untreated decay (≥13.9%) and low sealants present (<37.3%). When the schools were ranked based on the dental variables, schools with high levels of untreated decay and high levels of emergencies often had a high percent of students qualifying for free lunch. Schools with high levels of sealants present often had a low percent free lunch. This association was supported by correlation analysis. Univariate analysis indicated high levels of untreated decay was significantly associated with high emergency (≥3.5%), low sealants present, USD 259, school level elementary, predominant race of white, and high levels of free lunch (≥50%). A step-wise logistic regression model was developed to determine the association between high levels of untreated decay and the other variables. Based on this model, a school with low levels of sealants present was 22.48 (CI: 4.3-117.1) times as likely to be classified as a high percent untreated decay, when the effect of free lunch was considered. Based on the results of this study, the presence of dental sealants is associated with lower percentage of untreated dental decay in schools screened by the SCHD Children's Dental Clinic. The SCHD plans to target the three schools with the highest percent of untreated dental decay using a parent survey to determine which interventions will best promote oral health in Sedgwick County children.

Key words: Sedgwick County Health Department, SCHD, Oral Health, Dental Decay, Dental Sealants

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Abbreviations

BIS	Behavioral Intervention Specialists
CDC	Centers for Disease Control and Prevention
FIMR	Fetal Infant Mortality Review
HIV	Human Immunodeficiency Virus
IRB	Institutional Review Board
KDE	Kansas State Department of Education
KDHE	Kansas Department of Health and Environment
KPHA	Kansas Public Health Association
MMRS	Metropolitan Medical Response System
MRC	Medical Reserve Corps
NE	Northeast
NW	Northwest
PHIPR	Public Health Incident Planning and Response
SCHD	Sedgwick County Health Department
SE	Southeast
STD	Sexually Transmitted Disease
SW	Southwest
TB	Tuberculosis
USD	Unified School District
WIC	The Special Supplemental Nutrition Program for Women, Infants, and Children

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Preface

My field experience and capstone project were completed at the Sedgwick County Health Department (SCHD) in Wichita, Kansas. My internship preceptor was Mrs. Christine Steward, MPH, MT(ASCP). Mrs. Steward is the Epidemiology and Surveillance Coordinator for the Epidemiology Division at the SCHD. The field experience included 240 contact hours and was conducted between January 13, 2014 and March 11, 2014.

The purpose of this capstone project was to analyze data provided by the SCHD Children's Dental Clinic to determine rates of untreated dental decay, emergencies, sealants present, and sealants needed in Sedgwick County children. These data were then used to determine specific schools to target for intervention. The overall goal of this project is to improve the oral health of children in Sedgwick County.

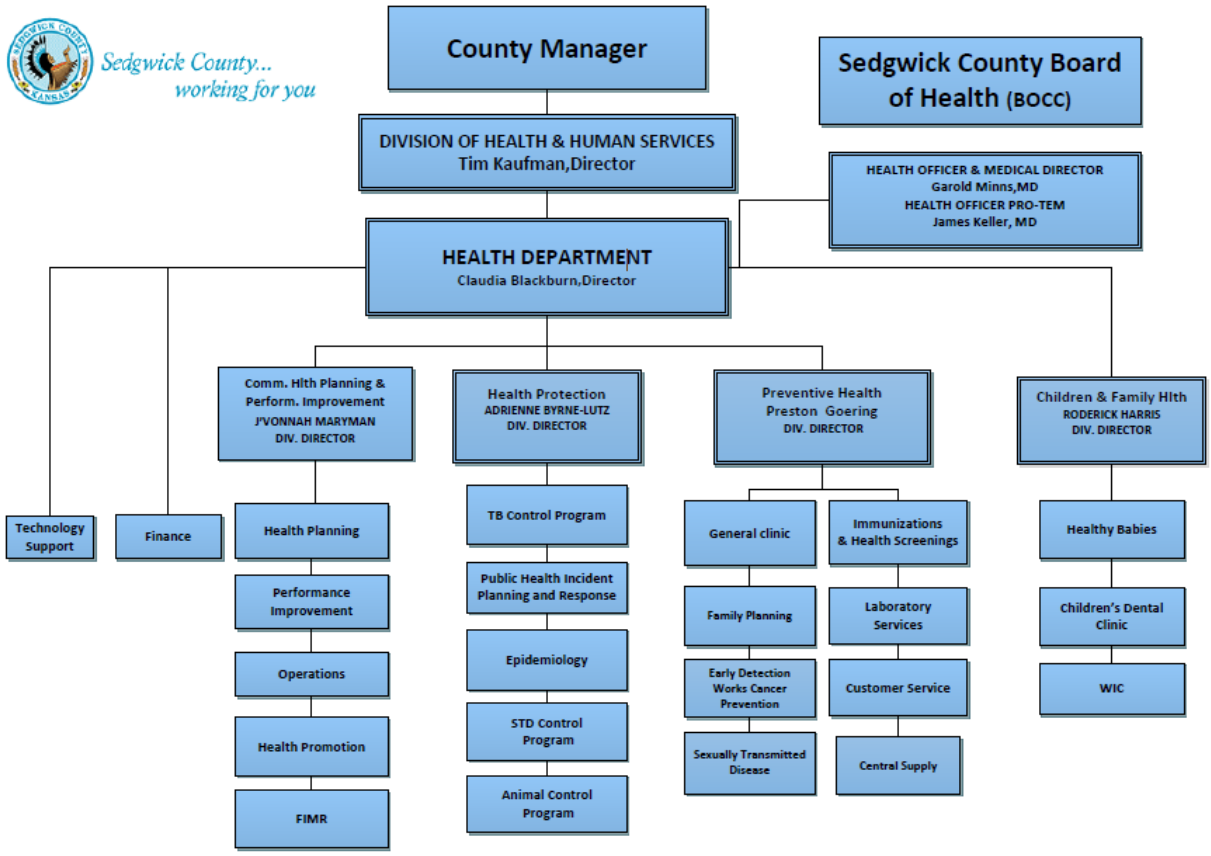
Chapter 1 - Sedgwick County Health Department

The Sedgwick County Health Department (SCHD) Mission Statement is, "To improve the health of Sedgwick County residents by preventing disease, promoting wellness and protecting the public from health threats." To accomplish this mission, the SCHD has established four main goals. These goals are, "to establish, maintain, and nurture partnerships to ensure effective and efficient delivery of services; to train, encourage, and recognize employees for hard work, creativity, and innovation in delivering quality public services; to foster two-way communication with citizens and employees to build trust, confidence, and teamwork, and to ensure informed decisions; and to allocate and use resources for basic and essential services that are responsive to the changing needs of our community."[1]

Organizational Structure

The SCHD is part of the Sedgwick County Division of Health and Human Services. The SCHD is divided into four major divisions: Community Health Planning and Performance Improvement, Health Protection, Preventative Health, and Children and Family Health. There are also two smaller divisions, Technology Support and Finance, a Health Officer, and a Sedgwick County Board of Health that promote and support the operation of the SCHD. **Figure 1.1** shows an overview of the SCHD as of January 14, 2014.

Figure 1.1 Sedgwick County Health Department Organizational Chart



(SCHD Organizational Chart)[2]

Community Health Planning and Performance Improvement

The Division of Community Health Planning and Performance Improvement is integral to the SCHD. One program, Health Promotion, was created to educate Sedgwick County residents about both healthy behaviors and health care. The areas targeted by Health Promotion are oral health, mental health, access to care, and tobacco use. A second program, Performance Improvement, was designed to improve the SCHD through workforce development. Workforce development includes staff preparedness and education, tracking educational improvement, ensuring proper training and education of student interns, and quality improvement initiatives. The final major program of the Division of Community Health Planning and Performance Improvement is the Fetal Infant Mortality Report (FIMR). FIMR consists of a Community Review Team and a Community Action Team. The Community Review Team studies de-identified cases of infant deaths in Sedgwick County and makes recommendations about

corrective actions. The Community Action Team then takes these recommendations and uses them to promote change in Sedgwick County. Since Sedgwick County has some of the highest rates of infant mortality in both Kansas and the United States of America, this program is critical to determine ways to reduce infant mortality.[3]

Health Protection

The Division of Health Protection encompasses several programs. The first of these programs is the tuberculosis (TB) control program. The TB control program was designed to educate residents about TB; assist health care organizations, schools, and shelters with screening, treatment, and education; perform surveillance for TB detection and outbreak prevention; and diagnosis and treat individuals who have a positive TB test or active TB.[3]

Two other programs in the Division of Health Protection are Epidemiology and sexually transmitted disease (STD) control. These two programs perform similar functions for the county. The Epidemiology program performs surveillance and investigations of non-STD notifiable diseases. This involves contacting medical providers and "cases" to determine how an infection was acquired. The Epidemiology program also performs data analysis for other areas of the SCHD. The STD control program performs surveillance and investigations of STD cases in 56 Kansas counties. The Behavior Intervention Specialists (BIS) in this program ensure that individuals in Kansas with the four major STDs (Chlamydia, gonorrhea, syphilis, and Human Immunodeficiency Virus (HIV)) are receiving treatment. For non-Chlamydia infections, they also interview all contacts of the patient to stop the spread of the disease.[3]

Another program in the Division of Health Protection is Public Health Incident Planning and Response (PHIPR). PHIPR was created to ensure that residents of Sedgwick County would be prepared if there was an emergency. This includes both natural disasters and acts of terror. One of the programs utilized by PHIPR is the Metropolitan Medical Response System (MMRS). This system is an operational system designed created for response to public health emergencies that can lead to mass casualties. It was designed to enable the SCHD and its partners to manage the emergency until state or federal response resources can be mobilized.[4] The other major program utilized by PHIPR is the Medical Reserve Corps (MRC). The MRC utilizes local volunteers to promote healthy living throughout the year. They are also trained to prepare for and respond to public health emergencies.[5]

The newest program in the Division of Health Protection is the Animal Control Program. Animal control ensures that animals in Sedgwick County are properly housed and cared for, as well as ensuring that any animal remains are disposed of in a way that does not pose a health or safety hazard. Animal control officers reunite owners with lost pets, investigate animal cruelty calls, and enforce Sedgwick County codes.[6]

Preventative Health

The Division of Preventative Health is based out of a general clinic, the West Central Clinic, located in Wichita. This clinic performs a multitude of functions for the residents of Sedgwick County. One of these functions is health screenings and immunizations. Residents who do not have a primary care physician can come to the SCHD clinic to receive blood lead testing, blood pressure checks, blood sugar testing, cholesterol testing, sickle cell screening, and TB skin testing. Residents can also receive immunizations at the clinic. These include childhood vaccinations, adult vaccinations, and travel vaccinations, such as yellow fever and typhoid.[3]

Other functions of the Division of Preventative Health include family planning and STD testing and treatment. Residents of Sedgwick County can visit the West Central Clinic to receive contraceptives, including prescription birth controls, pregnancy testing, and preconception counseling. They can also receive STD testing, diagnosis, treatment, and counseling at this location. All of these services are subject to either a sliding scale or voucher system for payment. The West Central Clinic also hosts its own laboratory services.[3]

Children and Family Health

The Division of Children and Family Health contains three major programs for Sedgwick County. The first of these is Healthy Babies. Healthy Babies is a free educational program with no income requirements for women from pregnancy through the child's first two years of life. Healthy Babies hosts both group and individual visits with registered nurses to promote healthy pregnancies and children. They also perform preconception education in Sedgwick County schools through the Healthy Today, Healthy Tomorrow program. Both of these programs are designed to improve the maternal and child health of Sedgwick County.[3]

A second program in the Division of Children and Family Health is the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC). Most Kansas health departments house and maintain a WIC program. It is designed to provide supplemental food and

nutrition to women who are pregnant or breastfeeding, new mothers, and children up to the age of five. To qualify for WIC, residents have to meet specific residency, income, or nutrition eligibility guidelines.[3]

A third program in the Division of Children and Family Health is the Children's Dental Clinic. The Children's Dental Clinic performs multiple roles in Sedgwick County. First, the Children's Dental Clinic conducts dental screenings at schools located in Sedgwick County. During these screenings, dental hygienists screen children between pre-kindergarten and eighth grade for untreated dental decay in primary or permanent teeth, sealants, fillings, gum infection, and other dental problems. The Children's Dental Clinic also performs dental services for children with no dental insurance. These services include both preventative measures, such as cleanings and sealants, as well as treatments.[3] Data collected by the Children's Dental Clinic in their school screening program forms the basis of this field experience.

Role at SCHD

At the SCHD, I worked with the Epidemiology program to analyze dental screening data for the Children's Dental Clinic. This data had been collected in 2012 and 2013 from school screenings in Sedgwick County. I was tasked with the role of determining the percent of untreated decay, the percent of emergencies, the percent of sealants present, and the percent of sealants needed in these schools. I also had to determine factors to describe the schools from which the students were screened. These included school district (USD) number, school location in Sedgwick County, school grade level, predominant race in the school, and the percent of students who qualified for the free lunch program. This information was used to create a survey for a pilot program to identify and reduce the barriers to accessing dental care in Sedgwick County.

During my time with the SCHD, I was able to not only learn about the Children's Dental Clinic and Epidemiology, but about the SCHD as a whole. I was provided with the opportunity to shadow nurses at the West Central Clinic, WIC, and Healthy Babies. I was also able to attend multiple meetings, including quality improvement, workforce development, West Nile Virus prevention, and blood lead investigation. During my field experience with the Epidemiology Division, I attended weekly disease investigation meetings, participated in disease investigations,

and aided in the creation of *Bordatella pertussis* informational material. Through this field experience, I became familiar with all aspects of the SCHD.

During the course of this field experience, I gained numerous skills that will benefit me as I continue on in my career in public health. First, I learned how to analyze "real world" data in situations that are not as simple as those presented in a classroom setting. This included determining how to properly clean and organize a dataset and how to overcome barriers induced by a lack of complete information. I also learned how to use new statistical programs including SPSS (IBM Corporation, Armonk, New York) and SAS (SAS Institute Inc., Cary, North Carolina). This knowledge immensely broadened my ability to perform data analysis. Second, I learned about current issues involved in the realm of public health. In January 2014, the Kansas Department of Health and Environment (KDHE) mandated that the local health departments begin investigations for elevated blood lead levels. As this was a new procedure, I was able to aid the Epidemiology program as they created a standardized protocol to handle this matter. Finally, I was able to understand what role a public health epidemiologist has in the local health department sector. By observing and assisting in the disease investigations, nuisance assessments of uninhabited properties to determine health concerns, conference calls, and publications produced by the SCHD epidemiologists, I was able to gain a deeper understanding of their importance in the protection and prevention of disease in Sedgwick County. All of the knowledge and skills I gained during my field experience and capstone project at the SCHD will be critical to me as I pursue a career in public health.

Chapter 2 - Introduction

Dental Decay

Oral Health is one of the most critical aspects of child development, but it is often overlooked in public and personal health. Oral health is defined as, "a standard of the oral and related tissues that enables an individual to eat, speak, and socialize without active disease, discomfort or embarrassment…."[7] Dental caries, more commonly known as dental decay, is the most common chronic disease in children.[8-10] Dental decay is five times more common than asthma in children and seven times more common than hay fever.[9,11-13] Worldwide, between 60% and 90% of children ages two to eleven have some form of untreated dental decay.[14] In the United States, between 40% and 50% of children have some level of dental decay present.[14,15] Since dental decay requires restoration placements (dental fillings) and replacements (crowns), it is the most expensive of the common dental diseases.[16] Dental decay places an enormous burden on the United States healthcare system, requiring at least $4.5 billion for treatment each year.[14]

Dental decay occurs when normal oral flora feed on sugars and carbohydrates present in the mouth. The most common cariogenic bacteria are *Streptococcus mutans* and *Lactobacilli* spp.[17,18] When consumed food is not properly removed from the teeth, these bacteria adhere to the sugars and carbohydrates on the enamel surfaces. Over time, these bacteria form biofilms, which are commonly referred to as dental plaque.[14] When the bacteria feed on the carbohydrates in the plaque, organic acids are produced.[11,14,18,19] Through multiple cycles of acid production, the microscopic dissolution of minerals occurs in the enamel surfaces of the teeth. If left untreated, this dissolution of minerals will lead to the formation of dental decay.[11, 20, 21] Biological and environmental factors have an impact on the number of oral bacteria present in a child's mouth. Since the oral bacteria linked to dental decay are acidogenic, the pH of the child's mouth can affect the rate of dental decay. Bhayat et al. demonstrated that a lack of buffering capacity of saliva is a strong risk factor for dental decay.[22] Individuals who have a high buffering capacity in their saliva are more likely to neutralize the mouth pH, reducing the number of acidogenic bacteria present.[23]

Untreated dental decay has a major impact in a child's quality of life. Dental decay has been shown to affect growth and development, ability to learn, and behavior.[10,11,24,25] Children with severe dental decay are more likely to experience interference with play, school attendance,

speaking, sleeping, and eating.[10,26] The pain and problems associated with dental decay are a major cause of missed school days in children.[13,15] High rates of dental decay can also cause numerous health problems. Casamassimo and others found that body measurements and blood tests used to indicate malnourishment and iron-deficiency anemia were significantly associated with childhood dental caries.[26] Dental decay can cause severe toothaches that are accompanied by sensitivity to temperatures and sweet foods. If left untreated, the decayed tooth can become infected. This infection can lead to abscess formation, cellulitis, destruction of the jawbone, and systemic infection.[15] Between 17% and 49% of child emergency room visits are attributable to dental decay.[27-29] Dental decay can also promote periodontal disease and gingivitis.[20] Dental decay in children can impact the psychosocial aspects of health, such as self-esteem and perceived appearance.[24,30] Childhood dental caries has been shown to impact children's and parent's perceptions of their smiles, as well as their smiling patterns.[24] Numerous studies have found that the presence of dental decay in primary teeth is a risk factor for increased decay formation in permanent teeth.[15,17,24,32,33] Dental decay is a disease that continues into adulthood, impacting speech, nutrition, economic productivity, and overall quality of life.[10,26] Preventing and treating dental decay improves the lives of both children and adults.

Every four years, Kansas conducts the Kansas Basic Screening Survey as a method of health surveillance for children's oral health. These surveys are titled "Smiles Across Kansas." One of the factors identified by the survey is dental decay. The 2012 Smiles Across Kansas oral health survey reported one out of ten Kansas third graders had untreated dental decay, compared to one out of four in the 2004 Smiles Across Kansas Survey.[12] However, dental decay is still a major problem in Kansas. The 2012 Smiles Across Kansas Survey also found that 48% of Kansas children have some form of dental decay.[12] Although this number is below the Healthy People 2020 target of 49%, there is still the need for dental decay interventions in Kansas.[11]

Behavioral Influences on Dental Decay

Certain behaviors increase the risk of dental decay in children. The factor with the largest impact is diet. Children who consume carbonated sugary drinks, such as soda pop, have an increased risk of dental decay.[10,17,33] In contrast, children who consume small amounts of 100% juice have lower rates of dental caries.[10,34] This difference is due in part to the sugar substrates found in the beverages. Soda pop utilizes sucrose and high fructose corn syrup, while the sugar

substrates in 100% juice are fructose and glucose. The glucosyltransferase produced by *S. mutans* uses sucrose to form extracellular glycans, which promote adherence to the enamel surface and dental decay.[10] Research shows the consumption of milk can be protective against dental caries. The compounds found within dairy foods (calcium, phosphorus, casein, and fat) promote remineralization, buffer acids, and limit demineralization. However, the consumption of nonmilk dairy foods (yogurt and dairy desserts) have been linked to an increased risk of dental caries.[10] This is likely due to the presence of added sucrose and high fructose corn syrup present in these products.

Children who consume sugary or starchy snack foods are at a higher risk of dental decay.[17,21,34] The consumption of these foods over extended periods of time provides cariogenic bacteria an optimum growth environment. Since *S. mutans* utilizes sucrose as a substrate, sugar consumption increases the risk of plaque formation. As the number of these bacteria increase, so does the risk of dental decay.[17] Inadequate intakes of specific nutrients can also contribute to dental caries, including riboflavin, copper, vitamin D, and vitamin B-12.[10] A proper diet containing few non-milk or water drinks and foods high in vitamins and low in sugars is one of the most important factors to preventing dental caries in children.

Prevention of Dental Decay

Preventing dental decay requires both behavioral changes and dental care. In their "Brush Up on Healthy Teeth" campaign, the Centers for Disease Control and Prevention (CDC) established four steps for dental decay prevention. These steps encouraged parents to conduct proper oral health care by cleaning teeth early, using fluoride toothpaste, teaching children correct brushing procedures, and ensuring that their child visits a dentist. The CDC recommends that dental care begin as soon as the first tooth appears. At this time, parents should wipe the gums with a damp cloth at least once a day. When more teeth appear, a soft, small toothbrush should be used to clean the teeth. Once the child turns two years old, a small amount (pea sized drop) of fluoridated toothpaste is recommended for use. After the child reaches age six, a fluoridated mouth rinse may be used.[35] Ashkenazi et al. stated that regular use of a toothbrush twice a day, fluoridated toothpaste, and attending regular dental appointments are significantly associated with lower rates of dental caries.[36]

Fluoride has been proven to be advantageous in the prevention of dental decay by strengthening tooth enamel.[11,37,38] Fluoride can be used both systemically and topically to prevent dental decay. The most common systemic source of fluoride is a community water supply. Communities have been supplementing fluoride in water for over half a century, and the CDC recognizes fluoridated drinking water as one of the ten greatest public health achievements in the 20th century.[11] Public water fluoridation allows for all populations to have access to fluoride, regardless of socioeconomic background. Fluoridated water prevents dental decay by delivering fluoride both systemically and topically. Currently, 63.8% of Kansas citizens live in an area with fluoridated public water sources.[11] Toothpaste, fluoride varnish, fluoride rinses, and fluoride gels are the most common sources of topical fluoride. These products work by increasing the local concentration of fluoride on the teeth and allowing for the remineralization of enamel.[11] The optimum concentration of fluoride is 1000ppm in children between the ages of two and six.[39,40] This level will reduce the likelihood of dental fluorosis. Dental fluorosis is the hypomineralization of enamel due to the ingestion of excessive amounts of fluoride. This most commonly occurs in children with developing teeth. Children over age six can use a product with a fluoride concentration between 1000ppm and 1500ppm.[39,40] At these levels, the use of fluoride will aid in the prevention of dental decay by reducing the amount of plaque on the teeth.

Another key element of dental decay prevention is the use of dental sealants. Dental sealants were developed in the 1960s to prevent dental decay in children. The sealants cover the pits and fissures of the occlusal (chewing) tooth surfaces.[11,37,41,42] These surfaces are the most susceptible to dental decay.[37,42] The use of dental sealants has been shown to have a preventative effect on the dental decay of the molars and premolars in up to 71% of children.[43] Dental sealants have been shown to prevent dental decay beyond four years.[41,42] Time of sealant application is also critical. The optimal time for sealant application is soon after the occlusal surface of the tooth is free of gingival tissue. Application of dental sealants up to four years post tooth eruption has also been found to be beneficial to the prevention of dental decay. After four years, the dental decay susceptibility of the individual must be evaluated to determine whether sealants should be applied.[42,44] In order to promote the use of dental sealants in Kansas, KDHE has developed the Kansas School Sealant Program. This program allows local dental providers to visit Kansas schools and apply dental sealants to students. During the 2011-2012 school year, 22,156 sealants were placed for 5,085 children.[45] The goal of the Kansas School Sealant Program

is to decrease the rates of dental decay in Kansas children and increase the overall oral health of the state.

Socioeconomic Status and Health Disparities

Socioeconomic status and health disparities play an important role in the rate of dental decay. Health disparities occur when there are differences in the health status of different cohorts of individuals in either general health or oral health. One commonly quoted statistic states that 80% of dental disease in children is found in only 20% of children.[46] These children are often from minority or low-income families.[47] Children between the ages of six and eleven from families living below the federal poverty level are twice as likely to develop dental caries than children from families with incomes at least two times greater than the federal poverty line.[14,42,48] Health disparities are not often linked to only one social determinant of health. These disparities can occur due to race and ethnicity, residence, family income, and parental education.[47,49] Neighborhood quality can also impact the rate of dental caries. Individuals with lower socioeconomic status often live in lower quality neighborhoods. These neighborhoods are less likely to have grocery stores and farmer's markets to sell nutritious foods, leaving the individuals to derive their diet from foods that promote dental decay.[49] Additionally, these individuals also may not have the income necessary to purchase nutritious foods, increasing the risk of dental decay.

Access to care is critical for the prevention and treatment of dental decay. Children from families below the federal poverty limit are three times as likely to have unmet dental care needs than their counterparts above the poverty limit.[15] It has been suggested that state or federal managed dental insurance can be utilized to cover the dental health disparities. Although government managed dental insurance does increase access to care rates, Liu et al. found government dental insurance is not capable of covering the access to care gap between uninsured and privately insured children. Children who have private insurance are more likely to receive preventative care than uninsured children.[47] This could be due to inadequate geographic distribution of dental clinics, lack of dental clinics who accept Medicaid, or a lack of pediatric dentists.[15,47] Without an improvement in access to care, dental decay will continue to be a major health issue in the United States.

Previous Analysis of Dental Decay Rates

Numerous studies on the rate of dental decay have been reported in the literature. Most of the studies observed in the literature analyzed the rates of dental caries in individual children with few addressing dental decay on a local school level. The association of dental decay with multiple dental factors (sealants, urgent care) and school descriptive variables (school district, location, grade level, race, and percent of students qualifying for free lunch) was also not addressed in previous literature. This study presents a novel approach to the identification of targets for oral health interventions on the local level. Although the information present in the literature was utilized in the interpretation and analysis of the SCHD dental screening data, the method of analysis was determined based on practices observed in other non-oral health association studies.

School Screening Program

Kansas state law requires that every child have one dental inspection during the school year. In the 2011-2012 school year, 140,000 children in Kansas received an oral health screening through a school-based screening program.[11] These screenings are especially beneficial because they can identify children who lack access to dental care.[50] Each year, the SCHD Children's Dental Clinic staff, along with three other safety net dental clinics (E.C. Tyree, GraceMed, and Hunter Health Clinic), visit schools in Sedgwick County to perform free dental screenings on children in grades pre-kindergarten to eighth grade. The head school nurses in Sedgwick County schools work with the dental clinics to ensure that all schools are screened. The clinics generally screen the same schools each year, and the schools are not randomly assigned to the clinics. Therefore the data from the SCHD Children's Dental Clinic school screenings are considered a non-probability sample. These screenings are conducted in both the fall and spring semesters by registered dental hygienists employed by the SCHD. During the screening, the dental hygienists record if the student has any of eleven different dental conditions. These conditions are "teeth have no apparent defect," "has had fillings/sealants," "need better brushing and flossing," "needs professional cleaning of teeth," "defect in primary teeth," "defect in permanent teeth," "gingivitis present," "needs advice on orthodontia," "your child may need dental sealants," "other abnormal condition," and "EMERGENCY-in need of immediate dental care!" These conditions are written on a card which is then given to the child's parents. If the child has a condition warranting dental

care, the parent should have the child treated and return the card to the child's school with a dentist's signature. If the child is classified with an emergency condition, a follow-up phone call is made to the parent to promote a dental visit.[11] However, there is currently no major consequence if this does not occur. Children who meet the following eligibility requirements can be treated at the SCHD Children's Dental Clinic: 1) be between ages 5 and 15, 2) be uninsured and not eligible for a medical card or KanCare, and 3) qualify for free or reduced lunches at school. If the child meets these requirements, they can schedule an appointment with the SCHD Children's Dental Clinic for treatment. Routine cleanings are completed by the dental hygienists, while more advanced dental work is performed by volunteer dentists.

Project Objectives

My field experience was part of a larger study titled "Identifying and Reducing Barriers to Accessing Services at the Sedgwick County Children's Dental Clinic." The study will be conducted between 2013 and 2015. The overarching goal of the study is for the Children's Dental Clinic to see a 20% increase in eligible students from three to five Sedgwick County schools selected based on untreated decay rates receiving care in the Clinic during the 2014-2015 school year as compared to the 2012-2013 school year. My field experience had four project objectives, as outlined below:

1. Analyze the Children's Dental Clinic data and determine which schools have the highest percentage of students with untreated dental decay.
2. Develop a pilot study to determine barriers to accessing services at the Dental Clinic.
3. Perform online research on oral health programs from other states and local health departments to determine if similar studies have been conducted and the results of those studies.
4. Assist in developing a Communications Plan for the Children's Dental Clinic that will target parents and school nurses in the three to five identified schools.

During my field experience, a second analysis was added to objective one. This analysis used logistic regression modeling to determine associations among the four major dental variables (untreated decay, emergencies, sealants present, and sealants needed), and certain descriptive variables (USD, school level, location, school type, predominant race, and free lunch status).

Chapter 3 - Methods

The data utilized for this project were collected by the SCHD Children's Dental Clinic as part of their school screening program during the 2012 and 2013 calendar years. One school in 2012 and three schools in 2013 were screened twice in their respective year. To avoid duplicate analysis of students in one calendar year, the data from the second screening for each school was removed from the dataset. This created a dataset which included 15,492 individual students and 51 screened schools in 2012 and 16,452 individual students and 54 screened schools and facilities in 2013.

Due to the method of screening data collection, this study would be classified as a cross-sectional study. In a cross-sectional study, the prevalent cases of disease and the exposure to the disease are collected at the same time-point.[51] In this study, the disease being studied is untreated decay, and the exposures are the other dental and descriptive variables described below. The analysis for this study was performed using the prevalence odds ratios. The prevalence odds ratios were used to compare the prevalence odds of untreated decay amongst screened schools to the other dental and descriptive variables.

Screening data collected by the SCHD Children's Dental Clinic were entered into Microsoft Excel (2007) (Microsoft Corporation, Redmond, Washington). Data included the number of children at each school who had the eleven conditions recorded during the school screenings. The condition, "has had fillings/sealants" was split into two variables. These were "fillings present" and "sealants present." SCHD Dental Clinic staff recorded "sealants present" for any student who had any evidence of sealants, including small residue around the gums. The condition "need better brushing and flossing" was found in all of the students screened; therefore it is the total number of students screened at a school. To maintain anonymity, school names were coded based on year, district, and school level.

For this project, two different levels of data analysis were conducted, entitled Part A and Part B. Part A was completed for the SCHD Children's Dental Clinic, and Part B was performed for the SCHD Epidemiology Program and the completion of this report. For the purpose of this report continuous variables are identified with "percent" prior to the variable name (percent untreated decay, percent emergency, percent sealants needed, percent sealants present, and percent free lunch) and categorical variables are identified by the lack of "percent" before the

variable name (untreated decay, emergency, sealants needed, sealants present, USD, location, school type, school level, predominant race, and free lunch).

Part A-Summary of Screening Data

Part A was a descriptive analysis conducted to describe the populations of the schools that were screened and to determine each school's overall percent of untreated dental decay, percent of students with emergencies, percent of students who need sealants, and percent of students with sealants present. The schools were ranked based on each of the aforementioned dental variables to determine the schools which would be best suited to a pilot intervention strategy.

The denominator for all dental variables was the total students screened for a particular school. The numerator used to determine percent untreated decay was the number of students with untreated decay in their primary teeth combined with the number of students with untreated decay in their permanent teeth for a particular school. For percent emergency, percent sealants needed, and percent sealants present, the numerator was the number of students in a particular school with emergencies, sealants needed, and sealants present, respectively. After the creation of the four dental variables, the schools in the 2012 and 2013 datasets were ranked based on percent untreated decay, percent emergencies, percent sealants needed, and percent sealants present (**Table 4.2-Table 4.17**). Schools with low percent of students screened were not included in the ranking tables. Low percent screened indicated those schools that were greater than two standard deviations below the mean percent screened for the year. Descriptive statistics and rankings were calculated using formulas in Microsoft Excel (2007).

During screenings, the SCHD Children's Dental Clinic collected only the dental variable data, school name, and the student's grade; no information was collected to describe the population screened. To characterize the population at each school and therefore to define or approximate the population screened, descriptive variables about the school populations were determined. These descriptive variables were USD, school type, school location, predominant race, and percent free lunch. The USDs used in this analysis were those recognized by the KSDE for Sedgwick County.[52] School type described whether the screened school was private or public. School location was determined by dividing Sedgwick County into four regions, northwest (NW), northeast (NE), southwest (SW), and southeast (SE). These regions were

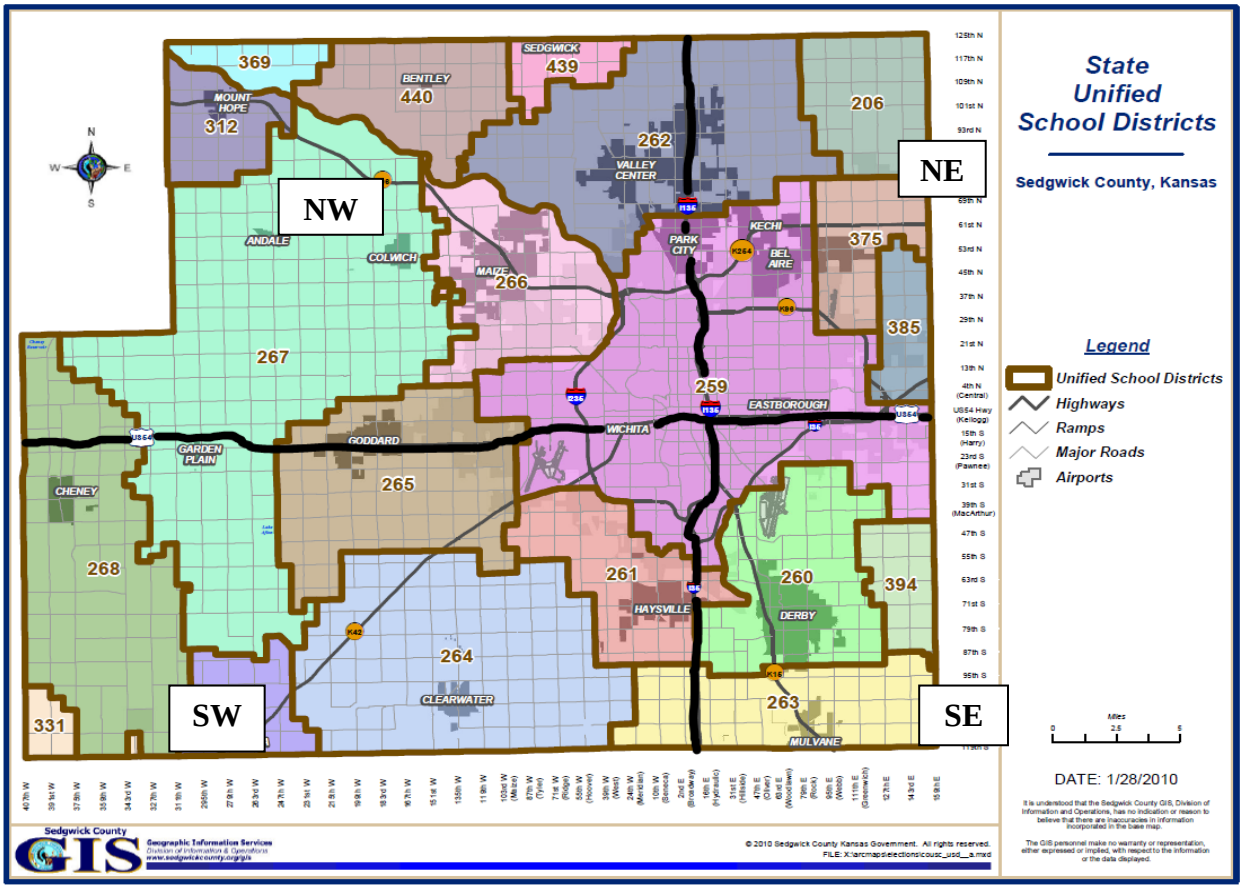
created using the major highways crossing Sedgwick County. The east-west determinants were Interstate 35 and Interstate 135. The north-south determinant was United States Highway 54. This division is shown in the Sedgwick County school district map (**Figure 3.1**) created by the Sedgwick County Geographic Information Services (Division of Information and Operation, Wichita, Kansas).

The variables of predominant race and percent free lunch were determined using the KSDE's "Kansas K-12 County, District, and School Reports."[52] For some schools with low numbers of students in a category, the percentage of race and free lunch percentage could not be calculated. When producing the "Kansas K-12 County, District, and School Reports," any category that contains a number of students less than ten is considered identifiable, and the indicator "<10" is placed in the table instead of a whole number. Since some of the results were incalculable as exact numbers but estimations were possible, the categories of predominant race and free lunch quartile were created. Predominant race was the race found in the highest number in a particular school. The predominant race of "mixed" indicates that there was more than one predominant race present in the school. A school was classified as having a predominant race of mixed if two or more races were within 10% of each other, and if these two percentages combined equaled greater than 50%.

The category of free lunch quartile was created by estimating the number of students present in a school who qualified for free lunch. To do this, any category with "<10" was calculated as 9 students. Nine was used as an estimated number because it was the highest potential whole number value for free lunch within the <10 result. Some schools had low numbers of total enrolled students which could bias estimations, indicating a potential for bias if the percent free lunch was estimated. For schools with <10 students in the free lunch category, the free lunch quartile was considered incalculable if the school had a student body one standard deviation (221 students) below the dataset mean (414 students). Since these schools had a low number of enrolled students, percent free lunch would be overestimated if the estimation of nine students was used. The quartiles for free lunch quartile were established using methods from Birnbaum, et al.[53] Quartile 1 included schools with 0% to 24% of students qualifying for the free lunch program, quartile 2 included schools between 25% and 49%, quartile 3 included schools between 50% and 74%, and quartile 4 included schools with 75% or greater of students qualifying for the free lunch program.

The KSDE's "Kansas K-12 County, District, and School Reports" were used to calculate the percent of students from each school who were screened. This was calculated using the total screened values provided by the SCHD Children's Dental Clinic and the total enrollment numbers obtained from the KSDE. For 20 schools in 2012 and 13 schools in 2013, total enrollment numbers had to be estimated. This was due to the presence of the "<10" value in a category for special education students. Total enrollment numbers were estimated using the same procedure as free lunch quartile. Three Juvenile Detention Facility screenings (80 children) were removed from the datasets, since this study focused on school screenings.

Figure 3.1 Map of Sedgwick County Indicating USD and School Location Regions



(Sedgwick County GIS)

Part B- Associations among Dental and Descriptive Variables

Part B used logistic regression to examine the association between untreated dental decay and the other three dental variables (percent emergency, percent sealants needed, and percent sealants present). The analysis also examined the association between untreated dental decay and other factors that may impact oral health, including school district, location, grade level, race, and a school's free lunch percentage. These were deemed the descriptive variables. The null hypothesis for Part B was as follows: among children screened during school screenings by the SCHD Children's Dental Clinic, a low level of students with sealants present in a school is not related statistically to a high level of untreated decay in that school, considering the effects of other dental screening conditions (dental variables) and school characteristics (descriptive variables). In this study, a low level of sealants present was defined as a school with percent sealants present below the dataset's mean percentage of sealants present, and a high level of untreated decay was defined as a school with percent untreated decay above the dataset's mean percent of untreated decay.

School screening results from 2012 and 2013 were combined into one dataset for Part B. The combined dataset was then imported into the SPSS statistical package (IBM Corporation, Armonk, New York) and the SAS statistical package (SAS Institute Inc., Cary, North Carolina) for analysis. The screening percent mean (80%) and standard deviation (25%) were calculated and five schools with screening percentages more than two standard deviations lower than the mean were removed from further analysis. The total enrollment mean (414) and standard deviation (221) were calculated, and six schools with mean enrollment more than one standard deviation below the mean (<193 enrolled) were removed from further analysis. Free lunch was not calculable for one school, so this school was removed to make a complete dataset of 72 schools with all variables.

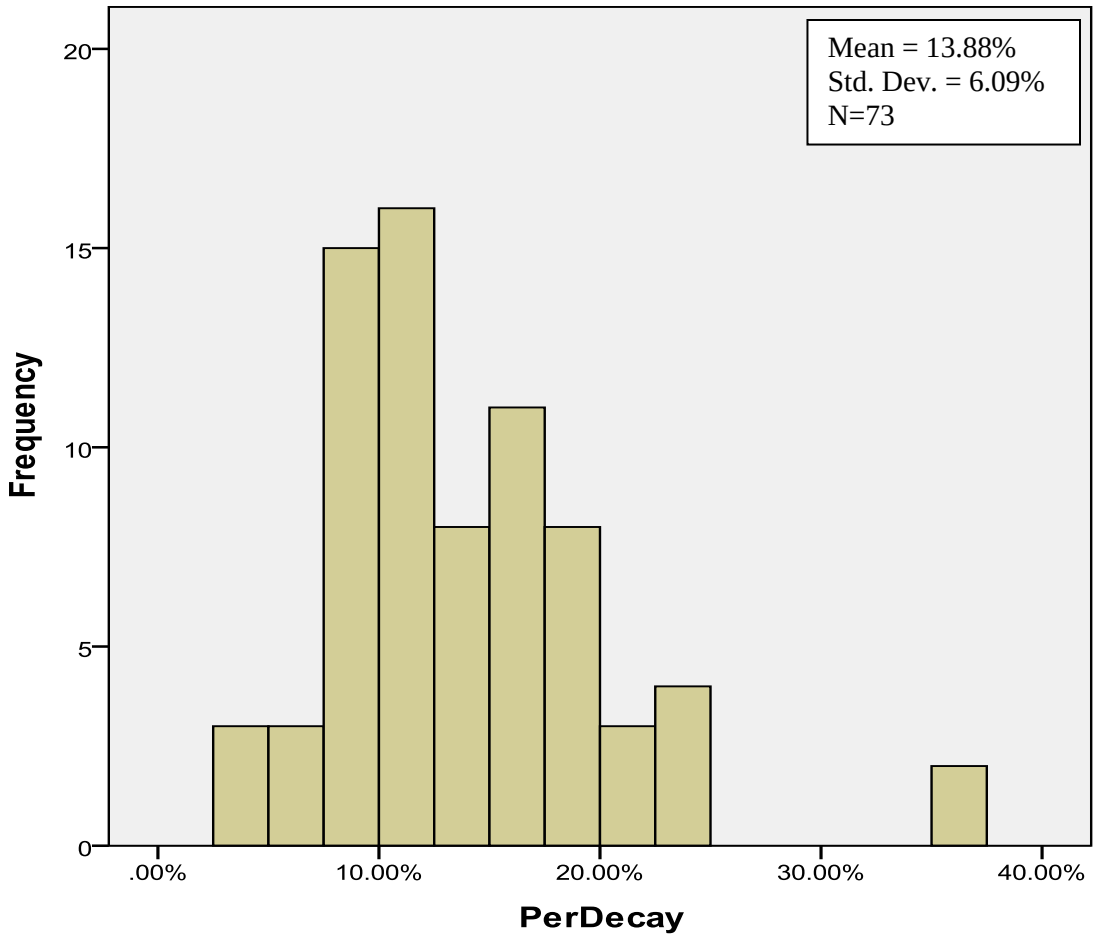
Variable Coding

As the outcome of interest for logistic regression analysis, the percent untreated dental decay was divided into two groups. To determine the cut-off point for dichotomization, a histogram was created (**Figure 3.2a**) and the mean of 13.9% untreated decay was used as the dividing point to create the variables untreated decay "low" (<13.9%) and untreated decay "high" (≥13.9%). Using this method of dichotomization, there were 39 schools categorized as

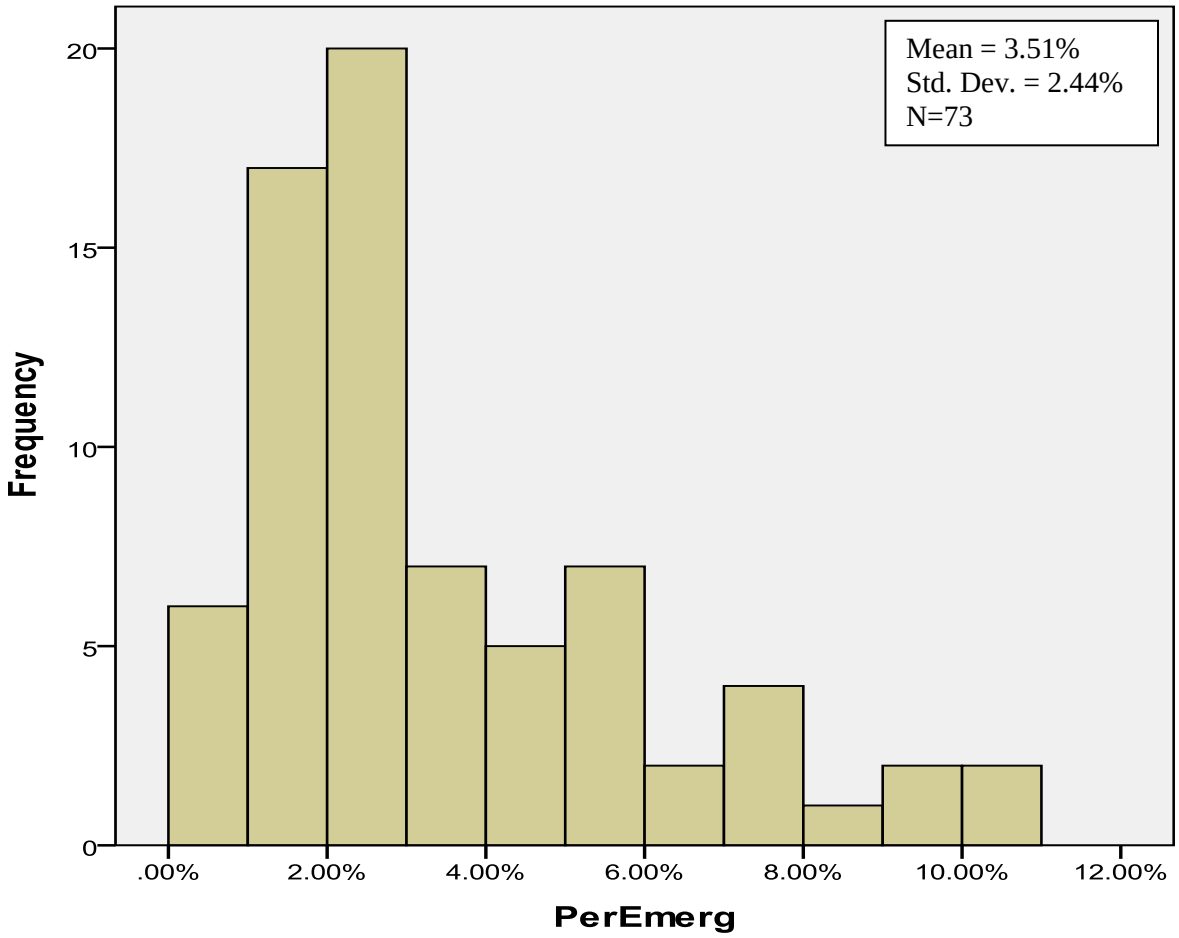
untreated decay “low” and 33 schools categorized as untreated decay “high”. The remaining three dental variables were dichotomized in the same manner using histograms (**Figures 3.2b, 3.22c, 3.22d**) and the corresponding mean. Percent emergency and percent sealants needed were coded as “high” for this analysis with “high” emergencies being schools ≥3.5%, and “high” sealants needed being schools ≥40.4%. Based on the null hypothesis, percent sealants present was coded as “low” (<37.3%). The descriptive variables were dichotomized. USD was dichotomized into USD 259 and non-USD 259 schools. USD 259 is the largest school district in Sedgwick County and had the highest number of schools screened. School location was dichotomized into SE and non-SE schools. The SE was selected as its own category because this area is considered a “dental desert” due to a lack of dentists in this region of the county. Predominant race was dichotomized into white and non-white due to a low number of observations for specific races.[49] Free lunch quartile was dichotomized by placing quartiles one and two into one category and quartiles three and four into a second category. There was only one private school observed in the combined dataset, so the school type variable was not analyzed.

Figure 3.2 Histogram of Distribution of Percent Untreated Decay (a), Percent Emergency (b), Percent Sealants Needed (c), and Percent Sealants Present (d)

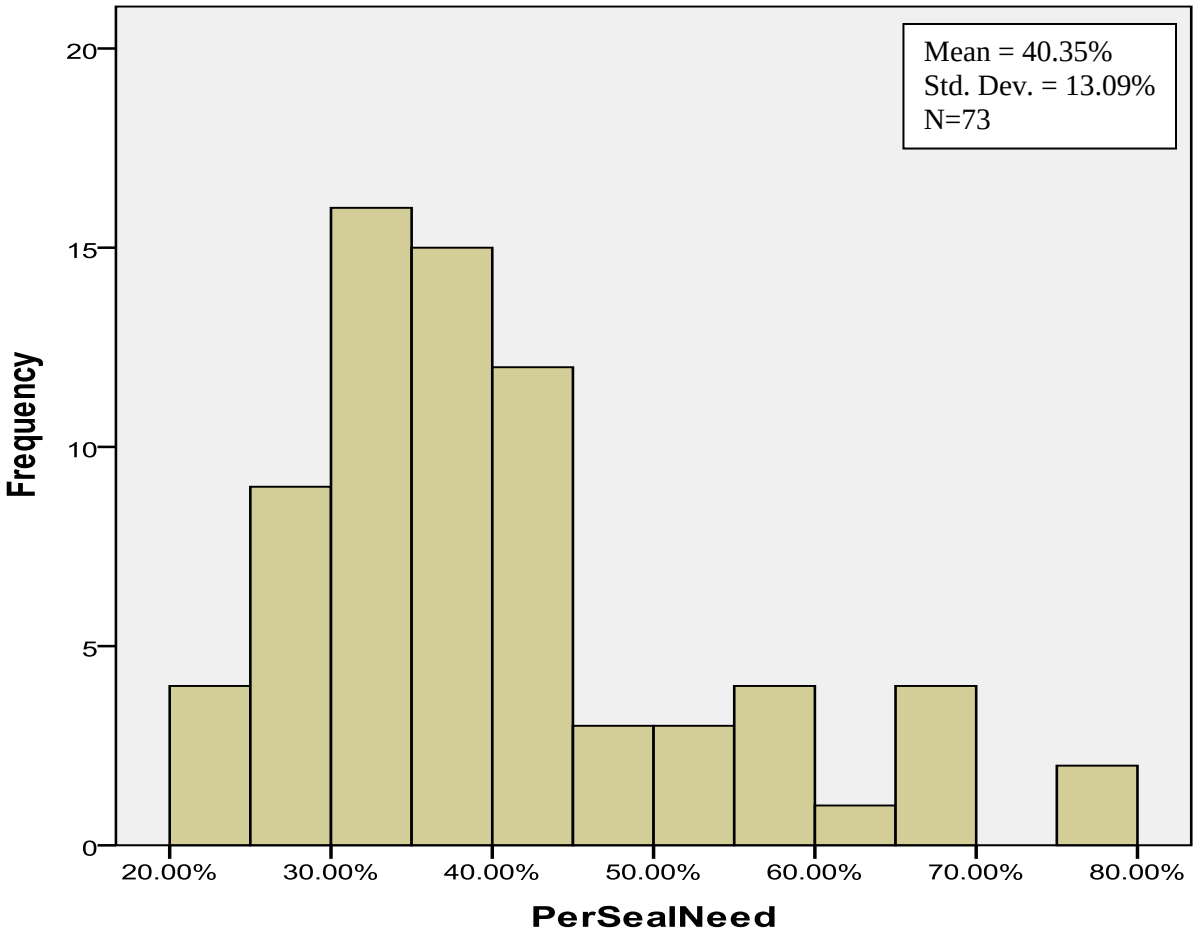
(a)



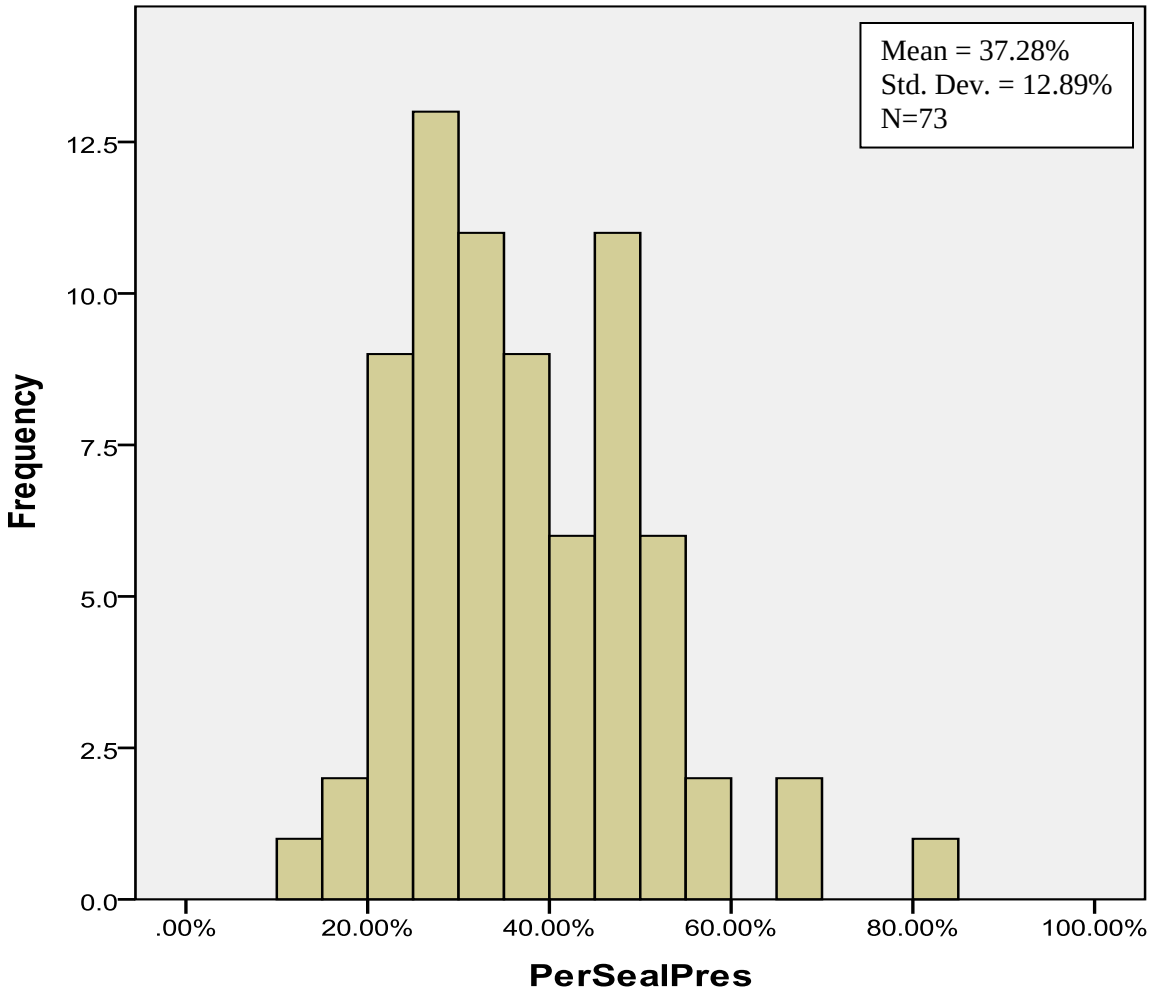
(b)


Mean = 3.51%
Std. Dev. = 2.44%
N=73
Frequency
20
15
10
5
0
.00%
2.00%
4.00%
6.00%
8.00%
10.00%
12.00%
PerEmerg

(c)


Mean = 40.35%
Std. Dev. = 13.09%
N=73
Frequency
0
5
10
15
20
20.00%
30.00%
40.00%
50.00%
60.00%
70.00%
80.00%
PerSealNeed

(d)



Data Diagnostics and Logistic Regression Analysis

Data diagnostics were conducted using the SPSS scatterplot program with bivariables. This allowed for the creation of scatterplots of the percent untreated decay compared to the other three dental variables, while also considering the descriptive variables. Using the SAS statistical package, frequencies of untreated decay compared to the dental variables and descriptive variables were calculated (**Table 4.18**). The Pearson Correlation Coefficient was used to analyze the four continuous dental variables, the percent of students screened in each school, and the percent of students who qualified for free lunch to determine if there were correlations present between the variables (**Table 4.19**). Univariate analysis was then performed to test associations

between untreated decay and the other dental and descriptive variables (**Table 4.20**). The Mantel-Haenszel chi-square and odds ratio were used for this analysis.

Based on the results of the scatterplots (**Figure 4.2**), emergency was further examined for its relationship to untreated decay. A crude prevalence odds ratio was calculated to test the dichotomous emergency variable's association with dichotomous untreated decay. A univariate analysis utilizing percent emergency as the outcome variable was completed (**Appendix A**). This allowed for the comparison of the Mantel-Haenszel odds ratios of untreated decay as the outcome variable and emergency as the outcome variable.

Logistic regression analyses were used to control for the potential effects that the dental and descriptive variables might have on the percent sealants present and percent untreated dental decay relationship. *Models A-E* were developed during this analysis using various determinations of the dental and descriptive variables. The models were developed in reverse order of what is shown in **Table 4.21**. The Hosmer-Lemeshow test was performed for each model in SAS to determine a single summary statistic to assess the goodness-of-fit of a logistic model, using a p-value of 0.05.[54] *Model A* was selected as the final model. A partitioned risk table is provided for the full model in **Table 4.22** to further verify the single Hosmer-Lemeshow test statistic. To calculate the goodness-of-fit for a logistic model, the Hosmer-Lemeshow test in SAS groups the estimated probabilities of the untreated decay "high" or "low" in the data. For the full *Model A*, the Hosmer-Lemeshow risk table was divided into ten groups (**Table 4.22**). The partitioned risk table allowed for the comparison of the observed and expected frequencies in the untreated decay "high" and untreated decay "low" groups within each partition of risk. The overall fit of the model and the reliability of the Hosmer-Lemeshow single test statistic can be assessed based on how close the observed and expected frequencies match for each partition of risk. The partitioned risk table also aids in the determination of areas of non-fit within the logistic model. These can be present even if the Hosmer-Lemeshow statistic and p-value are considered acceptable.[54]

One final reduced model was chosen from the full *Model A* for the logistic regression analysis. To produce the reduced model, *Model A* was analyzed using the step-wise logistic regression procedure, the backwards logistic regression procedure, and the forward logistic regression procedure. The step-wise and forward procedures both operate by adding variables to the logistic model if they are determined to have good-fit within the model. The step-wise goes a

step further and reanalyzes the model after each variable is added to determine if a variable should be removed. The backward model begins with all of the variables in the model before removing those that do not have good-fit within the model. Upon evaluation of the p-value and goodness-of-fit Hosmer-Lemeshow statistics of the reduced models produced by step-wise, forward and backward, the reduced model produced by the step-wise procedure was chosen as the final reduced model for this study (**Table 4.23**).

Chapter 4 - Results and Products

Results

Part A-Summary of Screening Data

Overview of Dental Screening Data

During 2012 and 2013, the SCHD Children's Dental Clinic screened 31,834 students for oral health problems. However, these students represented 17% (2012) and 18% (2013) of the total number of students enrolled in Sedgwick County. **Table 4.1** provides an overview of the dental screening data for both 2012 and 2013. The majority of the screened schools were in USD 259 for both 2012 and 2013, with USD 260 and 261 falling second and third, respectively. The SW location had the highest number of schools screened in both 2012 and 2013, followed by the NW and SE regions. Public schools were screened more often than private schools, as were elementary schools compared to middle schools. The majority of schools screened were predominantly white and had 25% to 49% of students qualifying for free lunch (quartile 2) in both 2012 and 2013. The fewest number of schools had 0% to 24% of students qualifying for free lunch (quartile 1).

The descriptive variable predominant race was analyzed based on four major categories: white, Hispanic, black, and mixed race. The mixed race was further divided into subcategories depending on the predominant races. **Figure 4.1** shows the distribution of races among the schools screened in 2012 (**4.1a**) and 2013 (**4.1b**). The schools screened in 2013 had a wider variety of predominant race classifications than those in 2012.

Table 4.1 Overview of Dental Screening Data in 2012 (n=51 Schools) and 2013 (n=51 Schools)

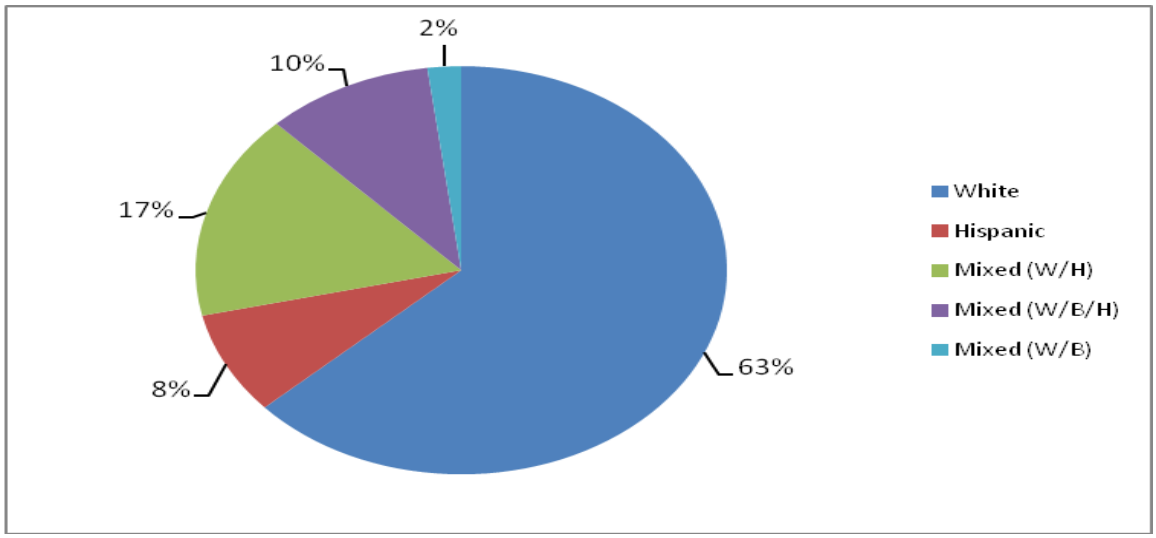
		2012		2013	
Variable		**Number of Students**	**Mean Percent of Students Screened (range)**	**Number of Students**	**Mean Percent of Students Screened (range)**
Screening Data	**Total Individual Students**	15492	81%	16372	88%
	Percent of County Enrollment		17%		18%
	Percent Untreated Decay	1154	14% (4%-50%)	2365	15% (0%-36%)
	Percent Emergency	252	3% (0%-14%)	724	5% (0%-26%)
	Percent Sealants Present	1805	38% (3%-74%)	6041	36% (11%-81%)
	Percent Sealants Needed	1870	35% (5%-67%)	7855	48% (2%-80%)
		Number of Schools	**Percent of Schools Screened**	**Number of Schools**	**Percent of Schools Screened**
USD	Private	6	12%	5	10%
	259	20	39%	23	45%
	260	7	14%	5	10%
	261	7	14%	7	14%
	262	5	10%	5	10%
	263	2	4%	2	4%
	264	3	6%	3	6%
	265	1	2%	1	2%
Location	NE	3	6%	8	16%
	NW	15	29%	15	29%
	SE	15	29%	12	24%
	SW	18	35%	16	31%
School Type	Private	6	12%	4	8%
	Public	45	88%	47	92%
School Grade Level	Elementary	37	73%	41	80%
	Middle	14	27%	13	20%
Predominant Race	White	31	61%	24	47%
	Hispanic	4	8%	4	8%
	Black	0	0%	2	4%
	Mixed	14	27%	17	33%
	Estimated*	2	4%	4	8%
Free Lunch Quartile**	Quartile 1	4	7%	1	2%
	Quartile 2	22	41%	21	39%
	Quartile 3	10	19%	10	19%
	Quartile 4	7	13%	11	20%
	Estimated*	8	20%	11	20%

*Schools with <10 students in a category are reported as such on the KDE "Kansas K-12 County, District, and School Reports" due to identifiability. Since there are no whole numbers, the quartiles for these schools were reported as "not calculable" in Methods.

** Free lunch quartile represents the percent of students qualifying for free lunch. Quartile 1 (0% to <25%), Quartile 2 (≥25% to <50%), Quartile 3 (≥50% to <75%), and Quartile 4 (≥75% to 100%).

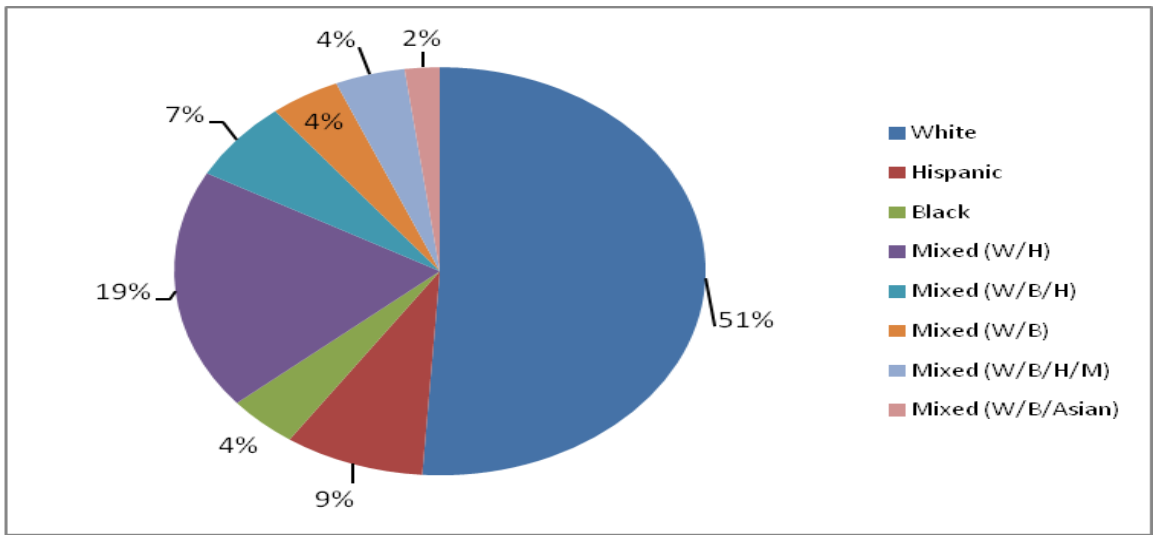
Figure 4.1 Predominant Race for Schools Screened in 2012 (a) and 2013 (b)

a.



W=White, H=Hispanic, B=Black

b.



W=White, H=Hispanic, B=Black, M=Multi-racial

School Rankings

Only public elementary schools ranked within the top ten schools for untreated decay in both 2012 and 2013 (**Tables 4.2 and 4.3**). In both 2012 and 2013, the majority of the top ten schools for untreated decay were in free lunch quartile 4 (≥75% of students qualifying for free lunch). When the ten highest schools were ranked by percent untreated decay are compared by year, four schools were top ten in both 2012 and 2013 (31 schools were screened in both years). These schools were all public elementary schools in USD 259. These four schools were either in free lunch quartile 3 or free lunch quartile 4. Two were located in the SE region and two were located in the SW region.

Table 4.2 Top Ten Schools Ranked by Percent Untreated Decay in 2012

School Identifier	% Total Decay	USD	Location	School Type	School Level	Predominant Race	Free Lunch Quartile	% Students Screened
12-259E4	24.91%	259	SE	Public	Elem.	Mixed	4	94.35%
12-259E7	24.08%	259	SW	Public	Elem.	Mixed	4	87.43%
12-259E3	22.73%	259	SW	Public	Elem.	White	4	69.53%
12-259E12	22.09%	259	NE	Public	Elem.	Mixed	3	57.85%
12-261E1	18.34%	261	SW	Public	Elem.	White	3	100.0%
12-259E13	18.17%	259	SE	Public	Elem.	White	4	91.45%
12-261E4	17.84%	261	SW	Public	Elem.	White	2	100.0%
12-259E5	16.99%	259	SW	Public	Elem.	Mixed	4	100.0%
12-261E3	16.54%	261	SW	Public	Elem.	White	2	100.0%
12-259E1	16.18%	259	SE	Public	Elem.	Mixed	3	94.71%

Table 4.3 Top Ten Schools Ranked by Percent Untreated Decay in 2013

School Identifier	% Total Decay	USD	Location	School Type	School Level	Predominant Race	Free Lunch Quartile	% Students Screened
13-259E16	35.08%	259	NE	Public	Elem.	Black	4	97.42%
13-259E13	35.58%	259	NW	Public	Elem.	Black	4	75.00%
13-259E11	24.60%	259	SE	Public	Elem.	Hispanic	4	84.42%
13-259E8	20.93%	259	SW	Public	Elem.	Mixed	4	71.33%
13-259E17	20.83%	259	SE	Public	Elem.	White	3	48.94%
13-259E6	19.18%	259	NE	Public	Elem.	Mixed	2	77.45%
13-259E1	18.25%	259	SE	Public	Elem.	Mixed	4	87.52%
13-259E4	18.06%	259	SW	Public	Elem.	White	3	74.35%
13-259E3	18.04%	259	SE	Public	Elem.	Hispanic	4	100.00%
13-259E10	17.69%	259	NE	Public	Elem.	White	2	91.42%

When the screened schools were ranked for percent emergency, the majority (9) of the top ten schools were elementary schools (**Tables 4.4 and 4.5**). In both 2012 and 2013, the majority of the schools (6) were in free lunch quartile 4. When the top ten schools were ranked by percent emergency, three schools were included in the top ten for both 2012 and 2013. All three of these schools were public elementary schools in USD 259. These schools were categorized in free lunch quartile 3 or quartile 4. Two of the schools were located in the SW region, with the third school being located in the SE region.

Table 4.4 Top Ten Schools Ranked by Percent Emergencies in 2012

School Identifier	% Emerg.	USD	Location	School Type	School Level	Predominant Race	Free Lunch Quartile	% Students Screened
12-259E7	7.02%	259	SW	Public	Elem.	Mixed	4	87.43%
12-259E4	5.87%	259	SE	Public	Elem.	Mixed	4	94.35%
12-259E3	5.52%	259	SW	Public	Elem.	White	4	69.53%
12-259E13	5.40%	259	SE	Public	Elem.	White	4	91.45%
12-261E1	4.37%	261	SW	Public	Elem.	White	3	100.00%
12-261E3	4.26%	261	SW	Public	Elem.	White	2	100.00%
12-261E4	3.99%	261	SW	Public	Elem.	White	2	100.00%
12-259E1	3.66%	259	SE	Public	Elem.	Mixed	3	94.71%
12-259E5	3.18%	259	SW	Public	Elem.	Mixed	4	100.00%
12-259M4	2.99%	259	NW	Public	Middle	Hispanic	4	94.51%

Table 4.5 Top Ten Schools Ranked by Percent Emergencies in 2013

School Identifier	% Emerg	USD	Location	School Type	School Level	Predominant Race	Free Lunch Quartile	% Students Screened
13-259E16	10.80%	259	NE	Public	Elem.	Black	4	97.42%
13-259E4	10.24%	259	SW	Public	Elem.	White	3	74.35%
13-259E10	9.03%	259	NE	Public	Elem.	White	2	91.42%
13-259E3	9.02%	259	SE	Public	Elem.	Hispanic	4	100.00%
13-259E14	8.67%	259	SW	Public	Elem.	Mixed	4	100.00%
13-259E11	7.75%	259	SE	Public	Elem.	Hispanic	4	84.42%
13-259E8	7.31%	259	SW	Public	Elem.	Mixed	4	71.33%
13-259E17	7.27%	259	SE	Public	Elem.	White	3	48.94%
13-259E15	6.96%	259	NE	Public	Elem.	Mixed	3	64.08%
13-259E13	6.37%	259	NW	Public	Elem.	Black	4	75.00%

When the schools were ranked based on percent sealants needed, seven out of the top ten schools in 2012 were public schools. For the variable school level, five of the top ten schools were elementary schools and five were middle schools **(Table 4.6**). In 2013, nine of the ten schools were public schools, six were middle schools, and four were elementary schools (**Table**

4.7). Only one school in the rankings had the highest percentage of students qualifying for free lunch (quartile 4). Four schools were in the top ten schools with the highest percentage of students needing sealants in both 2012 and 2013. Of these four schools, two were elementary schools and two were middle schools. These schools were found in free lunch quartile 2, quartile 3, and quartile 4. One school was not calculable for free lunch quartile.

Table 4.6 Top Ten Schools Ranked by Percent of Students who Need Sealants in 2012

School Identifier	% Sealants Needed	USD	Location	School Type	School Level	Predominant Race	Free Lunch Quartile	% Students Screened
12-000E6	48.80%	N/A	NW	Private	Elem.	Hispanic	Not Calculable	90.22%
12-264M1	45.61%	264	SW	Public	Middle	White	Not Calculable	91.94%
12-000E4	41.94%	N/A	NW	Private	Elem.	White	1	98.41%
12-000E1	41.86%	N/A	SE	Private	Elem.	Mixed	3	91.88%
12-259M1	41.81%	259	NE	Public	Middle	Mixed	3	87.62%
12-259M5	40.00%	259	NE	Public	Middle	Mixed	3	79.27%
12-260E6	40.00%	260	SE	Public	Elem.	White	2	67.57%
12-259M4	39.61%	259	NW	Public	Middle	Hispanic	4	94.51%
12-259M2	38.96%	259	NW	Public	Middle	Mixed	3	87.51%
12-260E3	38.50%	260	SE	Public	Elem.	White	2	75.00%

Table 4.7 Top Ten Schools Ranked by Percent of Students who Need Sealants in 2013

School Identifier	% Sealants Needed	USD	Location	School Type	School Level	Predominant Race	Free Lunch Quartile	% Students Screened
12-260E2	79.89%	260	SE	Public	Elem.	White	3	67.02%
13-262M1	75.52%	262	NW	Public	Middle	White	2	36.29%
13-259M6	69.59%	259	NE	Public	Middle	Mixed	3	89.15%
13-261M2	69.20%	261	SW	Public	Middle	Mixed	2	92.42%
13-261M3	68.28%	261	SW	Public	Middle	White	2	99.31%
13-259M1	65.37%	259	NE	Public	Middle	Mixed	3	100.00%
13-264E2	64.96%	264	SW	Public	Elem.	White	2	91.76%
13-261E5	64.29%	261	SW	Public	Elem.	Not Calculable	Not Calculable	80.00%
13-264M1	62.79%	264	SW	Public	Middle	White	1	92.97%
13-000E3	62.07%	N/A	NW	Private	Elem.	Mixed	3	98.07%

When the schools were ranked for percent students with sealants present, seven of the top ten schools were public schools, five were elementary schools, and five were middle schools in 2012 (**Table 4.8**). In 2013, nine of the top ten schools were public schools, four were elementary schools, and six were middle schools (**Table 4.9**). Only two schools in the rankings had the highest percentage of students qualifying for free lunch (quartile 4). Five schools were ranked in the top ten schools for students with sealants present in both 2012 and 2013. Of these five schools, three were middle schools and two were elementary schools. Four of these schools were categorized into each of the four free lunch quartiles, with the fifth school being not calculable for free lunch.

Table 4.8 Top Ten Schools Ranked by Percent of Students with Sealants Present in 2012

School Identifier	% Sealants Present	USD	Location	School Type	School Level	Predominant Race	Free Lunch Quartile	% Students Screened
12-264E1	65.68%	264	SW	Public	Elem.	White	1	90.08%
12-264M1	64.91%	264	SW	Public	Middle	White	Not Calculable	91.94%
12-261E5	60.00%	261	SW	Public	Elem.	Not Calculable	Not Calculable	71.43%
12-000E6	58.43%	N/A	NW	Private	Elem.	Hispanic	Not Calculable	90.22%
12-259M3	54.97%	259	SE	Public	Middle	Hispanic	4	100.00%
12-259M7	54.37%	259	NW	Public	Middle	White	2	93.37%
12-000E2	53.78%	N/A	NW	Private	Elem.	White	Not Calculable	99.17%
12-261M2	52.11%	261	SW	Public	Middle	Mixed	2	95.10%
12-000E5	51.74%	N/A	NW	Private	Elem.	Mixed	3	100.00%
12-259E9	51.74%	259	NW	Public	Middle	Mixed	3	33.50%

Table 4.9 Top Ten Schools Ranked by Percent of Students with Sealants Present in 2013

School Identifier	% Sealants Present	USD	Location	School Type	School Level	Predominant Race	Free Lunch Quartile	% Students Screened
13-259E6	80.82%	259	NE	Public	Elem.	Mixed	2	77.45%
13-260E2	67.20%	260	SE	Public	Elem.	White	3	67.02%
13-259M2	58.31%	259	SE	Public	Middle	Mixed	4	92.89%
13-259M4	56.08%	259	NW	Public	Middle	Hispanic	4	93.35%
13-264M1	55.81%	264	SW	Public	Middle	White	1	92.97%
13-264E2	52.56%	264	SW	Public	Elem.	White	2	91.76%
13-261M1	49.74%	261	SW	Public	Middle	White	2	99.31%
13-259M5	48.08%	259	NE	Public	Middle	Mixed	3	72.96%
13-259M7	48.08%	259	NW	Public	Middle	Mixed	2	82.81%
13-000E3	46.80%	N/A	NW	Private	Elem.	Mixed	3	98.07%

When comparing the top ten schools for percent untreated decay and percent emergencies, nine schools in 2012 and seven schools in 2013 were in the top ten for both. In 2012, the schools were 12-259E4 (percent untreated decay rank 1, percent emergencies rank 2), 12-259E7 (2, 1), 12-259E3 (3, 3), 12-261E1 (5, 5), 12-259E13 (6, 4), 12-261E4 (7, 7), 12-259E5

(8, 9), 12-261E3 (9, 6), and 12-259E1 (10, 8). In 2013, the schools were 13-259E16 (1, 1), 13-259E13 (2, 10), 13-259E11 (3, 6), 13-259E8 (4, 7), 13-259E17 (5, 8), 13-259E4 (8, 2), and 13-259E3 (9, 4). There were no schools ranked in the top ten schools for both percent untreated decay and percent sealants present or percent untreated decay and percent sealants needed.

The ten schools with the lowest percent untreated decay, percent emergencies, percent sealants needed, and percent sealants present were also analyzed. The majority of the schools with the lowest percent untreated decay were elementary schools (**Tables 4.10 and 4.11**). The majority of the schools in both 2012 and 2013 were in free lunch quartile 2 (≥25% to <50%). Two schools were in the ten school ranking for lowest percent of untreated decay in both 2012 and 2013. One of these schools was in free lunch quartile 2 and the other was not calculable for free lunch quartile. Both are public middle schools in the SW region.

Table 4.10 Ten Schools with Lowest Rates of Untreated Decay in 2012

School Identifier	% Total Decay	USD	Location	School Type	School Level	Predominant Race	Free Lunch Quartile	% Students Screened
12-261M2	9.36%	261	SW	Public	Middle	Mixed	2	95.10%
12-259M7	9.28%	259	NW	Public	Middle	White	2	93.37%
12-259E10	8.59%	259	NW	Public	Elem.	White	2	87.97%
12-264M1	7.60%	264	SW	Public	Middle	White	Not Calculable	91.94%
12-000E2	7.56%	N/A	NW	Private	Elem.	White	Not Calculable	99.17%
12-000E1	6.51%	N/A	SE	Private	Elem.	Mixed	3	91.88%
12-260E1	5.72%	260	SE	Public	Elem.	White	2	84.26%
12-000E5	4.98%	N/A	NW	Private	Elem.	Mixed	Not Calculable	100.00%
12-259E9	4.37%	259	NW	Public	Elem.	Mixed	3	33.50%
12-259E2	3.89%	259	SE	Public	Elem.	White	2	96.59%

Table 4.11 Ten Schools with Lowest Rates of Untreated Decay in 2013

School Identifier	% Total Decay	USD	Location	School Type	School Level	Predominant Race	Free Lunch Quartile	% Students Screened
13-260E3	9.35%	260	SE	Public	Elem.	White	2	81.29%
13-259M1	8.27%	259	NE	Public	Middle	Mixed	3	100.00%
13-264E3	8.12%	264	SW	Public	Elem.	White	2	97.76%
13-000E4	7.74%	N/A	NW	Private	Elem.	Mixed	Not Calculable	100.00%
13-259M6	7.69%	259	NE	Public	Middle	Mixed	3	89.15%
13-261M2	7.59%	261	SW	Public	Middle	Mixed	2	92.42%
13-264M1	7.56%	264	SW	Public	Middle	White	1	92.97%
13-000E1	5.88%	N/A	NW	Private	Elem.	White	Not Calculable	89.47%
13-260E1	5.04%	260	SE	Public	Elem.	White	2	93.21%
13-261E5	0.00%	261	SW	Public	Elem.	Not Calculable	Not Calculable	80.00%

The ten schools with lowest percent emergencies in 2012 and 2013 were also analyzed (**Tables 4.12 and 4.13**). In six schools, 0% of students had emergencies. Ten of the schools from both 2012 and 2013 were not calculable for free lunch quartile. Of the remaining schools, the majority were in free lunch quartile 2 or quartile 3. Four schools were ranked low for percent emergencies in both 2012 and 2013. These schools were 13-000E4 (1.20%, 1.79%), 13-000E3 (0.50%, 1.48%), 13-261E5 (0.00%, 0.00%), and 13-000E1 (0.00%, 1.18%).

Table 4.12 Ten Schools with Lowest Rates of Emergency in 2012

School Identifier	% Emerg.	USD	Location	School Type	School Level	Predominant Race	Free Lunch Quartile	% Students Screened
12-000E6	1.20%	N/A	NW	Private	Elem.	Hispanic	Not Calculable	90.22%
12-264M1	1.17%	264	SW	Public	Middle	White	Not Calculable	91.94%
12-260M1	0.86%	260	SE	Public	Middle	White	2	90.86%
12-260E5	0.65%	260	SE	Public	Elem.	White	1	46.86%
12-000E5	0.50%	N/A	NW	Private	Elem.	Mixed	Not Calculable	100.00%
12-259E9	0.49%	259	NW	Public	Elem.	Mixed	3	33.50%
12-261E5	0.00%	261	SW	Public	Elem.	Not Calculable	Not Calculable	71.43%
12-000E3	0.00%	N/A	SW	Private	Elem.	Mixed	Not Calculable	79.43%
12-000E4	0.00%	N/A	NW	Private	Elem.	White	1	98.41%
12-000E2	0.00%	N/A	NW	Private	Elem.	White	Not Calculable	99.17%

Table 4.13 Ten Schools with Lowest Rates of Emergency in 2013

School Identifier	% Emerg.	USD	Location	School Type	School Level	Predominant Race	Free Lunch Quartile	% Students Screened
13-259M6	1.97%	259	NE	Public	Middle	Mixed	3	89.15%
13-000E4	1.79%	N/A	NW	Private	Elem.	Mixed	Not Calculable	100.00%
13-259M5	1.75%	259	NE	Public	Middle	Mixed	3	72.96%
13-260E2	1.59%	260	SE	Public	Elem.	White	3	67.02%
13-000E3	1.48%	N/A	NW	Public	Elem.	Mixed	Not Calculable	98.07%
13-000E1	1.18%	N/A	NW	Private	Elem.	White	Not Calculable	89.47%
13-260E4	1.02%	260	SE	Public	Elem.	White	2	66.00%
13-260E1	0.84%	260	SE	Public	Elem.	White	2	93.21%
13-264E2	0.43%	264	SW	Public	Elem.	White	2	97.76%
13-261E5	0.00%	261	SW	Public	Elem.	Not Calculable	Not Calculable	80.00%

The ten schools with lowest percent sealants needed were also analyzed (**Tables 4.14 and 4.15**). The schools with the lowest percent sealants needed were 12-264E1 in 2012 (20.76%) and

13-259E12 in 2013 (18.75%). Of the lowest schools with percent sealants needed in 2012 and 2013, the majority were in free lunch quartiles 2 or 4. Two schools were ranked low for percent sealants needed in both 2012 and 2013. Both of these schools are public elementary schools in free lunch quartile 2.

Table 4.14 Ten Schools with Lowest Rates of Sealants Needed in 2012

School Identifier	% Sealants Needed	USD	Location	School Type	School Level	Predominant Race	Free Lunch Quartile	% Students Screened
12-260E2	29.18%	260	SE	Public	Elem.	White	2	88.69%
12-261E2	27.69%	261	SW	Public	Elem.	White	2	100.00%
12-261E1	27.51%	261	SW	Public	Elem.	White	3	100.00%
12-259E9	26.70%	259	NW	Public	Elem.	Mixed	3	33.50%
12-264E2	26.43%	264	SW	Public	Elem.	White	2	94.29%
12-259E13	25.18%	259	SE	Public	Elem.	White	4	91.45%
12-261E3	24.56%	261	SW	Public	Elem.	White	2	100.00%
12-263E1	24.03%	263	SE	Public	Elem.	White	2	99.09%
12-259E4	21.44%	259	SE	Public	Elem.	Hispanic	4	94.35%
12-264E1	20.76%	264	SW	Public	Elem.	White	1	90.08%

Table 4.15 Ten Schools with Lowest Rates of Sealants Needed in 2013

School Identifier	% Sealants Needed	USD	Location	School Type	School Level	Predominant Race	Free Lunch Quartile	% Students Screened
13-264E1	36.47%	264	SW	Public	Elem.	White	2	96.76%
13-259E2	35.54%	259	SW	Public	Elem.	Mixed	4	92.66%
13-260E4	34.58%	260	SE	Public	Elem.	White	2	66.00%
13-259E3	34.27%	259	SE	Public	Elem.	Hispanic	4	100.00%
13-259E5	31.55%	259	NW	Public	Elem.	Mixed	3	85.57%
13-259M3	30.88%	259	NW	Public	Middle	Hispanic	4	86.63%
13-000E1	29.41%	N/A	NW	Private	Elem.	White	Not Calculable	89.47%
13-263E1	28.67%	263	SE	Public	Elem.	White	2	96.51%
13-259E14	25.33%	259	SW	Public	Elem.	Mixed	4	100.00%
13-259E12	18.75%	259	NW	Public	Elem.	Mixed	Not Calculable	82.76%

The final ranking analyzed was the ten schools with the lowest percent sealants present (**Tables 4.16 and 4.17**). In both 2012 and 2013, all ten schools were elementary schools. The schools with the lowest percent sealants present were 12-259E1 in 2012 (20.62%) and 13-263E1 in 2013 (11.33%). Of the schools with the lowest percent sealants present, the majority were in free lunch quartile 2. In both 2012 and 2013, four schools were ranked low for sealants present. These schools were 12-261E4/13-261E4 (27.00%, 24.21%), 12-260E4/13-260E3 (26.76%, 23.74%), 12-259E3/13-259E4 (21.75%, 25.88%), and 12-259E1/13-259E1 (20.62%, 17.30%).

Table 4.16 Ten Schools with Lowest Rates of Sealants Present in 2012

School Identifier	% Sealants Present	USD	Location	School Type	School Level	Predominant Race	Free Lunch Quartile	% Students Screened
12-000E4	29.03%	N/A	NW	Private	Elem.	White	1	98.41%
12-259E11	28.25%	259	NW	Public	Elem.	White	3	92.53%
12-261E4	27.00%	261	SW	Public	Elem.	White	2	100.00%
12-260E6	26.91%	260	SE	Public	Elem.	White	2	67.57%
12-260E4	26.76%	260	SE	Public	Elem.	White	2	100.00%
12-261E2	25.49%	261	SW	Public	Elem.	White	2	100.00%
12-259E4	24.91%	259	SE	Public	Elem.	Hispanic	4	94.35%
12-259E7	22.74%	259	SW	Public	Elem.	Mixed	4	87.43%
12-259E3	21.75%	259	SW	Public	Elem.	White	4	69.53%
12-259E1	20.62%	259	SE	Public	Elem.	Mixed	3	94.71%

Table 4.17 Ten Schools with Lowest Rates of Sealants Present in 2013

School Identifier	% Sealants Present	USD	Location	School Type	School Level	Predominant Race	Free Lunch Quartile	% Students Screened
13-259E4	25.88%	259	SW	Public	Elem.	White	3	74.35%
13-261E4	24.21%	261	SW	Public	Elem.	White	2	99.33%
13-260E3	23.74%	260	SE	Public	Elem.	White	2	81.29%
13-259E3	22.65%	259	SE	Public	Elem.	Hispanic	4	100.00%
13-264E1	21.28%	264	SW	Public	Elem.	White	2	96.76%
13-259E15	20.51%	259	NE	Public	Elem.	Mixed	3	64.08%
13-259E11	19.52%	259	SE	Public	Elem.	Hispanic	4	84.42%
13-259E1	17.30%	259	SE	Public	Elem.	Mixed	4	87.52%
13-259E12	16.67%	259	NW	Public	Elem.	Mixed	Not Calculable	80.76%
13-263E1	11.33%	263	SE	Public	Elem.	White	2	96.51%

For percent untreated decay and percent emergencies, four schools in 2012 and six schools in 2013 were ranked in the lowest ten schools out of the 51 schools screened in each of those years. In 2012, the schools were 12-264M1 (percent untreated decay rank 45 out of 51, percent emergency rank 43), 12-000E2 (46, 51), 12-000E5 (49, 46), and 12-259E9 (50, 47). In 2013, the schools were 13-264E2 (44, 50), 13-000E4 (45, 43), 13-259M6 (47, 42), 13-000E1 (49, 47), 13-260E1 (50, 49), and 13-261E5 (51, 51). There were no schools ranked in the lowest ten schools for percent untreated decay and percent sealants present in 2012, and only one school in 2013. This school, 13-260E3, was ranked 41 for percent untreated decay and 44 for percent sealants present.

Part B-Associations among Dental and Descriptive Variables

Dental and Descriptive Variable Frequencies within Untreated Decay Categories

Frequencies of the three dental variables and seven descriptive variables within the untreated decay “high” and untreated decay “low” categories are presented in **Table 4.18**. Within the untreated decay “high” schools, 76% were also emergency “high”. Only 18% of the untreated decay “high” schools were sealants present “high”, but 64% of untreated decay “low” schools

were sealants present “high”. With the variable sealants needed, 38% of untreated decay “low” schools were sealants needed “high” and 36% of untreated decay “high” schools were sealants needed “high”. USD 259 had the highest percentage of untreated decay “high” schools (75%) and untreated decay “low” schools (36%). The SW region contained the most untreated decay “high” schools (45%), while the SE region contained the highest number of untreated decay “low” schools (44%). Elementary schools showed the highest percentage of untreated decay “high” (91%). For school type in the untreated decay “low” category, elementary and middle schools each represented approximately half of the schools. The predominant race of white had the highest percentage of untreated decay “high” (67%) and untreated decay “low” (42%) schools, followed by mixed race for both categories. Approximately half of the schools in the untreated decay “high” category were in free lunch quartile 4, while two-thirds of the schools in the untreated decay “low” category were in free lunch quartile 2.

Table 4.18 Frequencies of Dental and Descriptive Variables within Untreated Decay “Low” and Untreated Decay “High” Categories

Dental/Descriptive Variable		Untreated Decay “Low” (<13.88%) n=39	Untreated Decay “High” (≥13.88%) n=33	Total 72
Percent Emergency	“Low” (<3.5%)	37 (94.87%)	8 (24.24%)	45
	“High” (≥3.5%)	2 (5.13%)	25 (75.76%)	27
Percent Sealant Needed	“Low” (<40.4%)	24 (61.54%)	21 (63.64%)	41
	“High” (≥40.4%)	15 (38.46%)	12 (36.36%)	31
Percent Sealant Present	“Low” (<37.3%)	14 (35.90%)	27 (81.82%)	45
	“High” (≥37.3%)	25 (64.10%)	6 (18.18%)	27
Year N=72	2012	21 (53.85%)	15 (45.45%)	36
	2013	18 (46.15%)	18 (54.55%)	36
USD N=72	Private	1 (2.56%)	0 (0.00%)	1
	259	14 (35.90%)	25 (75.76%)	39
	260	11 (28.21%)	1 (3.03%)	12
	261	4 (10.26%)	7 (21.21%)	11
	262	1 (2.56%)	0 (0.00%)	1
	263	4 (10.26%)	0 (0.00%)	4
	264	4 (10.26%)	0 (0.00%)	4
Location N=72	NE	5 (12.82%)	5 (15.15%)	10
	NW	9 (23.08%)	3 (9.09%)	12
	SE	17 (43.59%)	10 (30.30%)	27
	SW	8 (20.51%)	15 (45.45%)	23

School Type	Private	1 (2.56%)	0 (0.00%)	1
N=72	Public	38 (97.44%)	33 (100.00%)	71
School Level	Elementary	20 (51.28%)	30 (90.91%)	50
N=72	Middle	19 (48.72%)	3 (13.64%)	22
Predominant Race	White	26 (66.67%)	14 (42.42%)	40
N=72	Black	0 (0.00%)	2 (6.06%)	2
	Hispanic	2 (5.13%)	5 (15.15%)	7
	Mixed Race	11 (28.21%)	12 (36.36%)	23
Free Lunch	1	2 (5.13%)	0 (0.00%)	2
Quartile	2	25 (64.10%)	8 (24.24%)	33
N=72	3	10 (25.64%)	9 (27.27%)	19
	4	2 (5.13%)	16 (48.48%)	18

Correlation Analysis

In the scatterplot matrix comparing the dental variables to each other and to percent of students screened, percent untreated decay had a positive association with percent emergency, but a negative association with percent sealants present (**Figure 4.2**). Percent sealants needed did not have any association with percent untreated decay. More scatterplots were used to analyze the categorical descriptive variables compared to the continuous dental variables (**Figures 4.3a, 4.3b, 4.3c**). The scatterplots showed no clear association for a particular school location (**Figure 4.3a**) or for elementary school (**Figure 4.3b**). When the free lunch quartiles were assessed, the scatterplots showed more schools in free lunch quartiles 3 and 4 had higher percent untreated decay and emergencies (**Figure 4.3c**). Schools in free lunch quartiles 1 and 2 were more often found with low percent untreated decay, but they ranged across all levels of percent sealants present. However, associations between the variables were difficult to assess based on the scatterplots, so no definite associations could be determined. Scatterplots with USD, predominant race, and school type variables showed no clear associations within percent untreated decay,percent emergencies, sealants present, or sealants needed.

Figure 4.2 Scatterplots Comparing Percent Decay with Dental Variables and Percent Screened

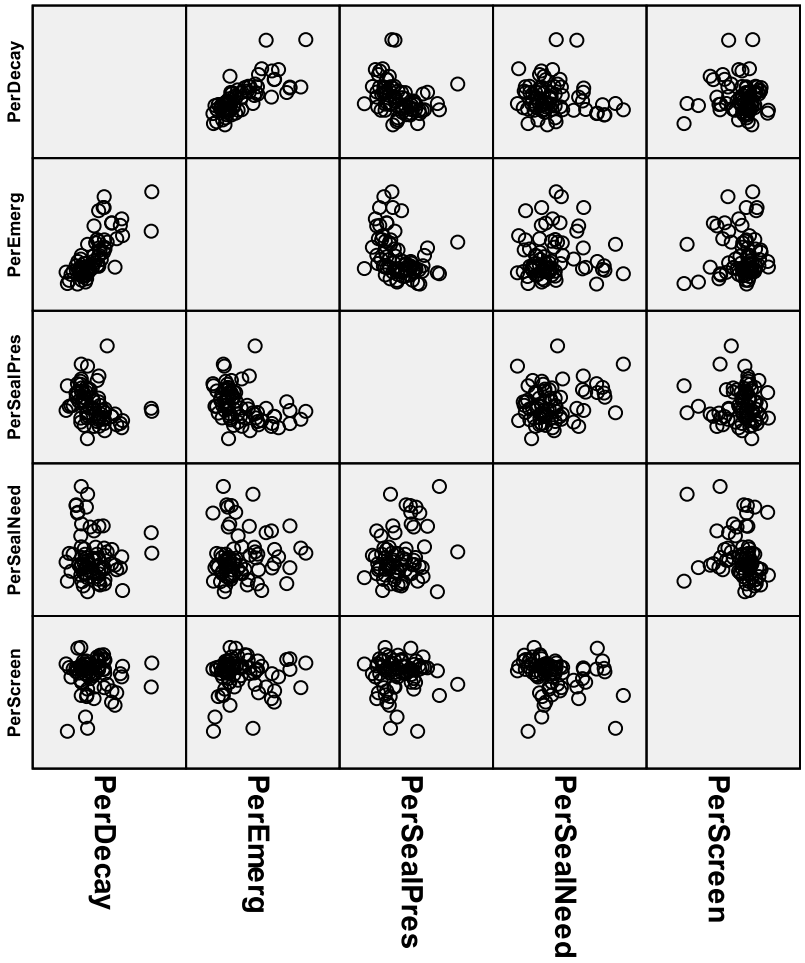
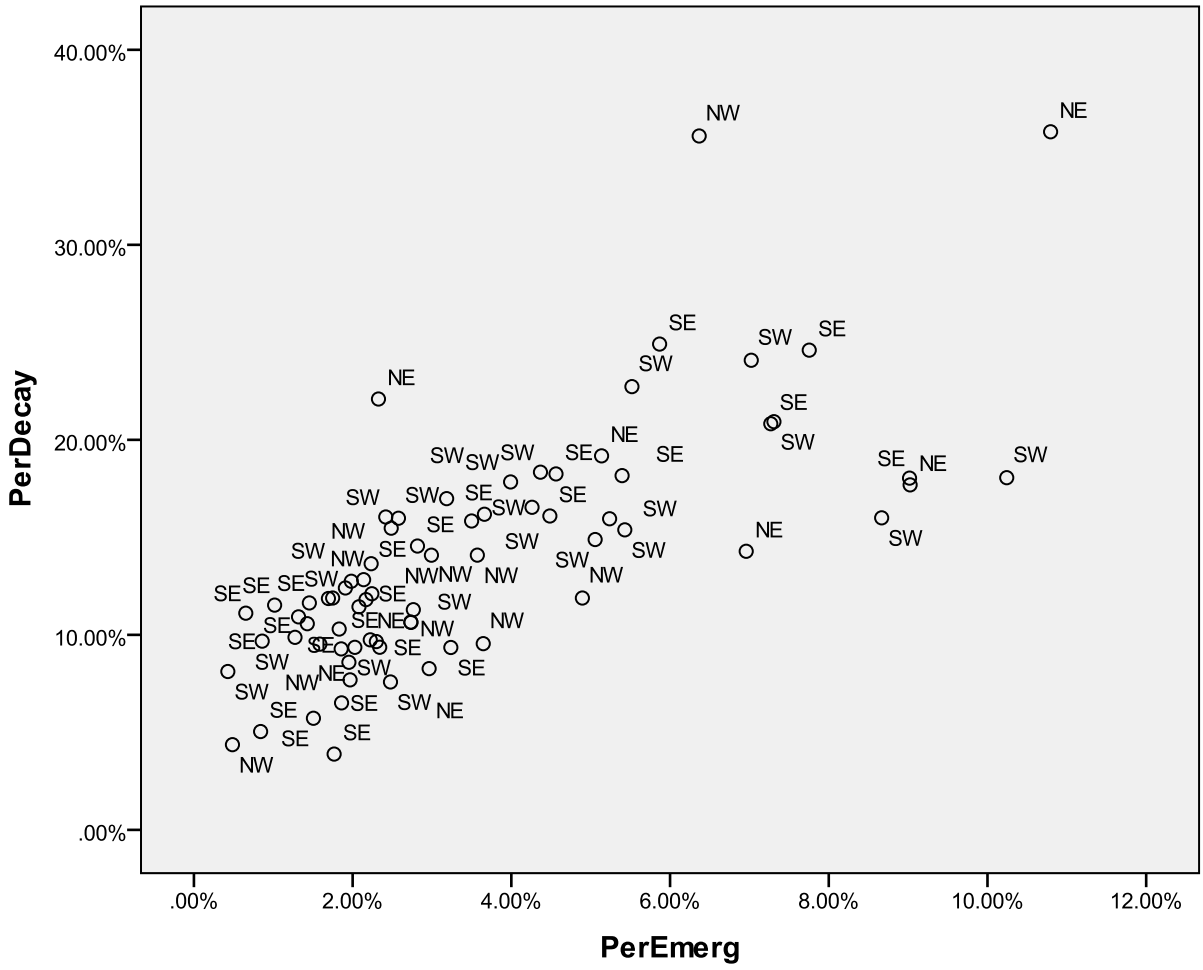
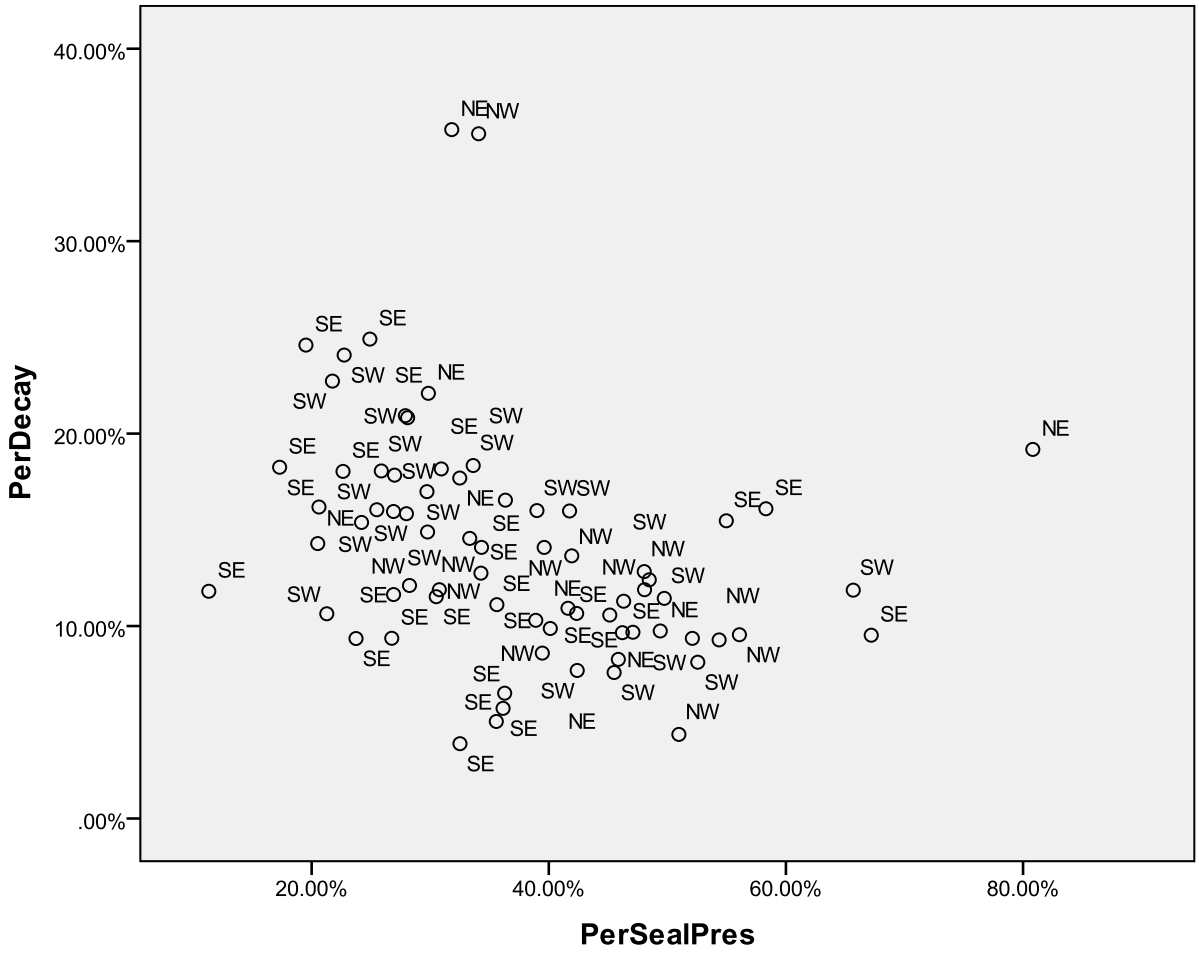


Figure 4.3 Scatterplots Comparing Percent Decay; Dental Variables; and Descriptive Variables: Location (a), School Level (b), Free Lunch Quartile (c)
(a) Location

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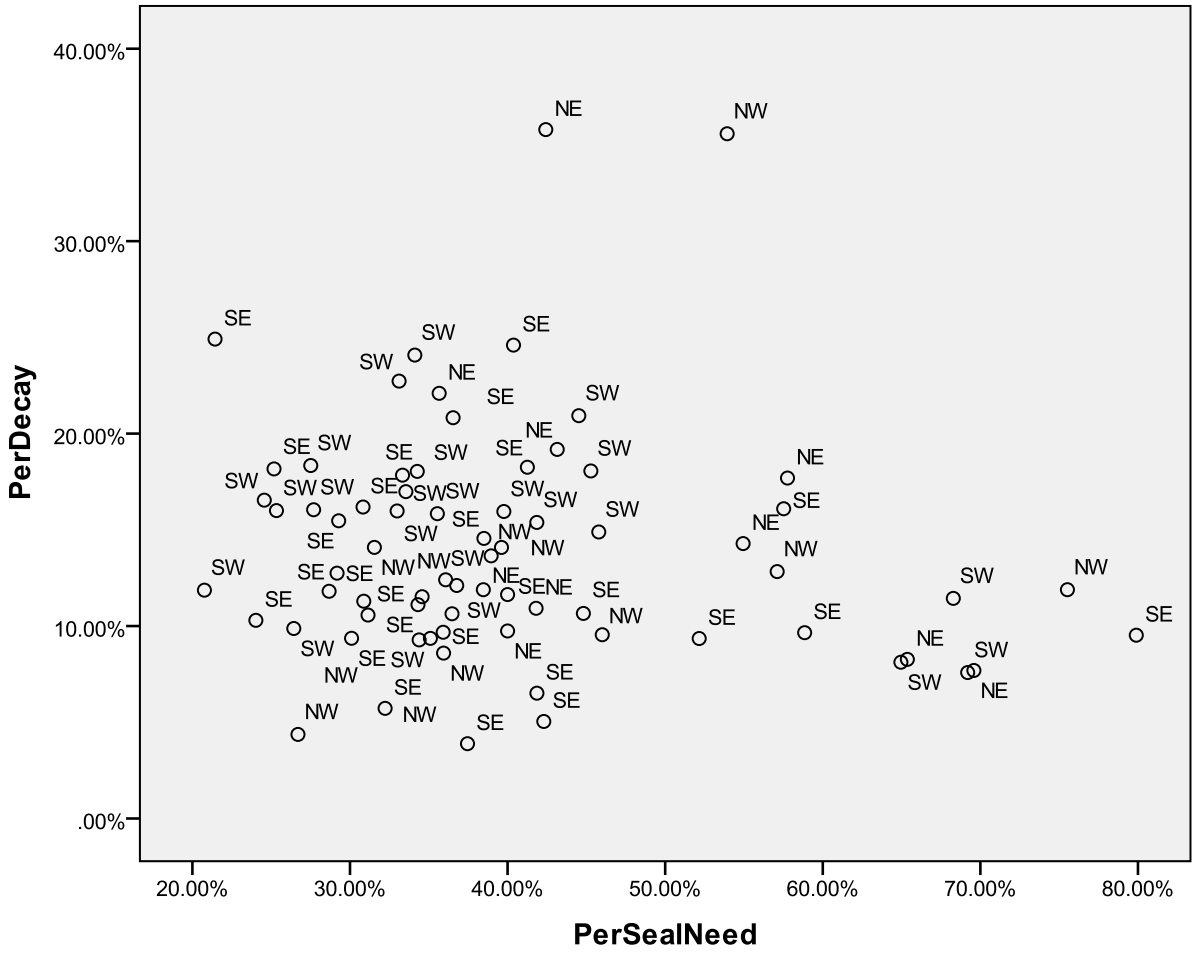
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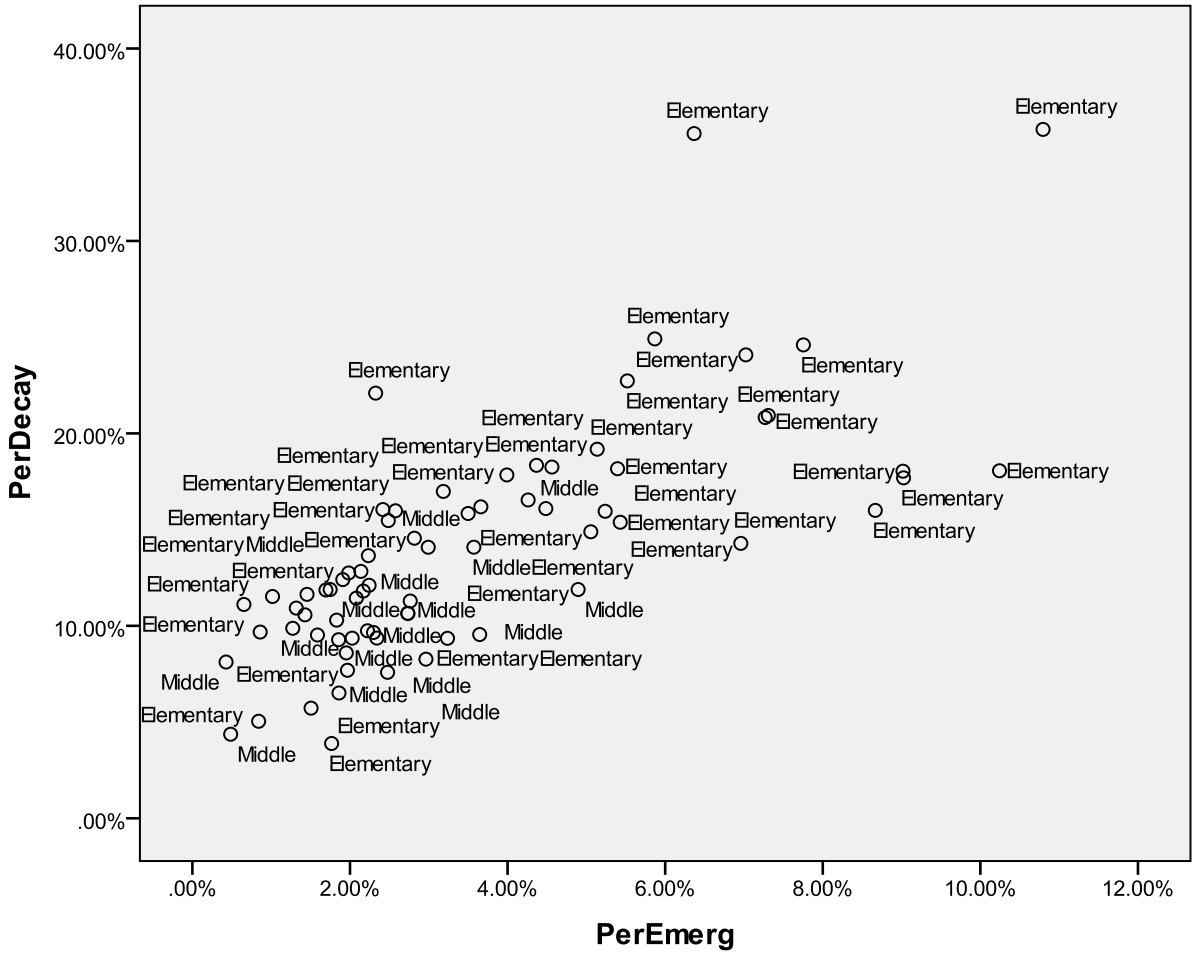
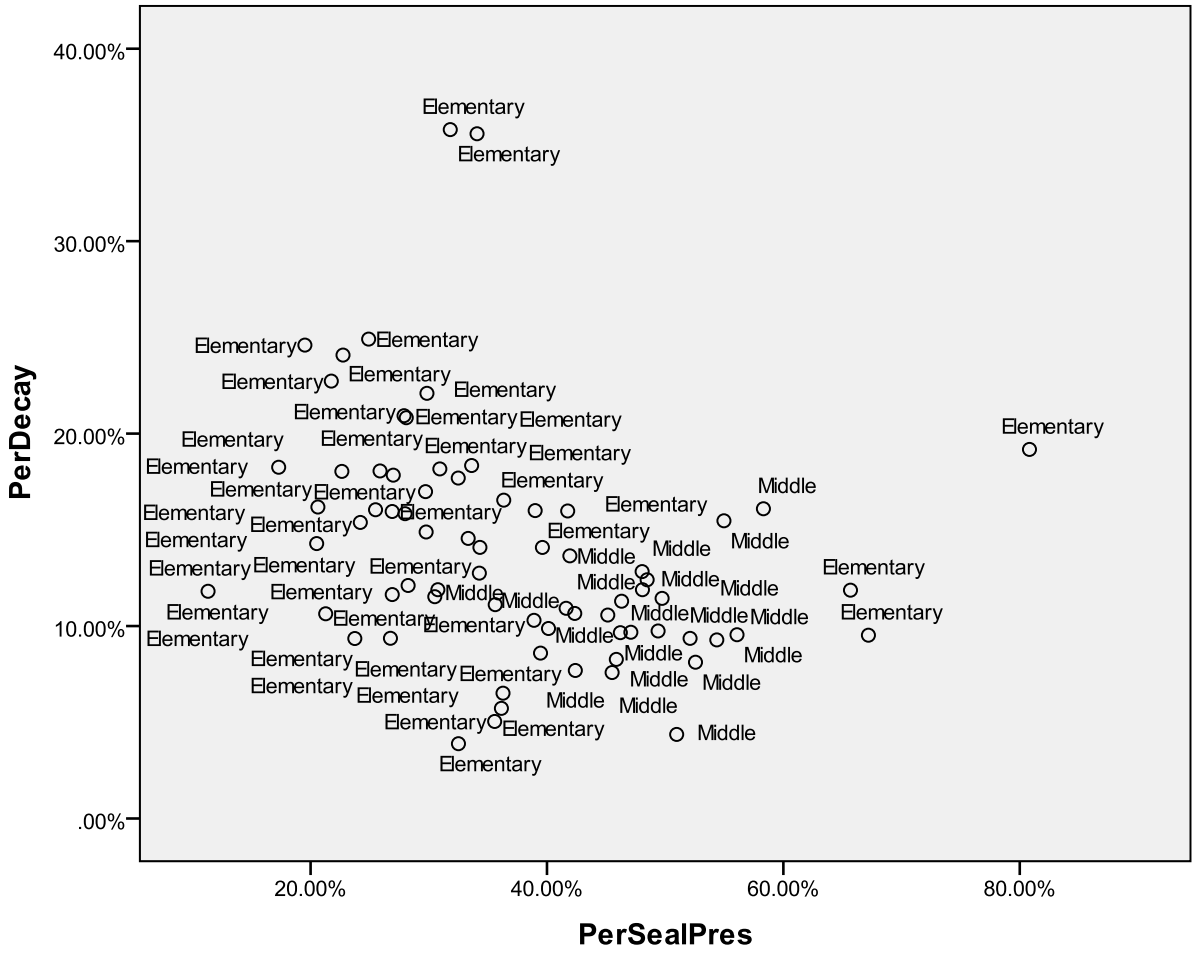
(b) School Level

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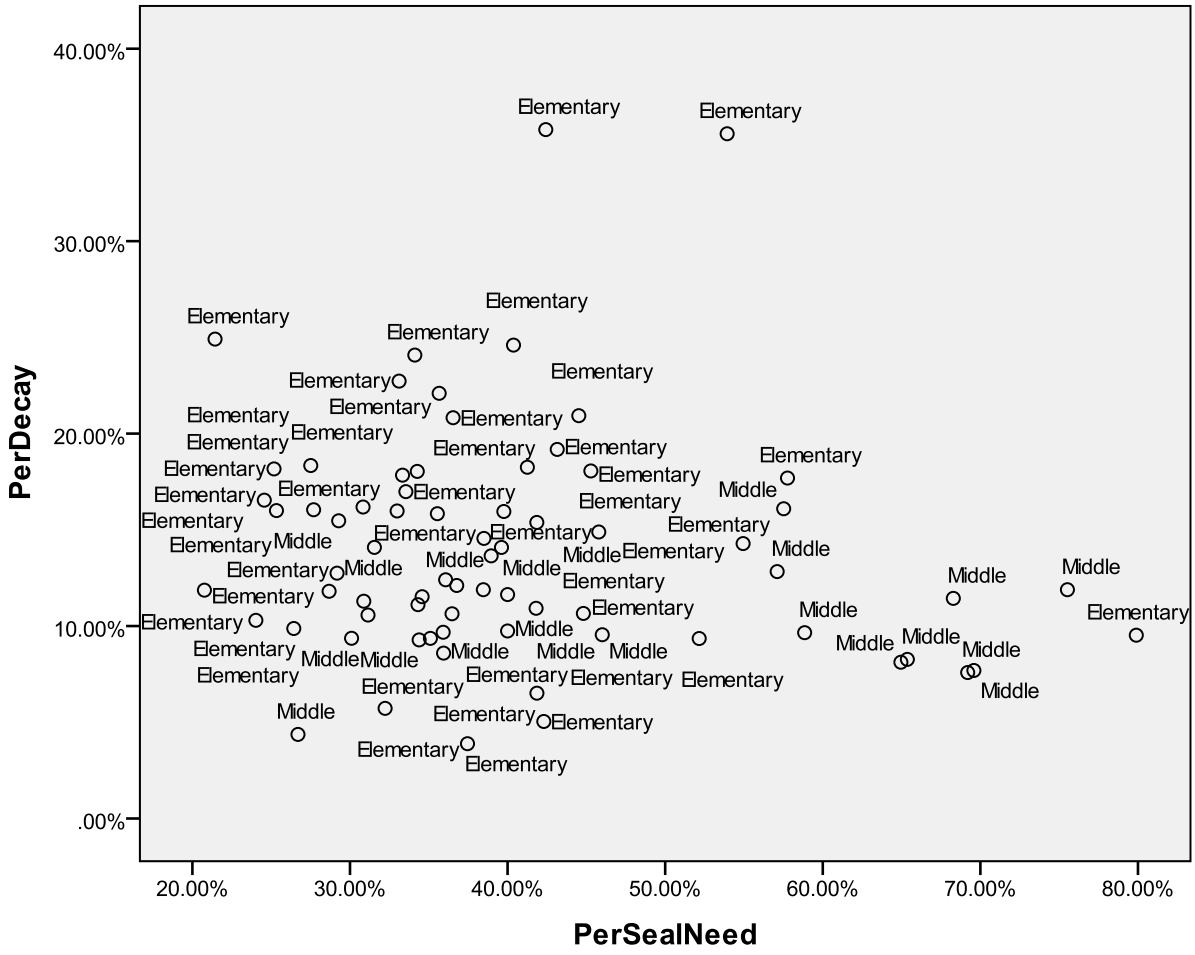
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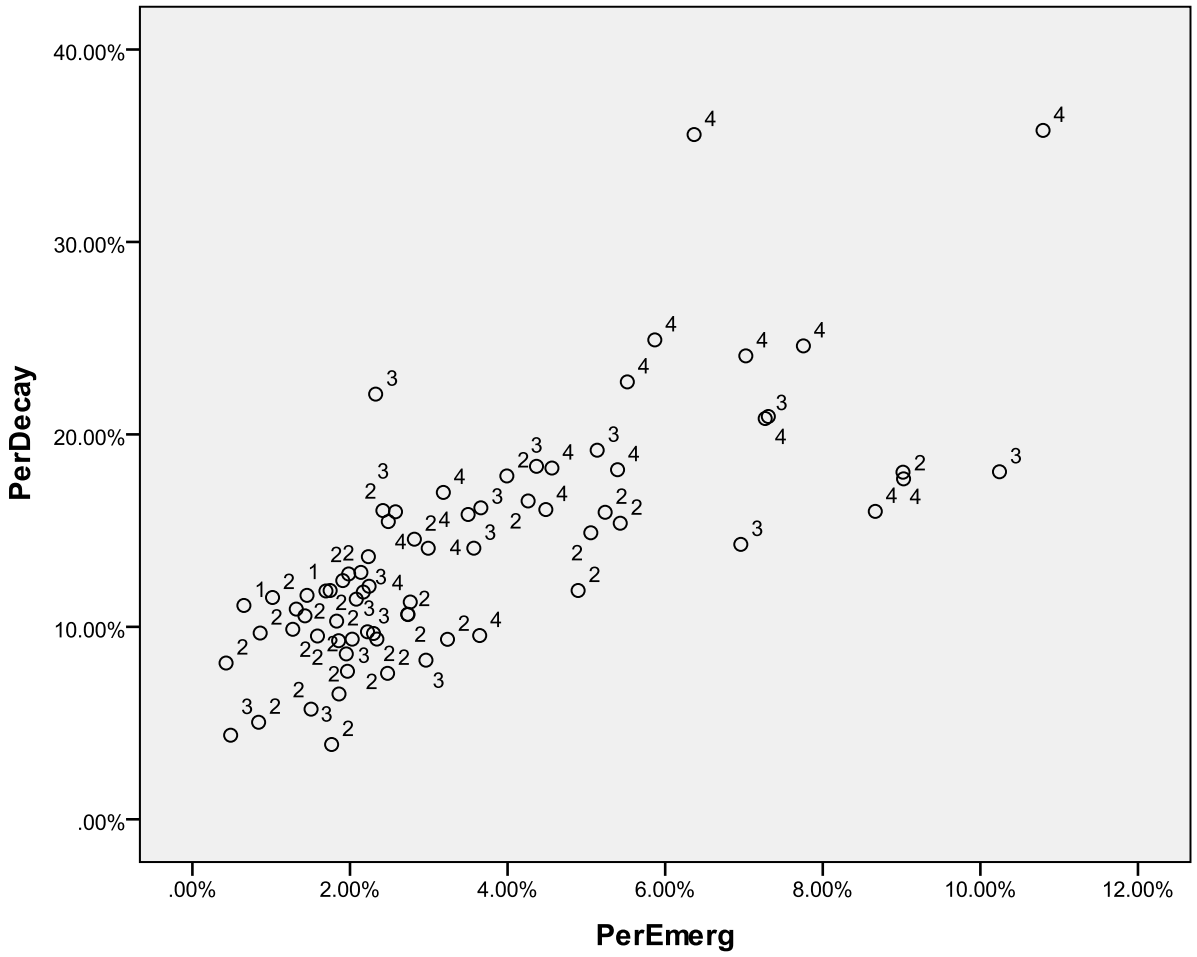
(c) Free Lunch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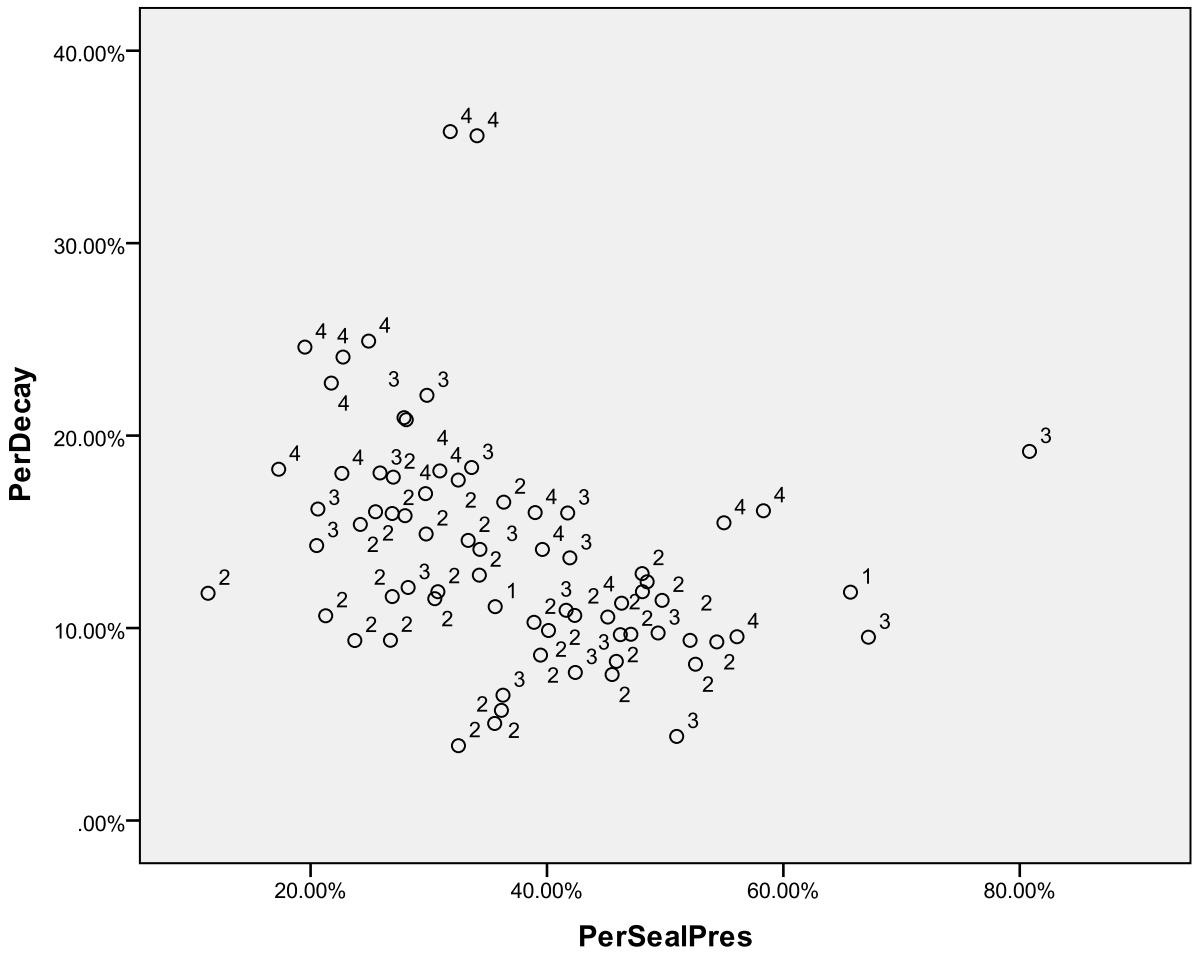
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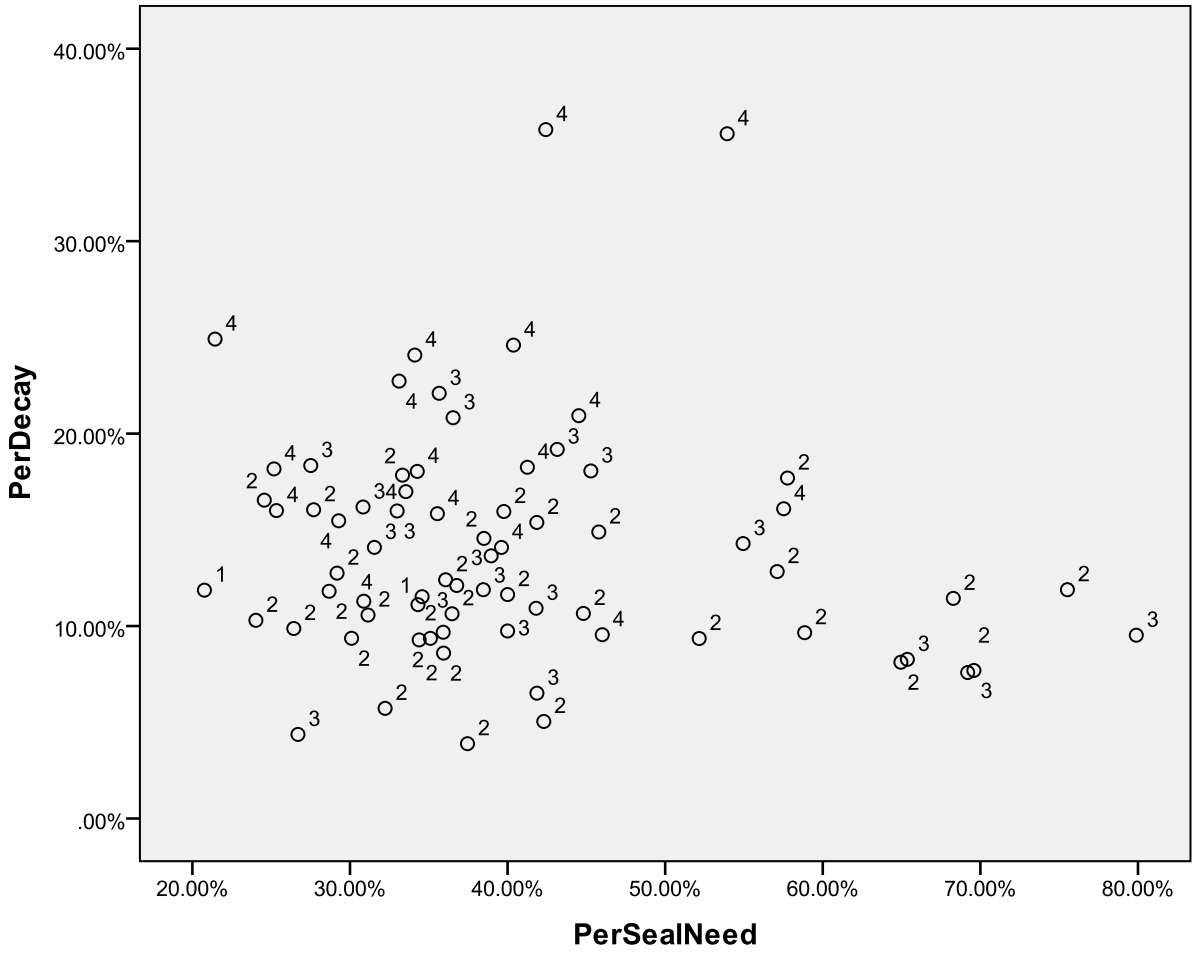

The Pearson Correlation Coefficients and corresponding p-values indicated the percent emergencies and percent free lunch had strong positive associations with percent untreated decay, while the percent sealants present had a strong negative association with percent untreated decay (**Table 4.19**). The percent sealants present also showed a strong negative association with percent emergency, while the percent free lunch showed a strong positive association with percent emergency. There was also a positive association between percent sealants present and percent sealants needed.

Table 4.19 Correlation Analysis: Pearson Correlation Coefficients (*P*-value) for Associations among Continuous Dental Variables

	Untreated Decay	Percent Emergency	Percent Sealants Present	Percent Sealants Needed	Percent Screened	Percent Free Lunch
Untreated Decay	1.000 (0.0)					
Percent Emergency	0.739 (<0.01)	1.000 (0.0)				
Percent Sealants Present	-0.335 (<0.01)	-0.385 (<0.01)	1.000 (0.0)			
Percent Sealants Needed	-0.132 (0.27)	0.036 (0.76)	0.239 (0.04)	1.000 (0.0)		
Percent Screened	-0.013 (0.92)	0.023 (0.85)	-0.015 (0.90)	-0.213 (0.07)	1.000 (0.0)	
Percent Free Lunch	0.571 (<0.01)	0.529 (<0.01)	-0.117 (0.33)	-0.072 (0.55)	0.049 (0.69)	1.000 (0.0)

Univariate Analysis

The univariate analysis indicated six of the ten analyzed variables had a significant association with untreated decay "high" (**Table 4.20**). The association with emergency indicated that a school categorized as high emergency is 57.18 times as likely to have high untreated decay as compared to a school categorized as low emergency. Untreated decay "high" was also associated with sealants present "low", indicating that schools with low sealants present are 8.04 times as likely to have high untreated decay as compared to a school with high sealants present. (In contrast, sealants needed was not significantly associated with high untreated decay.) The significant association between USD and untreated decay "high" indicated a school in USD 259 was 5.58 times as likely to be categorized as untreated decay "high" than non-USD 259 schools. A large Mantel-Haenszel odds ratio described the association between school level and untreated decay "high". This odds ratio of 9.50 (p-value: 0.0003) indicates that elementary schools are 9.5 times as likely to be categorized as high untreated decay than middle schools. Free lunch quartile "high" was also significantly associated with untreated decay "high", indicating that a school in free lunch quartile three or four was 7.03 times as likely to be classified as untreated decay "high" as compared to a school in free lunch quartile one or two. Year, location, and

predominant race were not associated with an untreated decay category. School type had low numbers of expected values for the private school type and therefore, an accurate Mantel-Haenszel χ^2 and odds ratio was incalculable. This variable was not included in further analyses.

Table 4.20 Categorical Dental and Descriptive Variables Unconditionally Associated with Untreated Decay "High" (≥13.9%) as Compared to Untreated Decay "Low"

Variable	Mantel-Haenszel Odds Ratio	95% Confidence Interval (test-based)	Mantel-Haenszel χ^2 (p-value)
Emergency-High	57.18	(11.32-295.20)	37.52 (<0.01)
Sealants Present-Low	8.04	(2.67-24.15)	15.16 (<0.01)
Sealants Needed-High	0.91	(0.35-2.38)	0.03 (0.85)
Year (2012 vs. 2013)	1.41	(0.55-3.55)	0.50 (0.48)
USD (259 vs. non-259)	5.58	(1.99-15.64)	11.28 (<0.01)
Location (SE vs. non-SE)	0.56	(0.21-1.49)	1.33 (0.25)
School Type* (Public vs. Private)	0.00	-	8462 (0.36)
School Level (Elementary vs. Middle)	9.50	(2.48-36.38)	13.04 (<0.01)
Predominant Race (White vs. non-White)	0.37	(0.14-0.96)	4.20 (0.04)
Free Lunch Quartile (1&2 vs. 3&4)	7.03	(2.47-20.03)	14.28 (<0.01)

*Due to low numbers of expected values for the Private school type, calculation of the Mantel-Haenszel chi-square, Mantel-Haenszel odds ratio, and 95% confidence interval cannot be performed accurately.

Developing the Logistic Model

The first stage of the logistic model development evaluated both the dental and descriptive variables. In the first model analyzed, *Model E*, percent emergency, school level, and percent free lunch were found to have inaccurate odds ratios of >999.99. Percent emergency was dichotomized for the next model, *Model D*, but this still led to high odds ratios for emergency (102.5) and percent free lunch (>999.99). On subsequent models, emergency was removed as a predictor variable; its strong collinear relationship with untreated decay made modeling difficult. Mantel-Haenszel odds ratios for the dental and descriptive variables using the dichotomous emergency as the outcome variable (**Appendix A**) were similar to those in **Table 4.20.**

After removing percent emergency, the logistic model was run utilizing percent free lunch, percent sealants needed, and percent sealants present as continuous variables (*Model C*). The remaining variables were categorical based on the previous dichotomization. In *Model C,* high odds ratios resulted for percent free lunch (>999.99) and school level (201.69). *Model B* was run using the dichotomous variables for USD, location, school level, predominant race, and free lunch, but with the continuous variables percent sealants present and percent sealants needed. For the final model, *Model A*, all variables were dichotomized. *Model A* and *Model B* produced similar Hosmer-Lemeshow test statistics, p-values, and -2 log likelihood statistics. For *Model A,* the Hosmer-Lemeshow test statistic was 10.5, with a p-value of 0.23 and a -2 log likelihood statistic of 51.5. For *Model B*, the Hosmer-Lemeshow test statistic was 11.4, with a p-value of 0.18 and a -2 log likelihood statistic of 54.9. Upon consideration of the Hosmer-Lemeshow test statistic and after running further logistic regression procedures (step-wise, forward, and backward), it was determined that *Model A* would be used to determine the reduced model. The results of the full logistic regression model using the *Model A* variable coding strategy is shown in **Table 4.22**.

Table 4.21 Logistic Regression Models with Varying Variable Type Coding using Untreated Decay (High*/Low) as the Outcome (Y) (N=72 Schools)

Dental/Descriptive Variable	Type of Variable	Odds Ratio (95% Confidence Interval)	
Model A**			
Sealants Present	Categorical	11.18 (1.06-117.54)	Hosmer-Lemeshow Test
Sealants Needed	Categorical	0.89 (0.19-4.19)	Statistic= 10.50
USD	Categorical	3.93 (0.44-35.05)	p-value= 0.23
Location	Categorical	0.21 (0.04-1.09)	
School Level	Categorical	18.33 (1.10-305.65)	-2 log likelihood= 51.50
Predominant Race	Categorical	0.29 (0.02-5.51)	degrees of freedom= 8
Free Lunch	Categorical	4.48 (0.36-55.37)	
Model B			
Percent Sealants Present	Continuous	0.02 (<0.01-9.99)	Hosmer-Lemeshow Test
Percent Sealants Needed	Continuous	0.35 (<0.01-143.92)	Statistic= 11.43
USD	Categorical	2.79 (0.38-20.48)	p-value= 0.18
Location	Categorical	0.29 (0.06-1.29)	
School Level	Categorical	52.78 (3.79-735.49)	-2 log likelihood= 54.94
Predominant Race	Categorical	0.27 (0.02-4.52)	degrees of freedom= 8
Free Lunch	Categorical	4.70 (0.45-49.20)	
Model C			
Percent Sealants Present	Continuous	0.23 (<0.01-123.70)	Hosmer-Lemeshow Test
Percent Sealants Needed	Continuous	1.27 (0.00-926.33)	Statistic= 7.19
USD	Categorical	0.44 (0.03-5.80)	p-value= 0.52
Location	Categorical	0.14 (0.02-0.87)	
School Level	Categorical	201.69 (9.10->999.99)	-2 log likelihood= 41.10
Predominant Race	Categorical	0.92 (0.04-19.57)	degrees of freedom= 8
Percent Free Lunch	Continuous	>999.99 (172.73->999.99)	
Model D			
Emergency	Categorical	102.46 (2.53->999.99)	Hosmer-Lemeshow Test
Percent Sealants Present	Continuous	0.02 (<0.01-766.43)	Statistic= 0.84
Percent Sealants Needed	Continuous	<0.01 (<0.01->999.99)	p-value= 0.99
USD	Categorical	0.74 (0.02-23.32)	
Location	Categorical	0.67 (0.05-8.94)	-2 log likelihood= 27.21
School Level	Categorical	65.01 (1.35->999.99)	degrees of freedom= 8
Predominant Race	Categorical	1.04 (0.03-33.77)	
Percent Free Lunch	Continuous	>999.99 (3.34->999.99)	
Model E			
Percent Emergency	Continuous	>999.99 (<0.01->999.99)	Hosmer-Lemeshow Test
Percent Sealants Present	Continuous	<0.01 (<0.01->999.99)	Statistic= 1.18
Percent Sealants Needed	Continuous	<0.01 (<0.01->707.16)	p-value= 0.88
USD	Categorical	0.81 (<0.01->999.99)	
Location	Categorical	3.80 (0.12-123.80)	-2 log likelihood= 13.41
School Level	Categorical	>999.99 (0.09->999.99)	degrees of freedom= 4
Predominant Race	Categorical	0.03 (<0.01-148.60)	
Percent Free Lunch	Continuous	>999.99 (<0.01->999.99)	

*Percent untreated decay high classified as ≥13.9% in all models.

** Model used in paper

Table 4.22 The Association of Dental and Descriptive Variables with Untreated Decay of ≥13.9% (High) Using Logistic Regression (*Model A*) (N=72 schools)

Dental/Descriptive Variable	Variable Type	Parameter Estimate (Standard Error)	Odds Ratio (95% Confidence Interval)	Wald χ^2 (p-value)
Sealant Present-Low	Categorical	2.414 (1.200)	11.181 (0.009-0.940)	4.045 (0.044)
Sealant Needed-High	Categorical	-0.117 (0.791)	0.889 (0.189-4.190)	0.022 (0.882)
USD	Categorical	1.368 (1.117)	3.927 (0.440-35.051)	1.501 (0.221)
Location	Categorical	-1.551 (0.833)	0.212 (0.041-1.085)	3.467 (0.063)
School Level	Categorical	2.908 (1.436)	18.328 (1.099-305.650)	4.104 (0.043)
Predominant Race	Categorical	-1.257 (1.512)	0.285 (0.015-5.512)	0.691 (0.406)
Free Lunch	Categorical	1.499 (1.283)	4.477 (0.362-55.368)	1.365 (0.243)
-2 log likelihood for intercept and covariates = 99.313				

*Full model with all categorical variables and without percent emergency

Hosmer-Lemeshow Goodness-of-Fit Test of Above Model:

Goodness-of-Fit Test Statistic= 10.50
P-value from χ^2 distribution with 8 degrees of freedom= 0.23

Partitioned Risk for Untreated Decay	Untreated Decay High (≥13.9%)		Untreated Decay Low (<13.9%)		Total (N=72)
	Observed	Expected	Observed	Expected	
1	0	0.06	7	6.94	7
2	1	0.28	6	6.72	7
3	1	0.74	5	5.26	6
4	1	1.68	7	6.32	8
5	1	2.65	9	7.35	10
6	6	4.65	3	4.35	9
7	6	5.62	1	1.38	7
8	7	6.52	0	0.48	7
9	5	5.86	1	0.14	6
10	5	4.94	0	0.06	5
Total	33	33	39	39	72

The Final Reduced Model

When the full *Model A* was analyzed by step-wise and forward logistic regression using p-values of 0.05, the reduced models yielded two statistically significant variables, sealants present and free lunch (**Table 4.23**). The reduced model is the most efficient form of the full

model with the variables remaining in the reduced model accounting for most of the variance in the model, where the addition of more variables did not improve the model significantly. By backwards logistic regression modeling, school level and location were additionally included with free lunch and sealants present in *Model A*. However, this model had a less acceptable Hosmer-Lemeshow summary statistic (9.40, p-value 0.09) than the step-wise and forward logistic models, so it was not selected as the final reduced model.

Since the reduced model contains only the variables significantly associated with the untreated decay "high" relationship, it was a more appropriate model than the full model. The likelihood ratio test statistic for the reduced model was 37.03 (p-value <0.01). The reduced model showed a clear association between sealants present "low" and untreated decay "high", while accounting for the effects of free lunch. In the reduced model, the odds of an untreated decay "high" school was 22.48 times as likely for schools with sealants present "low" than for schools with sealants present "high," considering the effects of free lunch quartile three or four schools. The reduced model also showed a clear association between free lunch and untreated decay "high", allowing for the effects of sealants present. In the reduced model, the odds of an untreated decay "high" school were 19.75 times as likely for free lunch quartile three or four schools than for free lunch quartile one or two schools, considering the effects of sealants present "low."

Table 4.23 Final Multivariable Model of Variables Associated with Untreated Decay of ≥13.9% (High) after Using Step-wise Logistic Regression (*Model A*) (N=72 schools)

Dental/Descriptive Variable	Variable Type	Parameter Estimate (Standard Error)	Odds Ratio (95% Confidence Interval)	Wald χ^2 (p-value)
Sealant Present-Low	Categorical	3.11 (0.84)	22.48 (4.32-117.11)	13.66 (<0.01)
Free Lunch	Categorical	2.98 (0.82)	19.75 (3.94-99.12)	13.14 (<0.01)
-2 log likelihood for intercept and covariates = 99.313				

*Reduced model with all categorical variables and without percent emergency

Hosmer-Lemeshow Goodness-of-Fit Test of Above Model:

Goodness-of-Fit Test Statistic= 0.5935
P-value from χ^2 distribution with 2 degrees of freedom= 0.7432

Partitioned Risk for Untreated Decay	Untreated Decay High (≥13.9%)		Untreated Decay Low (<13.9%)		Total (N=72)
	Observed	Expected	Observed	Expected	
1	0	0.40	15	14.60	15
2	6	5.60	10	10.40	16
3	8	7.60	12	12.40	20
4	19	19.40	2	1.60	21
Total	33	33	39	39	72

Products

"Understanding the Use of Children's Dental Services" Parent Survey

In order to determine the use of dental services in Sedgwick County, a survey was developed through collaboration between the Epidemiology Program and the Children's Dental Clinic (**Appendix C**). The goal of this survey was to determine the factors that are impacting the use of dental services by children. In order for the survey to be considered exempt under the KDHE Institutional Review Board (IRB) process, the survey asked for no identifying information. The survey first asked for basic information regarding the relationship of the person taking this survey to the child. The next question asked about the number of children a parent had attending the school. The survey instructions indicate that the survey is asking for information about the youngest child attending the school. This question allows for the assessment of the effect of multiple children in the school on response rate. The third question addresses the child's last visit to the dentist. If the child last visited a dentist more than one year ago, or has never been to the dentist, the respondent is asked to provide a reason for this. This allows for an assessment of the reasons for children not visiting the dentist. The fourth question addresses the type of appointment the child had on their last visit to the dentist (cleaning, restorative, etc.). The final question asks if the child has dental insurance. If the child does not have insurance, the respondent is asked to provide the location where the child last visited the dentist. This allows for an analysis of what dental services are being utilized by individuals without insurance. Since Sedgwick County has a high population of Hispanic and Vietnamese populations, the survey was translated into these languages to improve ease of use.

The SCHD has recently instituted a School Based Sealants Collaborative to increase the number of children who have dental sealants. The first goal of the School Based Sealants Collaborative is to improve oral health in Title I schools. The Elementary and Secondary Education Act established Title I schools to provide financial assistance to schools with high numbers of children from low-income families.[66] Based on this information and the school rankings, three schools were selected for a pilot study of the survey. The Children's Dental Clinic was interested in both elementary and middle schools, so two elementary schools and one middle school were selected. All three of these schools are public schools in USD 259 with a percentage of students qualifying for free lunch status in quartile 4. One school was located in the NE region, one was located in the NW region, and one was located in the SE region. Two of the schools have a predominant race of black, while the third school has a mixed predominant race.

Although the survey was considered to be exempt by the KDHE IRB, it took longer than expected for the approval process. We were informed that the survey would only take two weeks for approval, so it was submitted to IRB at the beginning of my field experience. However, it had not received approval by the end of my field experience. Therefore, I was unable to complete the project objective number two. During this process, we also discovered that USD 259 has a Survey Approval Committee for any surveys being sent to parents. We were able to receive this approval and now understand this process for future surveys. At this time, the survey will be sent to parents as soon as it is approved by IRB.

"Find Your Dental Home" Flyer

In an effort to improve access to dental care in Sedgwick County, a flyer was developed to show the numerous community health partners who provide dental care to Sedgwick County residents. This flyer aims to provide the residents with information to help them establish a "dental home." By establishing a "dental home," residents would have an ongoing relationship with a primary care dentist to promote continuing dental appointments. The "Find Your Dental Home" flyer includes information for individuals who have no dental insurance, state-managed insurance, and/or private insurance. It provides contact information for clinics that qualify for each of these categories, as well as for the SCHD call center. The flyer would be distributed to

children during the SCHD school screenings and would be available at the SCHD locations. The "Find Your Dental Home" flyer is included in **Appendix D**.

Kansas Public Health Association (KPHA) Abstract

The KPHA Fall 2014 Conference will be held from September 28th to October 1st in Topeka, Kansas. The theme for the conference is "Health is Where You Live." To attend the KPHA Conference as a presenter, an abstract must be submitted in February. This abstract is judged by KPHA members and if it qualifies, the submission will be prepared as a poster or oral presentation for the conference. It was decided that an abstract for a poster presentation would be submitted regarding the analysis performed using the SCHD Children's Dental Clinic screening data from 2012 and 2013. The abstract and poster will focus on the results of the screening data analysis, as well as its use in the development of a targeted intervention method. The abstract submitted for approval for the KPHA Conference is included in **Appendix E**.

Chapter 5 - Discussion and Conclusions

When univariate analysis was conducted using untreated decay "high" as the outcome variable, emergency "high," sealants present "low," USD 259, school level elementary, predominant race white, and free lunch quartile three and four were positively associated with untreated decay "high." However, when multivariable analysis was conducted using untreated decay "high" as the outcome variable, only sealants present "low" and free lunch quartile three and four were included in the final reduced model. The information found in this analysis provides a novel insight in the interaction of untreated decay, dental sealants, and free lunch status. This information has the potential to contribute to the broader goal of improving the oral health of children in Sedgwick County and Kansas as a whole.

Percent Sealants Present and Free Lunch

Since the presence of sealants indicate previous dental services and protected teeth, it is biologically plausible that individuals with sealants present would have lower rates of untreated decay, as sealants are commonly used by dentists to prevent dental decay in young children.[41] This analysis demonstrated this effect. Prior to the logistic regression, the preliminary analysis revealed a strong negative correlation between percent sealants present and untreated decay. The odds ratio relating sealants present "low" with untreated decay "high" was relatively large (8.04). This was due to the higher number of schools falling into either the sealants present "high" and untreated decay "low" or the percent sealants present "low" and untreated decay "high" groupings. Both the full and final logistic models indicated a strong association between percent sealants "low" and untreated decay "high". The odds ratio for sealants present "low" was 11.18 in the full model and 22.48 in the reduced model. Since sealants present was strongly associated with low untreated decay, it is expected that this variable would remain in the final logistic model.

The percent of students qualifying for free lunch was used in this analysis as an indicator of the socioeconomic status of the screened schools. Previous unpublished data analysis conducted by the SCHD indicated that a high free lunch was associated with high rates of untreated decay in Sedgwick County. The present analysis supported this association. When the continuous variable "percent free lunch" was included in the correlation analysis, a positive

correlation with both percent untreated decay and percent emergency was shown. This was supported using the free lunch quartiles in the scatterplot diagnostics. Since there were a low number of schools in each of the individual free lunch quartiles, they were dichotomized into free lunch "high" (quartile 3 and 4) and free lunch "low" (quartile 1 and 2) for the univariate analysis and logistic regression. The univariate analysis showed that there was a positive association between free lunch and untreated decay "high" categories.

When free lunch was included in the final model, the Wald χ^2 was not significant. The Wald χ^2 for the variables school level and location were significant in the final model. Therefore, the step-wise and forward logistic model selection procedure showing free lunch but not school level and location in the reduced model was unexpected. To test why, a univariate analysis using free lunch as the outcome was performed (**Appendix B**). This analysis indicated that free lunch was significantly associated with predominant race and USD. A second univariate analysis using sealants present "low" was also performed (**Appendix B**). Sealants present "low" was significantly associated with school level and was close to significance with school location (p-value 0.07). This analysis provides more evidence for the idea that sealants present "low" and free lunch are the main variables to explain untreated decay.

Percent Sealants Needed

Contrasting the sealants present variable, the sealants needed variable was not found to be associated with percent untreated decay. Although dental sealants have been shown to protect teeth from dental decay, there is a large number of children who do not have them. In 2012, 61% of students in Kansas and 53% of students in Sedgwick County needed dental sealants.[45] Since dental sealants produce a high beneficial effect in terms of dental decay, it is expected that the lack of sealants would be associated with a high rate of untreated decay. This association may not be present since there are other dental decay prevention methods that could be utilized. These include proper brushing and flossing techniques, fluoride rinses, and proper diet. All of these factors will also reduce the risk of a child having untreated dental decay. The children could also visit a dentist on a regular basis, allowing for the treatment of any decay that is present.

When the frequency of untreated decay "high" and sealants needed "high" was compared to the frequency of untreated decay "low" and sealants needed "low", the discordant pairs were more frequent than the concordant pairs. This shows that there was no real difference between

the sealants needed “high” and sealants needed “low” when compared to untreated decay “high” and untreated decay “low”. It is the lack of association between sealants needed and untreated decay that caused it to not be included in the final model.

Percent Emergency

Severe untreated dental decay indicates that a child has a high number of teeth with dental caries. These children are considered to be emergencies because they need immediate dental treatment to prevent further decay and tooth loss. Due to this, it is biologically plausible that schools with a high percent of untreated decay may also have a high percent of emergencies. This idea is supported by the results of this analysis. The rankings of the top ten schools with untreated decay and the top ten schools with emergencies were comparable in both 2012 and 2013. The correlation analysis showed there was a strong positive association between percent untreated decay and percent emergencies. When untreated decay “high” and emergency “high” were analyzed using the Mantel-Haenszel χ^2, the 95% confidence interval was extremely large (11.32-295.20). This indicated that these two variables were associated and could result in multi-collinearity if both variables were included in a multivariable model.

During the logistic regression analysis, the percent emergency variable caused the logistic regression model to run inappropriately and produce odds ratios of <999.99 for percent emergency, school level, and percent free lunch. When this variable was included in the logistic regression model as a continuous variable, the Hosmer-Lemeshow test statistic had a p-value that was close to one and the odds ratios for percent emergency, percent free lunch, and school level were all >999. To combat this, the percent emergency variable was included in the logistic model as a categorical variable. However, this produced similar results. One potential reason for this result could be the method of dichotomization of the continuous variables. The continuous variables were divided based on their respective means, potentially causing relationships to appear where they are not truly existing. Based on previous results and the univariate analysis shown in **Appendix A** compared to **Table 4.20**, it can be stated that percent emergency is associated with percent untreated decay, but it was unable to be included in the final model. This is in part due to the potential multi-collinearity of percent emergency and percent untreated decay.

USD

For the purpose of this analysis, USD was divided into schools in USD 259 and non-USD 259 schools. When the frequencies of this categorization were assessed, a higher number of schools in USD 259 were in the untreated decay "high" category than in the non-USD 259 category. This led to a positive association between USD 259 schools and high untreated decay. When the school districts used in the study are compared, USD 259 is found to have a higher number of Title I schools. Schools in USD 259 also had a larger number of schools in free lunch quartile 3 or 4 than did the non-USD 259 schools. Since free lunch was found to be associated with high untreated decay, there is the potential for this to be a confounding factor of the USD 259 association with untreated dental decay. Despite its association with untreated dental decay in the univariate analysis, USD was not statistically significant in the final model.

Predominant Race

Despite progress that has been made to improve the overall health of the United States, health disparities due to race are still prominent. This is true for oral health, as well as general health. Children who are non-Hispanic white are more likely to receive prompt dental care than those who are Hispanic or non-Hispanic black.[49] The analysis conducted in this study supports this finding. The univariate analysis showed that it was beneficial for a school to be categorized with a predominant race of white when untreated dental decay high was used as the outcome variable. Despite this, predominant race was not significant in the final model.

Comparison to KDHE School Screening Program and Healthy People 2020

KDHE School Screening Program

KDHE created a school dental screening program to improve the oral health of Kansas. In this program, dental clinics who conduct school screenings submit the results of their screening to KDHE. KDHE then generates reports using this data. **Table 5.1** shows the comparison of the SCHD dental screening data with the KDHE data for Sedgwick County and Kansas. Since the screening data was presented based on the 2012-2013 school year, the SCHD data was also presented based on school year. The KDHE school screening reports only include the dental variables untreated decay, sealants present, and urgent care needed (emergency). When the SCHD screening data was compared to both KDHE-Sedgwick County and KDHE-

Kansas data, the average percent untreated decay for the SCHD screening data was less than that of KDHE-Sedgwick County and KDHE-Kansas by approximately 3%. The SCHD percent sealants present is also less than KDHE-Sedgwick County by seven percent and less than KDHE-Kansas by 1.5%. However, the KDHE-Sedgwick County and KDHE-Kansas data included students up to twelfth grade for sealants present, while the SCHD screening data only contained students up to eighth grade. These results indicated schools screened by the SCHD Children's Dental Clinic have rates of untreated decay, sealants present, and emergencies that vary slightly more than the those from schools screened with data submitted to KDHE. The SCHD Children's Dental Clinic submits data to KDHE, so these results are included in the Sedgwick County and Kansas Oral Health Reports.

Table 5.1 Comparison of the 2012-2013 School Year Dental Screening Data from SCHD and the KDHE School Screening Program Reports

Oral Health Indicator	SCHD Dental Screening Data			Sedgwick County Oral Health Report**		Kansas Oral Health Report**	
	Total	Average	Range	Total	Average	Total	Average
Total Screened	14,965 (85%)			30,060		15,3977	
Untreated Decay Yes		11.4%	3.9%-19.2%		16.4%		16.2%
Untreated Decay No		88.6%	80.8%-96.1%		83.6%		83.8%
Sealants Present Yes		41.5%	48.5%-43.0%		48.5%*		43.0%*
Sealants Present No		58.5%	19.2%-83.3%		51.5%*		57.0%*
Sealants Needed		34.0%	2.0%-66.7%		-		-
Urgent Care Needed (Emergency)		4.8%	0%-16.0%		2.8%		2.5%

*Sealant screening data from Sedgwick County Oral Health Report and Kansas Oral Health Report represents only 3-12 grades.
**KDHE School Screening Program Screening Reports[55]

Healthy People 2020

Healthy People 2020 is a 10-year plan developed by the United States Department of Health and Human Services to improve the overall health of the United States. One of the areas of focus for Healthy People 2020 is oral health. Healthy People 2020 developed 17 objectives targeting oral health. Of these objectives, two address dental decay in children and one addresses the use of dental sealants. The dental decay objective that is applicable to this study is oral health

objective 2.2. This objective states: "Reduce the proportion of children aged 6 to 9 years with untreated dental decay in primary and permanent teeth."[56] The baseline for this objective is 28.8% of children with untreated decay between 1999 and 2004. The goal for this objective is to reduce the percent untreated decay to 25.9% or below. In the schools screened by the SCHD Children's Dental Clinic, the average percent untreated decay was 14% in 2012 and 15% in 2013. This is well below the Healthy People 2020 goal of 25.9%. Of all of the 102 schools screened in both 2012 and 2013, only five schools did not meet this goal. These schools had a percent of untreated decay between 34% and 50%.

One of the Healthy People 2020 oral health objectives also addresses the use of dental sealants in children. The specific objective that is applicable to this study is oral health objective 12.2, which states: "Increase the proportion of children aged 6 to 9 years who have received dental sealants on one or more of their primary molar teeth."[56] The baseline for this objective was 25.5% of children having dental sealants between 1999 and 2004. The goal for this objective is to achieve 28.1% of children receiving dental sealants. In the schools screened by the SCHD Children's Dental Clinic, an average of 38% of students had sealants present. This is above the Healthy People 2020 goal. Despite this high average, 31 of the 102 schools screened were below the Healthy People 2020 goal of 28.1%. These schools had a percent of sealants present between 3% and 27%. This comparison shows that while the schools screened by the SCHD Children's Dental Clinic have an average level of oral health above the Healthy People 2020 objectives, there is still a large amount of improvement that must be completed for all children in Sedgwick County to have sufficient oral health.

Limitations

Selection Bias

One limitation of this study was the fact that it was conducted using a convenience sample without random probability sampling. Due to this, the probability of a student in the county being selected for the study was unknown. It would have been impossible to determine the probability sampling information about the dental screening population in this study. Due to potential identifiability of individual children, it was not possible to obtain the complete enrollment information for all schools in Sedgwick County. The lack of enrollment information forced the estimation of total enrollment numbers in 33 schools. There was also the potential for

an issue with volunteer bias in the study. Volunteer bias is the phenomenon that individuals who choose to participate in a screening program are likely to be different than those who choose not to participate.[57] Parents of the children at the screened schools have the option to "opt out" their children from the screening process. One hypothesized reason for parents removing their children from the screening process is that they feel their children visit the dentist with enough frequency that screening is unwarranted. It would be expected that these children would have their dental decay treated. The exclusion of these children could potentially bias the study population towards children with higher rates of untreated decay. Since it is impossible to determine which of the potential children will be removed from the screening process, it is impossible to determine the sampling probability of all children in Sedgwick County. This could have impacted the final prevalence and odds ratio estimates generated by this study.

Generalizability

One way that a study is evaluated is through the external validity of the study. This external validity or generalizability relates to the ability of the inferences of the study to be expanded to populations beyond the study population.[58] In order for a study to be generalizable, the results of the study population must be expandable to a more general population. Due to the fact that the children included in the study were not randomly sampled from the screened schools, and the screened schools were not randomly sampled from all of the schools in Sedgwick County, this study is considered a convenience sample with nonrandom probability sampling. Due to the use of a convenience sample, the results from this study are only applicable to the sampled population. There was also an issue with a small study population. The study population for the logistic regression analysis only contained 72 observations, with only 33 of the schools having the untreated decay "high" outcome. This small study population reduces the ability of this study to be generalizable to schools beyond those screened by the SCHD Children's Dental Clinic in 2012 and 2013. However, the methods used in this analysis could be duplicated on future studies in other dental screening populations.

Misclassification Bias

Misclassification bias may also have occurred in this study. Misclassification bias is a form of information bias that occurs when subjects in a study are misclassified.[59] The potential for misclassification bias occurs in those variables that relied on the data from the KDE "Kansas

K-12 County, District, and School Reports." These variables were percent of students screened, predominant race, and percent free lunch. In the "Kansas K-12 County, District, and School Reports," there were schools that had less than ten students in the categories of enrollment, race, and free lunch. The variables for these schools had to be estimated. Since these variables were used to classify the schools based on percent of students screened, predominant race, and free lunch quartile, there is the potential for misclassification of these schools into the wrong categories.

Categorization

As described in the methods, the dental and descriptive variables were dichotomized for application in the logistic regression model. By dichotomizing the continuous variables, some of the information about these variables is lost in the analysis. This decreases the viability of the model. However, the dichotomization of the percent sealants needed and the percent sealants present variables produced a more appropriate goodness-of-fit from the Hosmer-Lemeshow test statistic than was observed with the continuous variables.

Comparison to Other Studies

When the literature was searched, no other studies utilizing logistic regression to analyze the rates of untreated decay in school dental screening programs at a school level were discovered. Due to this, no comparisons could be made with other studies. The final results of this study were understandable within this dataset. The variables placed in the final model, percent sealants present and free lunch, both demonstrated a clear statistical relationship with a high level of untreated decay. However, until similar analyses of other dental screening data are conducted with similar results, no firm conclusions relating to rates of dental decay in students can be drawn from this analysis.

Conclusions

The results of this study indicate a high percentage of sealants present in a school was associated with a low level of untreated decay. One reasoning for may be the fact that the presence of dental sealants indicates that a child has visited a dentist at some point in their life. Having access to a dentist will reduce the potential for untreated dental decay for a child. Dental sealants also help reduce the rate of dental decay by protecting the surface of a child's teeth. It is

this reasoning that has led to the creation of the School Sealants Program at KDHE and the School Based Sealants Coalition at the SCHD. By promoting the use of dental sealants in children, the percent untreated decay in the schools may be decreased.

Free lunch was used in this study as a socioeconomic indicator. Since free lunch "high" (>50%) was associated with untreated decay "high", it is plausible that students who are part of the free lunch program could have higher rates of untreated decay. However, the study population was neither large nor randomly selected, so this cannot be stated as a certainty.

Project Objectives

Due to various complications, not all of the original project objectives were able to be completed. Outlined below are each of the objectives and their status at the time of this report.

1. Analyze the Children's Dental Clinic data and determine which schools have the highest percentage of students with dental decay. Determine interactions and associations between dental and descriptive variables.
    a. This objective was completed during my field experience and is evidenced in the entirety of this report.
2. Develop a pilot study to determine barriers to accessing services at the Dental Clinic.
    a. The survey for the pilot study was completed for this objective (**Appendix C**). This survey is waiting for KDHE IRB approval before it will be sent out to three selected schools. A database was created based on this survey in order to reduce difficulties once the surveys are collected.
3. Perform online research on oral health programs from other states and local health departments to determine if similar studies have been conducted and the results of those studies.
    a. This objective was completed during my field experience. No similar analyses were identified.
4. Assist in developing a Communications Plan for the Dental Clinic that will target parents and school nurses in the three to five identified schools.
    a. This objective was partially completed during my field experience. I created the first document for the Communications Plan, the "Find Your Dental Home" flyer

(**Appendix D**). I also attended meetings to discuss the optimum method for developing the Communications Plan and what messages should be addressed. Although I was unable to complete all of my objectives regarding the "Identifying and Reducing Barriers to Accessing Services at the Sedgwick County Children's Dental Clinic" project, I still feel that my field experience was successful. I participated in all aspects of the SCHD, both those directly relating to epidemiology and those that did not. I also gained knowledge in the area of data analysis that will be crucial to me in my future career. Finally, I was able to learn about the realities of working in public health and what a career in this area truly entails.

Future Directions and Recommendations

The next step for completing this study is to distribute the "Understanding the Use of Children's Dental Services" parent survey. This survey would be distributed by the school nurses to all students in each of the three pilot schools. The surveys would be collected after a week and analysis would be conducted. This analysis would be performed to determine the number of students who are using dental services in Sedgwick County, how many have dental insurance, and what type of dental services are being utilized. After the analysis is completed, targeted interventions for each of the schools can be developed. These interventions would target the largest "problem areas" as determined by the parent survey and the analysis in this report. Several forms of intervention materials have been discussed. A flyer or brochure using each school's precise statistics could be developed and given to parents at the school. Having information about proper oral health care and access to dental services would also be important to provide. This information would enable the parents to make the most accurate decisions regarding their child's oral health welfare.

During the course of this study, three major issues were discovered. The first of these issues was a lack of demographic information about the screened population. One recommendation for future studies is that demographic information be collected during the screening process. However, this could be difficult due to the IRB approval process. The dental hygienists should at least collect the number of students enrolled in the school on the day of screening. The second major issue was due to the fact that not all of the students in the population were screened. This would allow for a more accurate analysis of the dental screening data. The third recommendation for future studies would be to randomly select the schools in the

county that will be screened. This would improve the statistical analysis of the data and allow for a more in depth analysis. Since the schools are assigned for screening by KDHE based on screener convenience, this may not be possible.[11]

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Appendix A - Univariate Analysis Using Emergency as Outcome Variable

Table A.1 Categorical Dental and Descriptive Variables Associated with Emergency "Low" (<3.5%) or Emergency "High" (≥3.5%)

Predictor	Mantel-Haenszel Odds Ratio	95% Confidence Interval (test-based)	Mantel-Haenszel χ^2 (p-value)
Untreated Decay-High	57.81	(11.32-295.20)	37.52 (<0.01)
Sealants Present-Low	8.63	(2.55-29.15)	13.86 (<0.01)
Sealants Needed-High	2.65	(0.98-7.15)	3.74 (0.05)
Year	3.91	(1.41-10.88)	7.07 (<0.01)
USD	3.91	(1.38-11.11)	6.80 (<0.01)
Location	0.58	(0.21-1.59)	1.13 (0.29)
School Type*	0.00	-	0.60 (0.44)
School Level	5.85	(1.53-22.28)	7.59 (<0.01)
Predominant Race	0.49	(0.18-1.28)	2.13 (0.14)
Free Lunch	4.71	(1.65-13.46)	8.78 (<0.01)

*Due to low numbers of expected values for the Private school type, calculation of the Mantel-Haenszel chi-square, Mantel-Haenszel odds ratio, and 95% confidence interval cannot be performed accurately.

Appendix B - Univariate Analysis Using Free Lunch and Sealants Present as Outcome Variables

Table B.1 Association of Descriptive Variables with Free Lunch "High" (Quartiles 3 and 4)

Predictor	Mantel-Haenszel χ^2 (p-value)
Sealants Present-High	<0.01 (0.97)
USD	43.03 (<0.01)
Location	1.93 (0.16)
School Level	0.12 (0.72)
Predominant Race	35.00 (<0.01)

Table B.2 Association of Descriptive Variables with Sealants Present "Low"

Predictor	Mantel-Haenszel χ^2 (p-value)
USD	0.33 (0.57)
Location	3.13 (0.08)
School Level	34.98 (<0.01)
Predominant Race	2.35 (0.13)
Free Lunch	0.33 (0.57)

Appendix C - "Understanding the Use of Children's Dental Services" Parent Survey

The "Understanding the Use of Children's Dental Services" parent survey will be distributed to the three selected schools by the SCHD Epidemiology Program. The school nurses will distribute the surveys to the students, who will then take the survey to their parents. After one week, the survey will be collected by the schools nurses and the SCHD for analysis.

Figure C.1 "Understanding the Use of Children's Dental Services" Survey

Sedgwick County... working for you

Understanding the Use of Children's Dental Services

The Sedgwick County Health Department and other clinics in the county are working to increase the number of healthy young mouths. Please fill out this short survey for the youngest child you have attending this school to help us understand the use of children's dental services in the county. Complete either the Spanish, English, or Vietnamese language side of this document. The survey does not ask for names or any other identifiers.

Question 1.
Please describe yourself
- ☐ Parent or guardian of a child at this school
- ☐ Other adult

Question 2.
How many children do you have who attend this school?
- ☐ 1 child
- ☐ More than 1 child

Question 3.
When was your child's last cleaning with a dentist or hygienist?

□ Less than 1 year (Please go to question 4.)
□ More than 1 year
□ Never been to a dentist

If it has been more than 1 year or if your child has never been to a dentist, please let us know why.
(For example: my child has good teeth; I forget to make an appointment; transportation is difficult; I don't know where to take my child; I cannot afford dental services; clinic hours are not convenient; my child has no insurance)

Question 4.
What type of appointment did your child have the last time he/she saw a dentist?

□ Cleaning
□ Restorative (such as filling a cavity)
□ Other
□ Never been to a dentist

Question 5.
Does your child have dental insurance?

□ Yes – private insurance (for example, Coventry)
□ Yes – State-run insurance (for example, KanCare)
□ No insurance

If no insurance, where was your child last seen by a dentist or hygienist (for example, E. C. Tyree, GraceMed, Hunter Health, Sedgwick County Dental Clinic, etc.)?

□ Never been seen by a dentist

Please return completed survey to your child's school by _____.

Thank you for completing the survey. The information you provided will help keep kids healthy.
Please contact your school nurse for more information on keeping your child's mouth healthy.

Appendix D - "Find Your Dental Home" Flyer

The "Find Your Dental Home" flyer was developed to inform Sedgwick County residents about their options for dental services and promote residents to establish ongoing relationship with a primary care dentist. The flyer is in the process of being approved and formatted by Sedgwick County Communications before being distributed around the county.

Figure D.1 "Find Your Dental Home" Flyer

Sedgwick County...
working for you

Find Your Dental Home

The Sedgwick County Health Department and community health partners would like all Sedgwick County residents to see a dentist regularly. If you do not have a dental home, the information below can guide you in selecting one.

If you have:

No Insurance

Sedgwick County Health Department Children's Dental Clinic
Phone: 316-660-7317
Address: 1900 E. 9th

- Free dental care for children who meet the eligibility requirements listed below (must meet all requirements)
  - **Only children** aged 5-15 and enrolled in school can receive treatment
  - Must **not** qualify for Medical cards, state insurance plans, or any type of private dental insurance
  - Must qualify for free or reduced lunches
- To schedule an appointment, either contact your school nurse or call the Sedgwick County Health Department Children's Dental Clinic at 316-660-7317

State-Managed Insurance (KanCare, Health Wave, Medicaid, etc.)

- **E.C. Tyree Dental Clinic**: Phone: 316-681-2454, Address: 1525 N. Lorraine
- **Hunter Health Clinic**: Phone: 316-269-0677, Address: 2318 E. Central
- **GraceMed Clinics**: Phone: 316-866-2000, Address: Multiple Locations
- **Delta Dental of Kansas Foundation Dental Hygiene Clinic at Wichita State University**: Phone: 316-978-3603, Address: WSU Campus, Ahlberg Hall Room 207
  - Cleanings and sealants only
- **Advanced Education in General Dentistry Dental Clinic at Wichita State University**: Phone: 316-978-8350, Address: 2838 N. Oliver
- Some private providers accept state-managed insurance.

Private Insurance

Contact your insurance company for a list of providers or one of the clinics listed under state managed insurance.

If you need help finding a dental home or learning more about affordable health coverage options, call 2-1-1 or visit www.sedgwickcounty.org

Appendix E - KPHA Abstract

Figure E.1 KPHA Abstract (submitted on February 28, 2014 for presentation at the KPHA Fall 2014 Conference

Analysis of School Dental Screening Data to Determine Target Areas for Intervention

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Introduction: Proper oral health is an often overlooked, but critically important aspect of children's development and learning. The Sedgwick County Health Department (SCHD) Children's Dental Clinic performs routine school screenings to improve oral health in Sedgwick County.
Methods: Using SCHD screening data from 2012 and 2013, each school was ranked for calculated percent of untreated decay (PUD), percent emergencies (PE), percent of students who needed sealants (PSN), and percent of students who had sealants present (PSP). Data was further described using school district (USD), school location, and school level. As an indicator of socioeconomic status, percent of students in each school who qualify for free lunch status (FL) was calculated using data from the Kansas Department of Education website.
Results: In 2012 and 2013, 31,864 children were screened. On average among the 102 schools screened, PUD was 15% (0%-50%), PE was 4% (0%-26%), PSN was 42% (2%-80%), and PSP was 37% (3%-81%). An increase in PUD corresponded with an increase in PE and FL and a decrease in PSP. Interestingly, an increase in PUD did not correlate with an increase in PSN. In this dataset, PUD was significantly higher in USD 259 and elementary schools.
Conclusion: Average PUD, PE, and PSP were similar to statewide results. The high PUD and PE found in individual schools, the high average PSN, and the low average PSP show that targeted interventions are still necessary. Based on the analysis of this data, projects are underway to improve the oral health of Sedgwick County children.