2018

# Assessing Feasibility and Effectiveness of Pediatric Dental Provider's Role in Oral Health and Prevention Education in the Care of Children with Leukemia

Hannah Rustin
*Virginia Commonwealth University*

# Assessing Feasibility and Effectiveness of Pediatric Dental Provider's Role in Oral Health and Prevention Education in the Care of Children with Leukemia

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Dentistry at Virginia Commonwealth University.


By

Hannah Rustin, DMD

BS, University of South Carolina, 2011

DMD, Medical University of South Carolina, 2016


Thesis advisors:

William Dahlke, DMD

Associate Professor, Chair of Department of Pediatric Dentistry

Frances Austin, MD

Assistant Professor, Department of Pediatrics, Division of Hematology Oncology


Virginia Commonwealth University

Richmond, Virginia

May, 2018

**Acknowledgements**

I would like to thank everyone who has been instrumental in the design and execution of this study. I greatly appreciate the help and encouragement of my committee members Dr. William Dahlke, Dr. Frances Austin, Dr. Caroline Carrico, Dr. Erica Brecher, Dr. Patrice Wunsch, and Dr. Todd Kitten. The friendship of my co-residents and mentorship of those in the Virginia Commonwealth University Department of Pediatric Dentistry has been invaluable. Finally, I would like to thank my family and husband, Charlton, for their steadfast love and support as I have pursued the realization of my dream of becoming a pediatric dentist.

## Table of Contents

## List of Tables

## List of Figures

## Abstract

ASSESSING FEASIBILITY AND EFFECTIVENESS OF PEDIATRIC DENTAL PROVIDER'S ROLE IN ORAL HEALTH AND PREVENTION EDUCATION IN THE CARE OF CHILDREN WITH LEUKEMIA
By: Hannah Rustin, DMD

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Dentistry at Virginia Commonwealth University.

Virginia Commonwealth University, 2018

Thesis Advisors:

William Dahlke, DMD

Associate Professor, Chair of Department of Pediatric Dentistry

Frances Austin, MD

Assistant Professor, Department of Pediatrics, Division of Hematology Oncology

Purpose: Pediatric dentists could serve a role in care of children with leukemia. Oral sequelae of cancer therapies are well documented. The purpose of this study is to assess the feasibility and effectiveness of the pediatric dentist in the care of patients with leukemia.

Methods: Pediatric Hematology and Oncology at Virginia Commonwealth University was educated on the proposed protocol and administered a questionnaire to assess feasibility of implementing prevention education by the pediatric dentist. Patients were randomized into two groups at diagnosis: one receiving current oral health protocol and those receiving one-on-one prevention education with the pediatric dentist at three points during treatment. Data was collected through clinical intraoral examination and salivary sample.

Results: All respondents reported this would address a known problem for patients. They agreed it is feasible and would be a valuable addition to care of these patients. Subject recruitment is ongoing for the effectiveness portion of the study.

Conclusion: The addition of the pediatric dentist to the pediatric oncology care team is warranted and feasible.

## Introduction

Leukemia is the most common pediatric malignancy, accounting for approximately 30% of cancers diagnosed in children under the age of 15.[1,2] Acute lymphoblastic leukemia (ALL) is most common pediatric leukemia; accounting for 75%of all new leukemia diagnoses and 25% of malignancies in childhood.[2,3] Most other cases are acute myeloid leukemia. Leukemia is characterized by uncontrolled reproduction of hematopoietic stem cells in the bone marrow and then diffusion of these cells into peripheral blood.[4] The highest incidence of leukemia in children is between 2 and 5 years of age.[2] Pediatric patients undergo extensive courses of therapy lasting 2 to 3 years, which has increased survival rates. Pediatric patients experience many well-identified acute oral sequelae during treatment for leukemia, and survivors continue to be at risk for dental abnormalities and complications associated with chemotherapy.[5]

There are multiple identified oral manifestations that can be attributed to the malignancy or secondary to cancer therapies. Hong et al reported a mean incidence of 54% of children experiencing acute oral sequelae, with varying percentages between 31-93% reported by others.[6] Oral mucositis is a commonly reported painful complication resulting from the cytotoxic effects of cancer therapies on epithelial and subepithelial tissues.[1,2,7] The lesions first present as an erythematous plaque and progress to ulcerations.[2] Gingivitis was noted more often in one study in children with ALL than healthy children in the control group. [3] Gingivitis was the most

common oral manifestation, affecting over 90%of patients undergoing therapy for ALL in a study by Ponce-Torres et al.[7] Oral petechiae has been observed in 32% of patients.[6] Oral mucosal infections due to various organisms have also been reported. [1,2,7,8]A 2009 literature review reported the mean incidence of oral candidiasis to be 15%. The reported incidence of herpes simplex virus infections was 8%, pseudomonas infection of lips was 4 percent, and necrotizing ulcerative gingivitis was 2%. [6] Xerostomia is also commonly reported. [1,2,7,8]

Pediatric oncology patients are also at an increased risk for systemic infections due to immunosuppression. It has been reported that 25-54% of incidences of septicemia in patients being treated for cancer with neutropenia seem to originate from bacteria that colonize the oral cavity.[9] Elad et al concluded that dental treatment preceding chemotherapy is supported for reduction of disseminated infections during subsequent periods of immunosuppression. Based on data analysis in this study, foregoing dental treatment prior to the initiation of chemotherapy increased the probability of mortality due to odontogenic infection for an additional 1.8 of every 1000 patients.[10]

In addition to the negative effects observed during a child's active treatment stage, pediatric oncology patients are at risk for long-term effects of chemotherapy on dental health and development. Chemotherapy is unfortunately nonselective, interfering with DNA synthesis and replication, RNA transcription, and cytoplasmic transport mechanisms to destroy both actively proliferating malignant and healthy cells.[3] Younger age during treatment has been associated with increased abnormalities of dental development as the effects of chemotherapy are intensified when dental cells are rapidly multiplying.[5] Formation of the primary second molar, the last primary tooth to erupt, is not complete until age 3. Calcification of premolars and second molars begins between 2-3 years of age, and crown enamel of most of the permanent dentition is

completed between the ages of 4 and 8. Both of these processes occur in the age range that most pediatric patients with leukemia are undergoing therapy. After eruption of the permanent dentition, root formation is not completed for 2 to 3 years.[11] Agenesis, microdontia, short and tapering roots were observed more often in children with ALL than healthy controls; hypomineralization or hypomaturation of enamel and taurodontism were also noted.[12] Nemeth et al identified root malformations as the most frequent developmental disturbance, occurring in over 50% of patients.[13]

Increased risk for dental caries has been identified in children who are undergoing or have undergone treatment for cancer. Hegde et al. noted that DMFT (decayed, missing, filled teeth) scores were significantly higher in children with ALL as compared to healthy controls.[1] Ponce-Torres et al. noted dental caries in 82% of patients.[7] Although increased DMFT was not observed by Yang et al, the number of untreated carious surfaces of primary teeth was increased in children with ALL.[9] Olszewska and Mielnik-Blaszczak concluded that caries activity increases in children receiving antineoplastic treatment due to a significant increase in the quantity of cariogenic bacteria in saliva during episodes of subsequent neutropenia.[14] Wogelius et al concluded that childhood cancer and cancer therapy were associated with increased caries risk, but that risk may decrease with longer follow up.[15] The weighted prevalence of dental caries amongst survivors was highest among patients that underwent chemotherapy only as compared to those who underwent radiation or chemotherapy and radiation in one systematic review. It was suggested that this may be due to different oral care management for patients preparing for radiation therapy versus chemotherapy in cancer treatment centers.[16] Xerostomia and levels of cariogenic bacteria, which are also acute-phase oral sequelae, are increased in survivors as well.[5]

Research has demonstrated that formation of dental caries is a multifactorial process

involving aciduric and acidogenic bacteria, fermentable carbohydrate exposure, and host factors including teeth and saliva.[17] Primary teeth are more vulnerable to rapid progression of caries due to thinner enamel and dentin layers and larger pulp chambers.[18] The caries balance concept is important to prevention. The progression or reversal of carious lesions depends on eliminating caries-promoting factors and maximizing caries-protective factors. Food preferences and tolerances may shift to highly cariogenic foods during therapy. Supplements with added sugar may be necessary to maintain weight and liquid medications high in sucrose may be prescribed frequently.[16] It has been well-established that patients experience decreased salivary flow rate secondary to salivary gland hypoplasia during chemotherapy.[3] This results in decreased buffering capacity and promotes a caries active state in the oral cavity. The mean salivary pH of patients undergoing chemotherapy was 6.5 and 7.5 in control patients.[1] Vomiting may also temporarily result in decreased intraoral pH. Compliance with oral hygiene may become more difficult and decrease with nausea, mucositis pain, and other complications secondary to therapy.[1,19] Therefore, optimizing caries-protective factors is of utmost importance for the pediatric oncology patient. Caries progression can be reduced or avoided with identification of disease indicators and individualized preventive practices.[20]

The importance of addressing the oral health of oncology patients during treatment and as a survivor has been identified.[2,7,8,19,21,22] Preventive practices have been shown to improve oral and dental outcomes for patients following chemotherapy.[15] However, a survey of supportive health care providers found that cohesive medical and dental services were only found in 25 % of the respondents' institutions. [22] Although a majority of responding institutions incorporated dental consultations and oral health education at diagnosis, only half provided care during treatment. [22] Another survey of National Cancer Institute-designated comprehensive care centers

found that only 19% of responding centers provided an oral assessment for all patients and 63% requested dental consultation for those with identified pathology or complaints. Also, 56% of centers did not have a dental department and only one third of patients undergoing chemotherapy were provided oral care and prevention education. [23] After treatment, research has also shown that dental utilization practices of survivors is suboptimal.[24]

Multiple barriers have been suggested as challenges to oral health and prevention education for the oncology patient. Gaps in knowledge, reliance on tradition, inconsistent or absent oral assessment, diverse oral care regimens and practices, administrative and clinical issues, and lack of interdisciplinary collaboration have been discussed as obstacles to the implementation of oral health care standards. A more fundamental barrier is the lack of an accepted universal standard. There is little agreement amongst experts in all disciplines concerned with oral care of the oncology patient in regards to tools for assessment of risk, most appropriate oral care instructions and dental chemotherapeutic agents, clinical outcomes, and protocols.[25] Dentists may also receive varying levels of training in the treatment of patients undergoing cancer therapies resulting in a limited number of dental providers comfortable and confident in providing oral health care and education to this unique population. [8,21] Another proposed barrier involves lack of financial resources for provision of dental services. [8]

The purpose of this study is to increase oral health and prevention education for pediatric patients with leukemia at Virginia Commonwealth University Medical Center (VCU) and to determine if the pediatric dental provider's role is feasible and effective in reducing caries-promoting factors and optimizing caries-protective factors.

Aim 1: Develop a protocol for interdisciplinary care of pediatric patients with leukemia that increases oral health and prevention education with the inclusion of a pediatric dental provider.

Aim 2: Assess the perceived feasibility of the protocol by current providers in the Department of Pediatric Hematology and Oncology at VCU

Aim 3: Assess the effectiveness of the increased oral health and prevention counseling on a sample of pediatric patients with leukemia.

## Methods

This study was approved by the Massey Cancer Center Protocol Review and Monitoring Committee Cancer Prevention and Control Subcommittee and the Institutional Review Board of VCU (IRB HM20006475), Richmond Virginia.

### Effectiveness Assessment

*Subject Population*

The targeted population of this study was pediatric patients ages 3 to 12 who have been recently diagnosed with leukemia (ALL and AML). This age range is representative of the pediatric patient with leukemia. Although the peak incidence occurs during ages 2 to 5, the age for inclusion was increased to 3 due to limited cooperation of younger patients. Subjects were patients of VCU Medical Center Pediatric Hematology and Oncology Clinic.

*Research Design*

Patients treated for leukemia at VCU are currently receiving oral hygiene instruction at diagnosis. In this study, patients were and were be randomized into 2 groups at diagnosis: 1) receive current prevention education and 2) receive one-on-one prevention education and counseling with a pediatric dental resident.

Standard oral health protocol at VCU involves an annual lecture given by a Pediatric Hematology and Oncology Attending discussing the importance of oral hygiene, current

standards of dental care for patients undergoing oncologic care, and dental complications of oncologic care. A similar lecture is given to the pediatric dental residents. Dental residents are called with all new diagnoses and perform a baseline examination and identify immediate needs. Plans are made for children who have urgent dental needs at the beginning of therapy. For non-urgent dental needs the oncology team and dental team discuss with family and make plans for dental care later in therapy. The oncology team provides education about the need for a regular oral health routine at diagnosis. Family are given fliers with pictograms describing proper brushing, use of mouth wash, and common oral complications during therapy. Families and patients are also given a bottle and prescription for chlorhexidine gluconate 0.12% rinse. Currently the Pediatric Hematology and Oncology Attending is tracking the compliance of and how well her colleagues are documenting ongoing oral hygiene care. For patients randomized into the second group, counseling with the hematology and oncology attending and pediatric dental resident will be in addition to standard protocol. Oral hygiene and care recommendations are reviewed at diagnosis, 16 weeks, and 32 weeks. Provided recommendations are based on American Academy of Pediatric Dentistry's guideline developed after systematic literature review and the National Institute of Dental and Craniofacial Research's Cancer Treatment and Oral Health guidelines for providers and patients.[26,27]

As caries risk is dynamic, a questionnaire was administered for each patient at diagnosis and future points of data collection to perform caries risk assessment. Caries incidence, *Streptococcus mutans, sobrinus, and sanguinis* levels, salivary flow rate, and salivary pH was assessed at week one (diagnosis), week 16 or start of interim maintenance therapy whichever comes second, week 32 or beginning of maintenance therapy whichever is later for all patients enrolled in the study. Data was collected through a clinical intraoral examination and salivary

sample. Data collected was used to assess the effect of increased prevention education on factors of importance in caries formation.

Data was collected and stored in a password protected laptop which was kept in a locked file cabinet in the Department of Hematology and Oncology. Patients were assigned a number from a randomization list and stored in a password- protected computer. All samples collected were labeled with that unique patient identifying number and no personal identifiers.

Sepsis is not uncommon during the first nine months of leukemic therapy. Bacteria isolates collected at induction, interim maintenance, and beginning of maintenance were stored. In the event of a disseminated infection, researchers will review the bacteria isolated from the disseminated infection and determine its consistency with one of colonies previously collected during data collection.

*Exclusions of Special Populations*

- > Age 12
- Full permanent dentition
- Primary language is not English
- Children in the custody of the state with no parent or legal guardian present to sign consent

*Sample Size*

The target sample size for the pilot study was 30 participants. Participants were randomized into 2 groups-fifteen in each group. A randomization list was created using a random number generator and each subject enrolled in the study was assigned to the corresponding treatment in the list. All were assigned consecutively and allocation was equal.

In terms of statistical power, a sample size of 30 will be able to detect a significant difference in the groups from baseline to follow-up with 80% power and a 0.05 significance level if the scores for the treatment group are better than 80% of the control group. This is based on a rank-sum test with n=15 per group, alpha=0.05, power=80%.[28] Using a t-test, a sample size of 15 per group will be able to detect an effect size of 1.06 (ratio of different in means to within group standard deviation) with 80% power and significance level of 0.05.[29] Because this is a pilot study, we were primarily powering the difference from baseline to final follow-up. We hope to use data from this study to power a repeated measures analysis in a larger study.

*Enrollment Procedures*

Potential subjects were approached at diagnosis. The Pediatric Hematology Oncology fellows and attending physicians discuss enrollment with the family and patient in a private and quiet room in the Pediatric Hematology Oncology clinic or in the hospital. Physician, family, and patient discuss risks and benefits of enrollment. The letter of consent was administered and collected at this appointment. Assent was obtained from potential participants of appropriate age.

**Explanation of Measured Variables and Instruments**

*Caries risk assessment*

A caries risk assessment involves discussion with parents concerning dietary habits, oral hygiene, and other caries-promoting and caries-protective behaviors and clinical examination of the pediatric patient. Information gathered on disease indicators (white spot lesions, cavitated lesions), risk factors (plaque, gingivitis, xerostomia), and protective factors (fluoride) is used to determine caries risk. Once caries risk is determined, direction was provided for implementation

of prevention practices. A questionnaire was administered at each point in data collection to help in assessment of caries risk.

*Merged ICDAS*

The concept of International Caries Detection and Assessment System (ICDAS) is based on the idea that a standardized, evidence-based system for detecting caries will result in improved diagnosis and clinical management. The Merged ICDAS format involves describing enamel as sound tooth (0), visual change in enamel (A), moderate decay (B), and extensive decay (C). Activity will be described as active lesions (+) or arrested lesions (-).[30]

*Salivary flow rate*

Salivary flow rate serves as an indicator of host potential for biologic repair. Stimulated salivary flow rate was measured utilizing pre-weighed cotton rolls. Patients were asked to saturate a cotton roll over one minute by chewing. Tubes were centrifuged for two minutes at 1,000 X g to collect saliva. Saliva was transferred to dose cup with micropipette. Dose cups were weighed prior to and after data collection. The change in weight in grams were converted to mL of saliva collected. Density of saliva is approximately 1g/mL. The obtained volume was divided by collection time to provide salivary flow rate in mL/min. [3]

*Salivary pH*

Salivary pH was measured from saliva sample collected for salivary flow rate after flow rate was determined with 5.5-8.0 litmus paper. Fifty microliters of saliva were measured with pipette.

Bacteria known to be involved in the caries process are aciduric and acidogenic. Therefore, lower pH may indicate higher presence of cariogenic bacteria.

*Streptococcus mutans, streptococcus sobrinus, and streptococcus sanguinis*

*Streptococcus mutans and sobrinus* are two bacterial species that represent bacterial challenge and serve as indicators of a caries-promoting environment. *Streptococcus sanguinis* is a health-associated commensal. Samples were collected from the buccal surface of most posterior maxillary right tooth and maxillary left tooth at each point of data collection. Samples from most posterior maxillary right tooth were analyzed with qPCR to quantify levels of *Streptococcus mutans, sobrinus, and sanguinis*. Samples from the most posterior maxillary left tooth were stored at -70 degrees Celsius for comparison to bacteria isolated in the event of disseminated infection. All specimens collected were analyzed in the Phillips Institute for Oral Health Research at VCU.

**Feasibility Assessment**

Members of the VCU Pediatric Hematology Oncology Clinic were presented details of the aforementioned protocol and given a questionnaire to assess their perceptions and get feedback (Appendix 1). The items addressed the potential benefit to the patient and the burden on the providers and allowed for respondents to indicate any potential barriers for implementing the protocol.

**Data Analysis**

Results from the feasibility questionnaire were described using summary statistics (counts and percentages). For the effectiveness portion of the study, changes in continuous, normally distributed measures from diagnosis to follow-up visits were assessed using t-tests.

Changes from baseline to follow-up in caries risk (and any other non-normally distributed measures) were assessed using a nonparametric rank-sum test. If possible, repeated measures ANOVA will be used to account for all three time points (baseline, 16 weeks, 32 weeks) but given the limited sample size and nature of this pilot study, our primary analyses will be on the change from baseline to each follow-up.

.

# Results

## Feasibility Results

A total of 13 of the 15 included providers completed the questionnaire (response rate: 86.67%). Prior to completing the questionnaire, respondents received education of the proposed role of the pediatric dentist, inclusion criteria for the study, and supplemental education materials. Respondents were asked to indicate their agreement with statements regarding the feasibility, importance, and implementation of the proposed protocol using a scale from Strong Disagree to Strongly Agree (scored as -2 through 2 by 1). For the feasibility of the protocol, the average response was 1.4 (between Agree and Strongly Agree) and the responses ranged from Neutral (n=1) to Strongly Agree (n=6). The importance of addressing oral health during oncology treatment was rated on average 1.7 (between Agree and Strongly Agree), with 10 respondents strongly agreeing and 3 agreeing. When asked if the addition of the protocol would be a valuable addition to the patients' care, 8 respondents strongly agreed and 5 agreed (average agreement: 1.6). Results are given in Table 1.

A set of 7 possible strengths were presented and respondents were asked to indicate which they felt were strengths of the proposed protocol. The complete list is given in Table 2/Figure 1. All respondents indicated that the protocol addresses a known problem for the patients (n=13, 100%). Other highly indicated strengths were increasing parent and patient knowledge (n=11, 85%) and the interdisciplinary addition of the pediatric dentist to the patient care team (n=11,

85%). Roughly 75% felt the protocol would be simple to implement (n=10, 77%) and would improve patient quality of life (n=10, 77%). Sixty-two percent (8 of 13) felt there would be low burden on the current providers to implement.

A set of 6 possible weaknesses were presented and respondents were asked to indicate which they felt were weaknesses of the proposed protocol. The complete list is given in Table 3. Over half of the respondents indicated that they would need more training before full implementation of the protocol (n=7, 54%). No one indicated the burden it would place on current providers or that it would have a low impact on the patients as possible weaknesses.

## Discussion

As leukemia is the most common pediatric malignancy and oral sequelae are noted during therapy and in survivors, pediatric dentists should serve an important role in multidisciplinary care of these children. Acute and long-term oral sequelae are well-documented in children receiving cancer therapies, including dental caries. Pediatric patients with leukemia are immunosuppressed; therefore, prevention of the start or progression of oral disease is important in reducing complications during treatment. Increased role of the pediatric dentist in the oral health and prevention education and care of patients with leukemia could also play an important part in decreasing risk for caries in patients undergoing cancer therapy and survivors. Although it is more difficult to eliminate or minimize risk for some acute and long-term sequelae of cancer therapy, dental caries is a preventable and common effect of therapy that may be addressed by increased role of pediatric dental provider as a member of the oncology care team.

There is minimal prospective or randomized research regarding the dental provider's involvement in care of survivors of childhood cancer.[31]

Many of the previously suggested barriers are addressed in the proposed protocol, including gaps in knowledge, reliance on tradition, diversity in oral care regimens and practices, inconsistency of oral assessment, administrative and clinical issues, and lack of interdisciplinary collaboration. One hundred percent of responding providers in the Department of Hematology and Oncology were in agreement that the proposed protocol addressed a known problem for their

patients. None of the providers indicated they believed implementation would have a low impact on their patients. Gaps in knowledge, especially of the patient and parent, would be lessened with one-on-one prevention and supportive oral health education with the pediatric dental provider at several points during treatment. Eighty-five percent of responding physicians identified increased parent and patient knowledge as a strength of the protocol. The family would also have an established relationship with a dental provider knowledgeable of the patient's unique special healthcare needs. The proposed protocol provides preventive and supportive oral care recommendations based on a systematic review of most recent oncology literature and presented as a guideline by the American Academy of Pediatric Dentistry. This minimizes reliance on tradition and proposes an alternative to diverse oral care regimens and practices previously noted. The protocol provides a schedule for follow up oral examination and review of preventive and supportive recommendations and self-management goals which provides consistency of oral assessment.

Administrative and clinical issues have also been mentioned as a barrier, particularly limited time of the nurse or physician to address oral health amongst other responsibilities.[25] Delegation of responsibilities to the pediatric dental provider would lessen the burden on current members of the pediatric oncology care team and ensure more dedicated attention by one provider to oral preventive and supportive care. None of the responding providers indicated that a weakness of the proposed protocol was burden on the current provider. While 77% and 62% indicated that a strength was simplicity of implementation and low burden on the current provider respectively, this may be higher if there was a dental department and designated provider within the cancer center. At VCU, pediatric dentistry serves as a consulting service so current providers are responsible for notifying pediatric dentistry of new diagnoses and

scheduling consultations. This may also explain why 23% of respondents identified time required for implementation as a weakness. The 53% indicating that more training would be necessary in order to implement is likely due to the assumption of assumed responsibility of education, oral assessment, and salivary analysis in the absence of the pediatric dental provider. Addition of the pediatric dentist addresses the recommended standard of interdisciplinary care of pediatric oncology patients; 85% of respondents indicated that this was a strength of the proposed protocol.

Limitations of this study are important to note. Feasibility agreement of providers in our study may not be generalizable to other institutions. Providers already have an established, yet limited relationship with pediatric dentistry and are thus more familiar with the idea of inclusion of the pediatric dentist in multidisciplinary care of their patients. It is not uncommon for physicians and nurses provide preventive and supportive oral health care. In a survey of National Cancer Institute (NCI)- designated comprehensive cancer centers, 32% of responding centers stated that physicians and nurses managed oral complications.[23] This may represent an optimistic view as centers that did not respond may have had less awareness of importance and established support of oral health care during cancer therapy. In another survey of current practice, nurses were responsible for oral health in 23% of responding cancer care centers.[32] It may be more difficult to implement the pediatric dentist's role in centers without established dental presence, which may be why NCI recommends that all cancer treatment centers have an established dental department.[23]

If clinical effectiveness is demonstrated, this proposed protocol involving the pediatric dentist as a member of the pediatric oncology patient's care team throughout therapy may contribute to a universal evidence-based guidelines and recommendations for oral health and

prevention care. Oncology literature supports that the prevention and effective management of oral and dental complications during therapy may improve oral function and quality of life and decrease morbidity and cost of care.[22] Seventy-seven percent of responding providers in the Department of Pediatric Hematology and Oncology indicated the potential of the protocol to improve patient quality of life. It may also provide support in the realization of the National Cancer Institute's recommendation that all cancer treatment centers have an established dental department.[23]

## Conclusion

The addition of the pediatric dentist to the pediatric oncology care team is warranted and feasible.

## References


1. Hegde A, Joshi S, Rai K, Shetty S. Evaluation of Oral Hygiene Status, Salivary Characteristics and Dental Caries Experience in Acute Lymphoblastic Leukemic (ALL) Children. *J Clin Pediatr Dent*. 2011;35(3):319-323. doi:10.17796/jcpd.35.3.u5kx28q33m760834.

2. Valéra M-C, Noirrit-Esclassan E, Pasquet M, Vaysse F. Oral complications and dental care in children with acute lymphoblastic leukaemia. *J Oral Pathol Med*. 2015;44(7):483-489. doi:10.1111/jop.12266.

3. Javed F, Utreja A, Bello Correa FO, et al. Oral health status in children with acute lymphoblastic leukemia. *Crit Rev Oncol / Hematol*. 2012;83:303-309. doi:10.1016/j.critrevonc.2011.11.003.

4. McDonald, Ralph E., Avery, David R., Dean JA. *Dentistry for the Child and Adolescent*. St. Louis, MO: Mosby; 2011.

5. Gawade PL, Hudson MM, Kaste SC, et al. A systematic review of dental late effects in survivors of childhood cancer. *Pediatr Blood Cancer*. 2014;61(3):407-416. doi:10.1002/pbc.24842.

6. Hong CH, Brennan MT, Lockhart PB. Incidence of Acute Oral Sequelae in Pediatric Patients Undergoing Chemotherapy. *Pediatr Dent*. 2009;31(5):420-425. http://www.ingentaconnect.com.proxy.library.vcu.edu/content/aapd/pd/2009/00000031/00000005/art00010. Accessed January 17, 2018.

7. Ponce-Torres E, Ruíz-Rodríguez M del S, Alejo-González F, Hernández-Sierra JF, Pozos-Guillén A de. Oral Manifestations in Pediatric Patients Receiving Chemotherapy for Acute Lymphoblastic Leukemia. *J Clin Pediatr Dent*. 2010;34(3):275-279. doi:10.17796/jcpd.34.3.y060151580h301t7.

8. Epstein JB, Güneri P, Barasch A. Appropriate and necessary oral care for people with cancer: Guidance to obtain the right oral and dental care at the right time. *Support Care Cancer*. 2014;22(7):1981-1988. doi:10.1007/s00520-014-2228-x.

9. Ou-Yang L-W, Chang P-C, Tsai AI, Jaing T-H, Lin S-Y. Salivary Microbial Counts and Buffer Capacity in Children with Acute Lymphoblastic Leukemia. *Pediatr Dent*. 2010;32(3):218-222.

http://www.ingentaconnect.com.proxy.library.vcu.edu/content/aapd/pd/2010/00000032/00000003/art00008#. Accessed January 17, 2018.

10. Elad S, Thierer T, Bitan M, Shapira MY MC. A decision analysis: the dental management of patients prior to hematology cytotoxic therapy or hematopoietic stem cell transplantation. *Oral Oncol*. 2008;44(1):37-42.

11. American Academy of Pediatric Dentistry. Dental Growth and Developement. *Pediatr Dent*. 2017;39(6):456. doi:10.1159/000242399.

12. Maciel JCC, de Castro CG, Brunetto AL, Di Leone LP, da Silveira HED. Oral health and dental anomalies in patients treated for leukemia in childhood and adolescence. *Pediatr Blood Cancer*. 2009;53(3):361-365. doi:10.1002/pbc.22108.

13. Nemeth O, Hermann P, Kivovics P, Garami M. Long-term Effects of Chemotherapy on Dental Status of Children Cancer Survivors. *Pediatr Hematol Oncol*. 2013;30(3):208-215. doi:10.3109/08880018.2013.763391.

14. Olszewska K, Mielnik-Błaszczak M. An Assessment of the Number of Cariogenic Bacteria in the Saliva of Children with Chemotherapy-Induced Neutropenia. *Adv Clin Exp Med*. 2016;25(1):11-19. http://www.advances.umed.wroc.pl/pdf/2016/25/1/11.pdf. Accessed January 17, 2018.

15. Wogelius P, Dahllöf G, Gorst-Rasmussen A, Sørensen HT, Rosthøj S, Poulsen S. A population-based observational study of dental caries among survivors of childhood cancer. *Pediatr Blood Cancer*. 2008;50(6):1221-1226. doi:10.1002/pbc.21464.

16. Hong CHL, Napeñas JJ, Hodgson BD, et al. A systematic review of dental disease in patients undergoing cancer therapy. *Support Care Cancer*. 2010;18(8):1007-1021. doi:10.1007/s00520-010-0873-2.

17. Twetman S. Treatment Protocols: Nonfluoride Management of the Caries Disease Process and Available Diagnostics. *Dent Clin North Am*. 2010;54(3):527-540. doi:10.1016/j.cden.2010.03.009.

18. Berg, J.H., Donly KJ. Restorative Dentistry. In: Nowak, A.J., Casamassimo PS, ed. *The Handbook of Pediatric Dentistry*. Fourth Edi. Chicago, Illinois: American Academy of Pediatric Dentistry; 2011:106.

19. Elad S, Raber-Durlacher JE, Brennan MT, et al. Basic oral care for hematology–oncology patients and hematopoietic stem cell transplantation recipients: a position paper from the joint task force of the Multinational Association of Supportive Care in Cancer/International Society of Oral Oncology (MASCC. *Support Care Cancer*. 2015;23:223-236. doi:10.1007/s00520-014-2378-x.

20. Ramos-Gomez FJ, Crystal YO, Ng MW, Crall JJ, Featherstone JDB. Pediatric dental care: prevention and management protocols based on caries risk assessment. *J Calif Dent Assoc*. 2010;38(10):746-761. http://www.ncbi.nlm.nih.gov/pubmed/21162350. Accessed October 17, 2016.

21. Nuernberg MAA, Nabhan SK, Bonfim CMS, Funke VAM, Torres-Pereira CC. Access to oral care before hematopoietic stem cell transplantation: understand to improve. *Support Care Cancer*. 2016;24(8):3307-3313. doi:10.1007/s00520-016-3142-1.

22. Barker GJ, Epstein JB, Williams KB, Gorsky M, Raber-Durlacher JE. Current practice and knowledge of oral care for cancer patients: A survey of supportive health care providers. *Support Care Cancer*. 2005;13(1):32-41. doi:10.1007/s00520-004-0691-5.

23. Epstein JB, Parker IR, Epstein MS, Gupta A, Kutis S, Witkowski DM. A survey of National Cancer Institute-designated comprehensive cancer centers' oral health supportive care practices and resources in the USA. *Support Care Cancer*. 2007;15(4):357-362. doi:10.1007/s00520-006-0160-4.

24. Yeazel MW, Gurney JG, Oeffinger KC, et al. An examination of the dental utilization practices of adult survivors of childhood cancer: a report from the Childhood Cancer Survivor Study. *J Public Health Dent*. 2004;64(1):50-54. http://www.ncbi.nlm.nih.gov/pubmed/15078062. Accessed February 8, 2018.

25. McGuire DB. Barriers and strategies in implementation of oral care standards for cancer patients. *Support Care Cancer*. 2003;11(7):435-441. doi:10.1007/s00520-003-0466-4.

26. American Academy of Pediatric. Dental Management of Pediatric patients Receiving Chemotherapy, Hematopoietic Cell Transplantation, and/or Radiation Therapy. *Pediatr Dent*. 2017;39(6):380-388.

27. National Institute of Dental and Craniofacial Research. Cancer Treatment and Oral Health. 2014-07-10. https://www.nidcr.nih.gov/oralhealth/Topics/CancerTreatment/. Accessed February 18, 2018.

28. Noether GE. Sample size determination for some common nonparametric statistics. *J Am Stat Assoc*. 1987;82:645-647.

29. Dixon, W.J., Massey FJ. *Introduction to Statistical Analysis*. 4th Editio. McGraw Hill; 1983.

30. ICDAS Foundation- International Caries Detection and Assessment System. https://www.icdas.org/home. Published 2016. Accessed October 18, 2016.

31. Effinger KE, Migliorati CA, Hudson MM, et al. Oral and dental late effects in survivors of childhood cancer: a Children's Oncology Group report. *Support Care Cancer*. 2014;22(7):2009-2019. doi:10.1007/s00520-014-2260-x.

32. Glenny AM, Gibson F, Auld E, et al. A survey of current practice with regard to oral care for children being treated for cancer. *Eur J Cancer*. 2004;40(8):1217-1224. doi:10.1016/j.ejca.2004.01.030.

## Tables

**Table 1.** Average Agreement with Statements Regarding Feasibility, Importance, and Value

| | Average | SD |
|---|---|---|
| It is feasible to incorporate this protocol into patient care. | 1.38 | 0.65 |
| It is important to address oral health during oncology treatment. | 1.77 | 0.44 |
| Implementing this protocol would be a valuable addition to our patients' care. | 1.62 | 0.51 |

*2=Strongly Agree, -2=Strongly Disagree

**Table 2.** Strengths of Proposed Protocol as Indicated by Respondents

| Strengths | n | % |
|---|---|---|
| Addresses a known problem for the patients | 13 | 100% |
| Simple to implement | 10 | 77% |
| Potential to improve patient quality of life | 10 | 77% |
| Increases parent and patient knowledge | 11 | 85% |
| Addition of pediatric dentist to the patient care team | 11 | 85% |
| Low burden on current providers | 8 | 62% |
| Other | 2 | 15% |

**Table 3.**Weaknesses of Proposed Protocol as Indicated by Respondents

| **Weaknesses** | **n** | **%** |
|---|---|---|
| Burden on current providers | 0 | 0% |
| Time required for implementation | 3 | 23% |
| Low impact on patient | 0 | 0% |
| Quality of distributed patient education materials | 2 | 15% |
| More training would be necessary in order to implement | 7 | 54% |
| Other | 2 | 15% |

## Figures

**Figure 1.** Strengths of Proposed Protocol as Indicated by Respondents

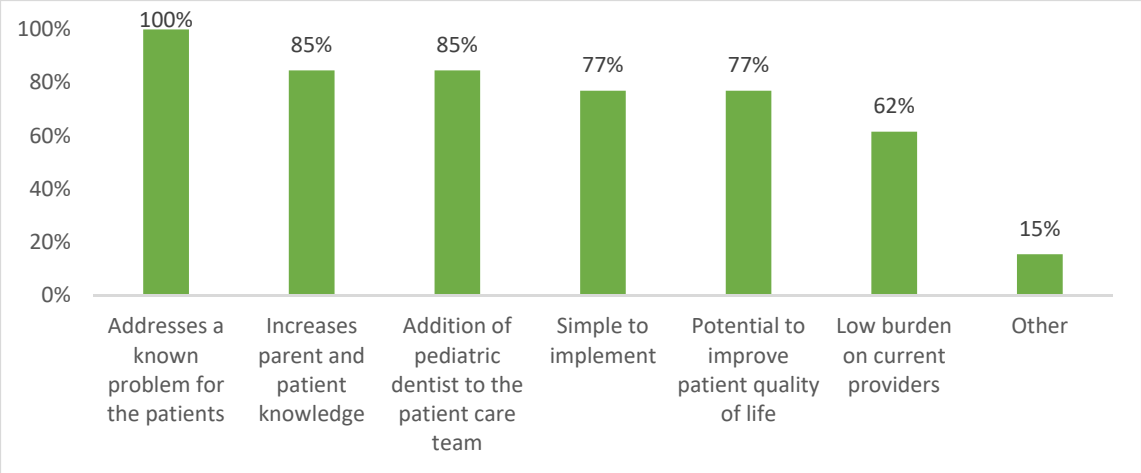
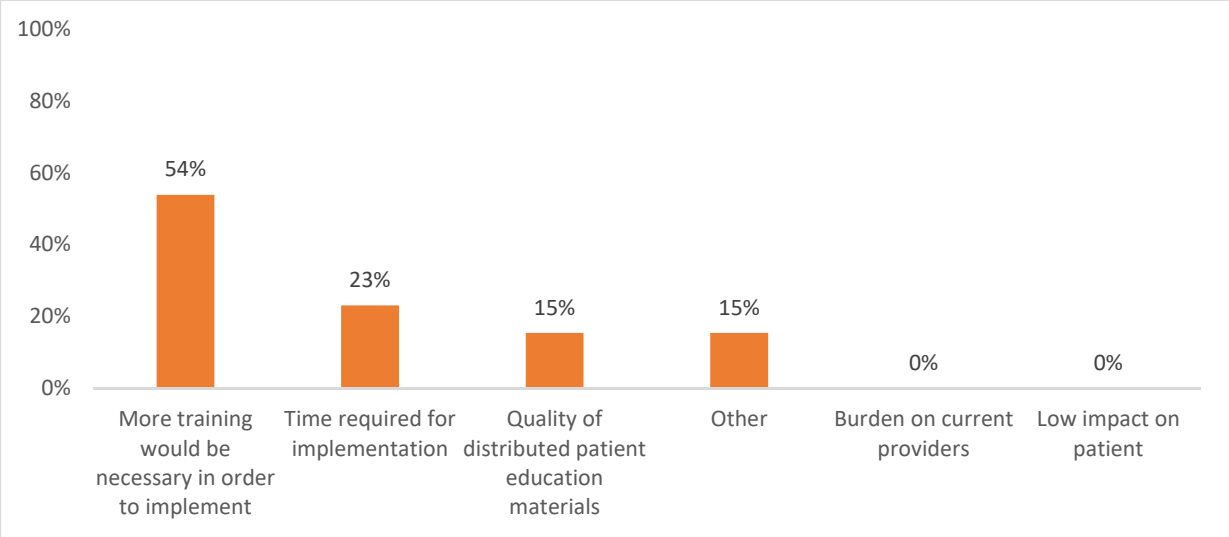



**Figure 2**.Weaknesses of Proposed Protocol as Indicated by Respondents



# Appendix

# CARIES CHARTING

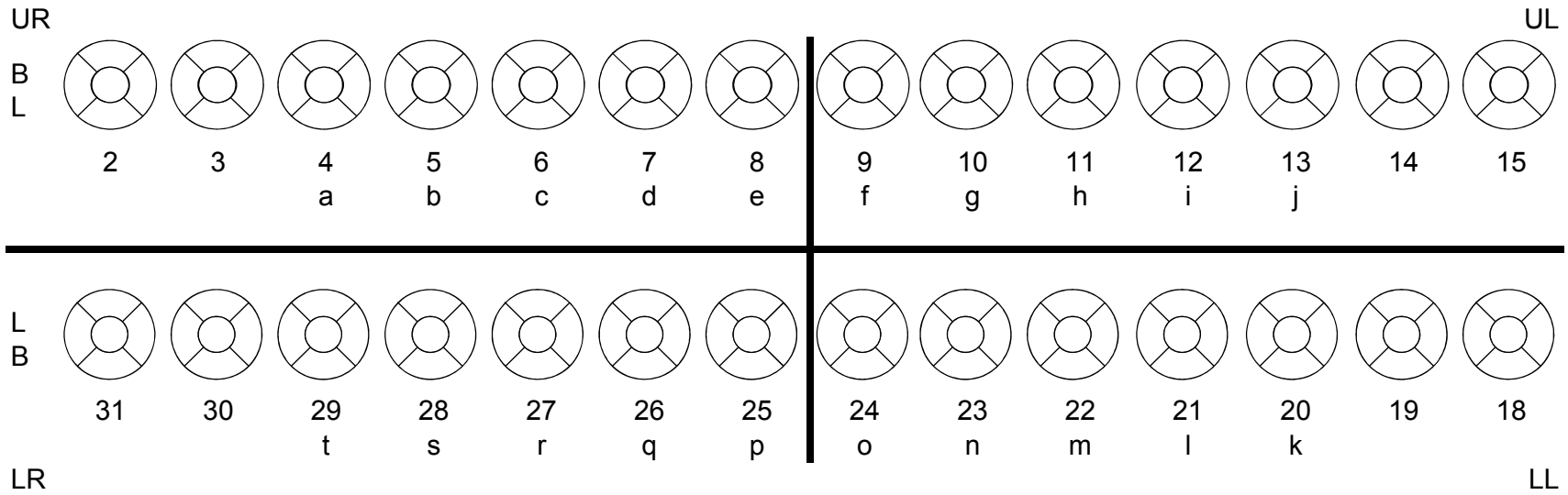
SUBJECT NUMBER _____ _____ _____

SUBJECT INITIALS _____ _____ _____

DATE OF VISIT _____/ _____/_____

Completed by: _____

VISIT NUMBER:_____




Examiner Signature: _____ Date: _____

Surface Condition
0 not restored or sealed
1 sealant (partial)
2 sealant (full)
3 tooth colored restoration
4 amalgam
5 stainless steel crown
7 lost or broken restoration
8 temporary restoration

Caries Code
0 sound enamel
A visual changes in enamel
B moderate decay
C extensive decay

Activity
+ active lesion
- arrested lesion

Missing Codes
97 tooth missing due to caries
98 tooth missing for other reasons
99 tooth unerupted

CHILDREN'S HOSPITAL OF RICHMOND AT VCU
VCU VIRGINIA COMMONWEALTH UNIVERSITY

# Pediatric Hematology Oncology Questionnaire

Please complete the survey below.

Thank you!

It is feasible to incorporate this protocol into patient care.

◯ Strongly Agree
◯ Agree
◯ Neutral
◯ Disagree
◯ Strongly Disagree

It is important to address oral health during oncology treatment.

◯ Strongly Agree
◯ Agree
◯ Neutral
◯ Disagree
◯ Strongly Disagree

Implementing this protocol would be a valuable addition to our patients' care.

◯ Strongly Agree
◯ Agree
◯ Neutral
◯ Disagree
◯ Strongly Disagree

Please select any of the following that you feel are strengths of this proposed protocol (Check all that apply).

☐ Addresses a known problem for the patients
☐ Simple to implement
☐ Potential to improve patient quality of life
☐ Increases parent and patient knowledge
☐ Addition of pediatric dentist to the patient care team
☐ Low burden on current providers
☐ Other

Please specify any other strengths or suggestions:

_____

Please select any of the following that you feel are areas for improvement with the proposed protocol (Check all that apply).

☐ Burden on current providers
☐ Time required for implementation
☐ Low impact on patient
☐ Quality of distributed patient education materials
☐ More training would be necessary in order to implement
☐ Other

Please specify any other areas for improvement or suggestions:

_____