

Dental Needs of Oncology Inpatients at Seattle Children's Hospital

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Abstract

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Background: Over 15,000 children and adolescents are diagnosed with cancer annually in the US. Guidelines suggest a dental examination be completed prior to starting cancer-directed therapies, but there is little data on the dental needs of these patients at the time of diagnosis.

Purpose: To analyze and describe the characteristics and dental needs of newly diagnosed pediatric oncology patients in an academic, tertiary care center, based on their inpatient baseline evaluations.

Study design: This study included all newly diagnosed patients with cancer for whom an inpatient consultation for baseline dental evaluation was requested from January 1, 2013 to December 31, 2016, with follow-up care not extending past December 31, 2017. Demographics, oncology diagnosis, medical comorbidities, timing of consultation, dental findings, and treatment recommended/rendered were recorded.

Results: Amongst 861 inpatient dental consults, 296 (35%) were for newly diagnosed cancer patients. Seventy-nine percent of patients received a baseline exam prior to starting oncology therapy ($p < 0.01$). Patients who had not seen a dentist within twelve months prior to consult had increased odds of immediate dental needs, OR 3.75 (95% CI 1.43, 9.84). Fixed orthodontic appliances (braces) were significantly indicative of immediate dental needs, OR 22.8 (95% CI 7.66, 67.9).

Conclusions: Most children with a new diagnosis of cancer for whom an inpatient dental consultation was ordered, received a baseline dental examination prior to starting oncological therapy. Fixed orthodontic appliances required the most immediate dental treatment. Treatment other than removal of orthodontic appliances was equally provided in the operating room and the clinic.

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DEDICATION

I would like to dedicate this project, first and foremost, to the patients and families battling cancer. It is my hope that this project can lead to continued changes to ease your pain and difficulties through this terrible time. I would like to dedicate this to my fellow residents, for making the last two years some of the best of my life – without you all, this program would have been totally different, and I cannot imagine going through this without “y’all.” To my friends, for always being there for me and willing to talk on the phone at ridiculous hours, even across the country. You have been with me through this journey for the last 10 years and have helped define who I am today. Lastly, to my family (Mom, Dad, Nana, Pa, & Colby), for always being my support during the good and bad times, for always believing in me, and for always pushing me to be better and do better. Without you, I would not be where or who I am today, and for that, I am forever grateful.

Introduction

Children and cancer

In the United States, 15,780 children and adolescents are diagnosed with cancer each year (Ward, 2014). The diagnoses most frequently seen are leukemia, brain and other central nervous system tumors, germ cell tumors, lymphoma, soft tissue sarcomas, and bone tumors (Noone, 2018). At Seattle Children's Hospital (SCH), from 2010-2014, approximately 256 new patients were diagnosed each year (Seattle Children's Hospital, 2016).

Dental caries in childhood

Caries is the most common disease of childhood, with 78% of children under the age of 17 having caries experience (National Institute of Health, 2003). When left untreated, caries can progress into the dental pulp, resulting in pain and localized or systemic infection. A dental home is the ongoing relationship between a patient and the dentist, where the patient receives preventive care at regular intervals and receives dental treatment as needed. It has been shown that having a dental home lowers the risk for and amount of unmet dental treatment needs (Kierce, 2016), and can minimize the need for and cost of invasive dental treatment (Savage, 2004).

Dentist role in cancer therapy

Dentists are one of many specialists who may be requested to evaluate a patient newly diagnosed with cancer. The National Institute of Dental and Craniofacial Research (NIDCR, 2009), American Academy of Pediatric Dentistry (AAPD) (AAPD Guideline on Dental Management of Pediatric Patients Receiving Chemotherapy, Hematopoietic Cell Transplantation, and/or Radiation Therapy, 2017/2018), and American Society of Clinical Oncologists (ASCO, 2017) recommend that a dental examination be completed prior to starting

cancer therapy. The oral cavity is highly susceptible to the effects of chemotherapy and radiation and is one of the most frequently documented sources of sepsis (AAPD Guideline on Dental Management of Pediatric Patients Receiving Chemotherapy, Hematopoietic Cell Transplantation, and/or Radiation Therapy, 2017/2018). Children are at a higher risk of oral sequelae compared to adults (Lockhart, 2009), with complications ranging from pain and discomfort to infection and septicemia (daFonseca, 2011). Although the AAPD has clinical practice guidelines to aid in helping the pediatric dentist succeed in keeping these patients free from infections during cancer therapy, patient complications still arise. Hong et al., found a 5.8% prevalence of dental infections and abscesses during therapy (Hong, 2010).

Inpatient Dental Consultations for Hematology/Oncology

The Seattle Children's Hospital (SCH) dental team performs inpatient consultations for a variety of reasons. Oncology is the inpatient service most frequently requesting dental consultations at SCH (Kanuga, 2012; Perry, 2015). Consultations may be requested at any point and during all stages of cancer treatment: newly diagnosed, waiting to begin treatment, mid-treatment, and post-treatment. The SCH consulting dentists follow a standardized protocol (Figure 1), which includes medical and dental history, home care practices, diet, fluoride exposure, caries history, clinical examination findings, and radiographic examination as indicated. Following the consultation, a report is given to the oncology team including oral health status, dental treatment needs, urgency of treatment needs, and other recommendations as indicated for the patient.

Studies outside of the United States have focused on identifying pre-therapy diagnoses and describing dental findings of adults and children (Elad, 2003) or used adult data to drive the decision analysis (Elad, 2008). One study in Brazil described the dental needs of cancer patients

at a Hematology/Oncology dental clinic at a teaching hospital (Carrillo, 2010). No studies were identified that focus specifically on the dental needs of pediatric patients with cancer in the US.

Study Purpose

The purpose of this retrospective study was to describe the dental status of pediatric hematologic and oncologic patients with their first cancer diagnosis. The goals were to characterize patients at greater risk of having immediate dental needs; to categorize the dental treatment needs and document treatment recommended and/or performed; and to develop a risk assessment tool to aid the oncology team in identifying patients at highest risk of having unmet dental needs when starting cancer therapy.

We hypothesized that: 1) 50% of baseline consultations would occur before the start of cancer-based therapy, 2) patients with an established dental home, seen within 12 months of consult date, would have a fewer immediate dental needs than those who had not, 3) those with fixed orthodontic appliances would have the highest frequency of immediate dental treatment needs, and 4) patients with consultations completed after beginning cancer therapy would most often have dental treatment provided under a single general anesthetic.

Methods

Study Population

This retrospective cross-sectional study consisted of data obtained from initial baseline dental consultations for oncology inpatients performed at Seattle Children's Hospital from January 1, 2013 through December 31, 2016, with subsequent dental treatment rendered or recommended no later than one year following consult. Consults not requested by the oncology service were excluded. Patients were excluded from the study if it was not their first ever cancer diagnosis, or if the consultation was requested for reasons other than baseline dental examination. The SCH Institutional Review Board (IRB), Study #00000771, approved this study.

Variables

Demographic variables: Demographic data for all subjects was obtained from medical records in EPIC™ and/or CIS© (Clinical Information System). Demographic variables collected were age (years), gender, residency (in-state or out-of-state), and insurance status (private, public or none).

Medical Variables: Medical data was collected from CIS©. Variables collected included primary oncology diagnosis, medical co-morbidities, date of dental consultation, and the start date of cancer therapy.

Dental Variables: The dental examination data was obtained from the dental consultation note in the electronic health record. Variables collected in the consults included presence of dental home, most recent appointment (0-6 months, 6-12 months, greater than 12 months, never), cariogenic diet, history of caries, history of dental trauma, caries present on examination, radiographs taken, consult date (listed as either before or after the start of cancer-directed treatment), dental treatment indicated, and treatment location (clinic, operating room, dental home, recall at SCH, recall at dental home, or missing). All variables were recorded as *yes, no,*

and/or *not recorded* unless otherwise specified. Data was compared across age (Tables 3). Patients receiving the dental consultation and the start of cancer therapy on the same day were categorized as receiving the exam prior to start of therapy. Orthodontic data recorded included presence of appliances (none, fixed, removable/space maintainer, or not recorded) and type of appliance (braces, retainer/space maintainer, palate expander, or other).

Data Analysis

Descriptive statistics, including counts, mean, median, standard deviation and percentages were calculated for all demographic information. Counts and percentages were calculated for all medical diagnostic information. Dental variables were analyzed by age. Categorical data was compared with categorical age using Fisher's Exact tests. Interrater testing was completed after 13 samples collected, revealing a Cohen's kappa score of 0.7956. One-sample T-test were used to evaluate consult date and start of cancer-directed therapy, as well as location of treatment when consult date is after the start of therapy. Odds ratios were calculated when comparing dental home to dental needs identified and frequency of treatment for those with orthodontic appliances. Data was recorded into RedCap (Harris, 2009) and analyzed using R-project. The level of statistical significance was set at $p \leq 0.05$.

Results

Seattle Children's Hospital (SCH) is a large, academic tertiary care center with 403 pediatric beds, serving Washington, Wyoming, Alaska, Montana, and Idaho. Between January 1, 2013 and December 31, 2016, 861 patients at our institution received an inpatient dental consultation. Of those, 504 were requested by the Oncology or Bone Marrow Transplant teams; 296 patients met the inclusion criteria for this study (Figure 2). The mean age for subjects was 9.9 years old, 53% were males, and 92% were in-state residents. All patients had insurance coverage, with 164 private (55%) and 132 public (45%) (Table 1). Prior to diagnosis, 232 patients (78%) had no other medical diagnosis. Trisomy 21(3%) and other genetic conditions (3%) were the among the most frequent co-occurring medical conditions (Table 2A). Acute lymphoblastic leukemia (ALL) was the most prevalent oncology diagnosis (46%), followed by bone tumors (17%), lymphomas (11%) and acute myeloid leukemia (6%). (Table 2B; Figure 3).

When comparing dental findings by age, the variables of dental home, date of last appointment, diet, history of caries, radiographs completed, treatment indicated, and treatment location all were statistically significant with $p \leq 0.05$ (Table 3). Eighty-two percent of subjects ($n= 243$) had an established dental home, with 48% ($n= 141$) seeing their dentist within the six months prior to their oncology diagnosis. Forty-eight percent of patients had a self-reported or parent reported cariogenic diet. Prevalence of caries increased with age, and 41% ($n= 120$) had a history of caries or fillings. Among the 85 patients indicated for treatment, 62% ($n= 55$) were planned to or received treatment in the dental clinic.

Eighty-seven percent of patients had no orthodontic appliances, 12% had fixed or removable appliances (Table 4A). Retainers and space maintainers were the most prevalent appliances in the adolescent (12-17 year) and young adult (18+ year) groups. Braces were almost

exclusively found in the adolescents. No child under the age of 6 years had any orthodontic appliance (Table 4B & 4C).

We found that 79% of patients (95% CI 74%, 84%; $p < 0.01$) received their dental consultation prior to initiation of cancer therapy. The mean age of patients seen for consultation prior to cancer therapy initiation was 13.10 years (± 6.54), and the mean age of patients whose consultation occurred after the start of cancer therapy was 9.07 years (± 6.33) (Table 5). The majority of patients reported seeing a dentist within a year prior to their cancer diagnosis (82%). Subjects who had not seen a dentist within a year, or ever, were 3.75 times more likely to have urgent dental needs (95% CI 1.43, 9.84; $p = 0.01$) (Table 6).

Patients with fixed orthodontic appliances had a 22.8 times increased odds of immediate dental treatment needs compared to patients without orthodontic appliances (95% CI 7.66, 67.9; $p < 0.01$) (Table 7). Sixty-two percent of patients who were receiving cancer therapy had treatment completed in the dental clinic, however this was not significant ($p = 0.07$). After excluding treatment related to orthodontic appliances, 46% of patients received treatment in the dental clinic, ($p = 0.65$) (Tables 8A & 8B).

Discussion

This study describes the characteristics and dental treatment needs for a group of children, adolescents, and young adults with their first cancer diagnoses, based upon their inpatient medical and dental evaluations. Amongst inpatient consults for baseline evaluations, approximately 80% of the patients received their consult as recommended prior to initiation of cancer directed therapy, while 20% did not. While the differences between the groups of 1) patients receiving dental consult prior to starting therapy, 2) patients receiving the dental consult after the start of therapy, and 3) patient for whom no consultation was requested are not clear, potential explanations include patients who presented with life-threatening conditions that required immediate treatment, or patients for whom dental evaluation was not prioritized by the oncology team. We believe that the no baseline dental examination requested patient group includes patients whose planned cancer therapy posed low immediate risk for neutropenia, patients without active dental complaints or concerns, and those without fixed orthodontic appliances such as braces. SCH is a large tertiary care facility where a dental consultation service is readily available; patients in hospitals that lack consulting dentists would be challenged to coordinate a dental evaluation in a timely way amid starting oncology treatment.

Orthodontic appliances are a significant comorbidity during cancer therapy (Sheller, 1996). Per the AAPD Guidelines, due to the potential complications associated with appliances, it has been recommended that most potentially irritating appliances or for patients with moderate-to-severe risks of mucositis have their appliances removed. Our results were consistent with these recommendations. Patients presenting with fixed appliances had 23 times increased odds of requiring immediate dental treatment.

It was hypothesized that dental treatment would be completed most often under general

anesthesia (GA) in the operating room (OR) for patients who had started oncology treatment; this was not the case. Overall, more patients were treated in the clinic than in the OR. Orthodontic appliance removal was done in the clinic and a slight majority of patients requiring restorations and/or extractions received treatment in the OR. This highlights the need for hospital access for dentists who will be providing treatment for oncology patients.

When children and adolescents with cancer have acute and/or extensive dental treatment needs, the option for performing dental treatment under GA should be available. This must be done when the patient is healthy enough to proceed with surgery. For some patients, this may not occur for weeks or months following the initial dental consultation. When dental treatment is not emergent, dentists can employ palliative care. After the patient becomes immunosuppressed, routine dental treatment options become more limited. The patient will cycle through periods where they are able or unable to withstand the insult to body presented by invasive dental treatment (AAPD Guideline on Dental Management of Pediatric Patients Receiving Chemotherapy, Hematopoietic Cell Transplantation, and/or Radiation Therapy, 2017/2018). Some patients are never well enough to have dental treatment completed during their course of cancer-related treatment and palliative dental treatment options are indicated.

Silver diamine fluoride (SDF) is approved by the FDA for the treatment of tooth hypersensitivity, but it can also play a role in arresting caries. (AAPD Policy on the Use of Silver Diamine Fluoride for Pediatric Dental Patients, 2017/2018). For patients with dental caries diagnosed during a consultation and unable to have definitive dental care, SDF may be an adjunctive treatment modality until definitive treatment can be safely rendered. More research is needed on SDF in practice-based efforts, including the oncology population. Together with other forms of medical, non-invasive caries management, SDF may be a safe option for this population

of patients.

Our study has highlighted and quantified the dental needs of newly diagnosed pediatric oncology inpatients in a tertiary care hospital in the Pacific Northwest. We believe that we have identified high-risk characteristics that are indicative of having urgent dental needs that should, when possible, be evaluated prior to starting chemotherapy or radiotherapy. Based on this study, we propose the “Dental Risk Assessment Questionnaire for Patients Beginning Cancer Therapy” which may allow practitioners to rapidly assess the possible dental needs of oncology inpatients. (Figure 4) Having a dental home and visiting the dentist within the last year were significant indicators for low caries risk in our subjects. In contrast, a history of caries and consuming a cariogenic diet were significant risk factors that increased the likelihood of caries. Another question on the risk assessment tool indicates if the planned cancer-directed therapy poses a greatest risk of oral soft tissue complications. The goal is that this questionnaire can be tested and verified as a reliable tool for pre-screening patients dental needs prior to the start of cancer-directed therapy.

A limitation of this study is that not all oncology patients at SCH receive a baseline dental evaluation at the time of diagnosis. Some diagnoses do not require inpatient therapy, and/or may be treated with less intensive chemotherapy regimens and the patients have lower risk for mucositis and neutropenia, significant risk factors for infection. For these patients, attention to dental needs and removal of dental appliances is less urgent. Other patients may have received assessment and treatment by their primary dentists.

Conclusion

The majority of child and adolescent patients receiving a dental consultation prior to the start of cancer therapy did not have unmet dental treatment needs. Patients without a dental home or with fixed orthodontic appliances were most likely to have immediate dental needs. When those needs are identified, timely treatment is essential to the well-being and health of the patient. The proposed “Dental Risk Assessment Questionnaire for Patients Beginning Cancer Therapy” is a 9-question survey developed to help coordinate multidisciplinary care in the pediatric and young adult cancer populations. We intend to test the validity of this tool as a reliable instrument for identifying dental treatment needs in patients with a new diagnosis of cancer.

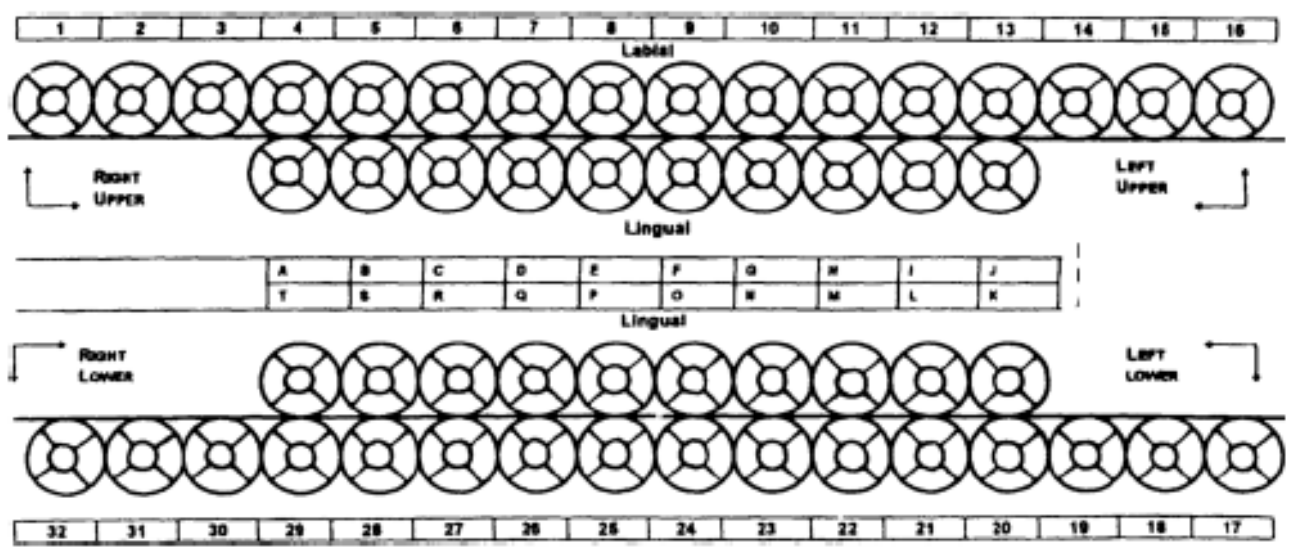
Figure 1.

Dental consultation template used at Seattle Children's Hospital

DENTAL INPATIENT CONSULTATION									
PATIENT NAME: _____									
MRN: _____		DATE OF BIRTH: _____			ROOM # _____				
ADMISSION DATE: _____				CONSULT DATE: _____					
MEDICAL DIAGNOSIS: _____									
REQUESTING SERVICE: SCCA ICU Heme-Onc Rehab Other: _____									
Attending requesting: _____									
REASON FOR CONSULT: Baseline exam Other (specify): _____									
NAME /RELATIONSHIP OF HISTORIAN: _____ Mother Father Sibling Other: _____									
DENTAL HISTORY									
DENTAL HOME: YES NO		Dentist name/city: _____			Month/year of last appt: _____				
HX CARIES: YES NO					Reason: Exam x-rays Cleaning Operative Extraction Orthodontic				
DIET: SWEET DRINKS /DAY: 0 1 2 3+ SNACKS /DAY: 0 1 2 3+ SNACK TYPE: CRACKERS CHIPS COOKIES FRUIT									
ORAL HYGIENE: BRUSHING/DAY: 0 1 2 2+ FLOSS: YES NO RINSE YES NO									
FLUORIDE USE: TOOTHPASTE SYSTEMIC SUPPLEMENT RINSE GEL									
ORAL HABITS: DIGIT PACIFIER BRUXISM LIP BITING OR CHEWING									
HX TRAUMA: Yes <input type="checkbox"/> No <input type="checkbox"/> SCARS Yes <input type="checkbox"/> No <input type="checkbox"/> Location of scars: R L Chin Lip Cheek Forehead									
Comments: _____									
TMJ: PAIN Yes <input type="checkbox"/> No <input type="checkbox"/> R L LIMITED OPENING No <input type="checkbox"/> Yes <input type="checkbox"/> if yes maximum opening _____ mm									
DENTAL EXAMINATION									
SOFT TISSUE EXAMINATION (Circle appropriate response) -- (Describe "other" in dictated note)									
TONGUE:	NORMAL	GEOGRAPHIC	LACERATION	OTHER					
FLOOR OF MOUTH:	NORMAL	OTHER							
PALATE:	NORMAL	NARROW	WIDE						
BUCCAL MUCOSA:	NORMAL	APHTHOUS ULCERS	INFLAMMATION	OTHER					
GINGIVA:	NORMAL	INFLAMMATION	BLEEDING	RECESSION	HYPERPLASTIC OTHER				
FRENUM:	NORMAL	MX CRESTAL	MN CRESTAL						
ORAL HYGIENE	POOR	AVERAGE	GOOD	STAIN	Yes <input type="checkbox"/>	No <input type="checkbox"/>	CALCULUS	Yes <input type="checkbox"/>	No <input type="checkbox"/>

(cont.)

DENTITION: PRIMARY MIXED PERM
ARCH LENGTH (MAX): OK SPACING CROWDING ANT POST MILD MOD SEVERE
ARCH LENGTH (MAN): OK SPACING CROWDING ANT POST MILD MOD SEVERE
FIXED ORTHODONTIC APPLIANCE MX MN BRACES SPACE MAINTAINER
REMOVABLE ORTHODONTIC APPLIANCE: MX MN RETAINER OTHER _____



TEETH: HYPOCALCIFIED FLOUROISIS

BEHAVIOR ++ + - -- *Comments:* _____

RADIOGRAPHIC: Panorex PA 2 BW 4 BW **FINDINGS:** Caries OTHER: _____

PHOTOGRAPHS: _____

DENTAL DIAGNOSIS AND PLAN:

TREATMENT: EXAM in pt room Exam in clinic **DISPENSED:** BRUSH FLOSS BIOTENE PACK

Caries Risk: HIGH MODERATE LOW

DISCUSSED OHI DIET MUCOSITIS PREVENTION BRUXING OTHER: _____

FOLLOW-UP PLANS: HOME DENTIST-recall TX UNDER GA TX AT SCH CLINIC TX WITH HOME DENTIST-oper

ORTHO APPLIANCE REMOVAL MOUTHGUARD OTHER: _____

ATTENDING: _____ **RESIDENTS:** _____

Figure 2.

Flow chart of dental consultations reviewed for inclusion in this study

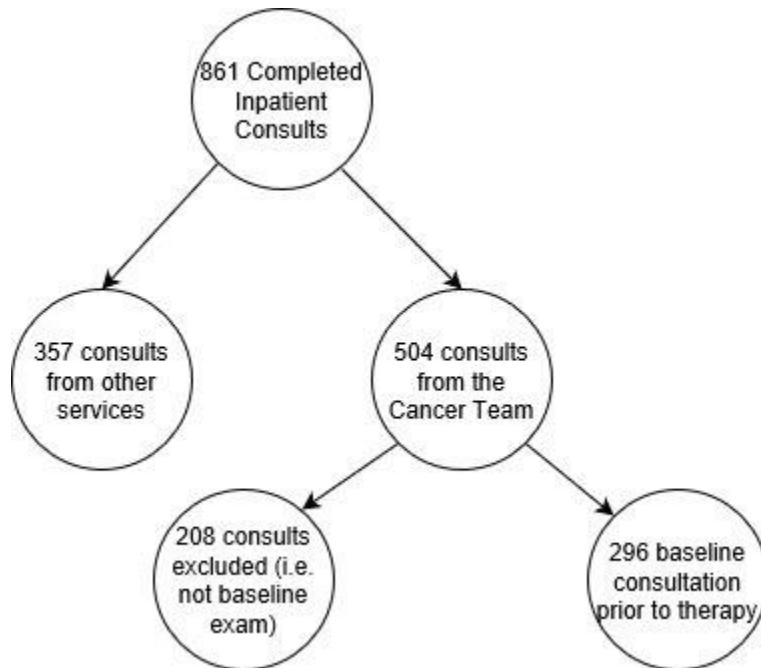


Figure 3.

Oncology diagnoses amongst inpatient consultations for baseline dental evaluations

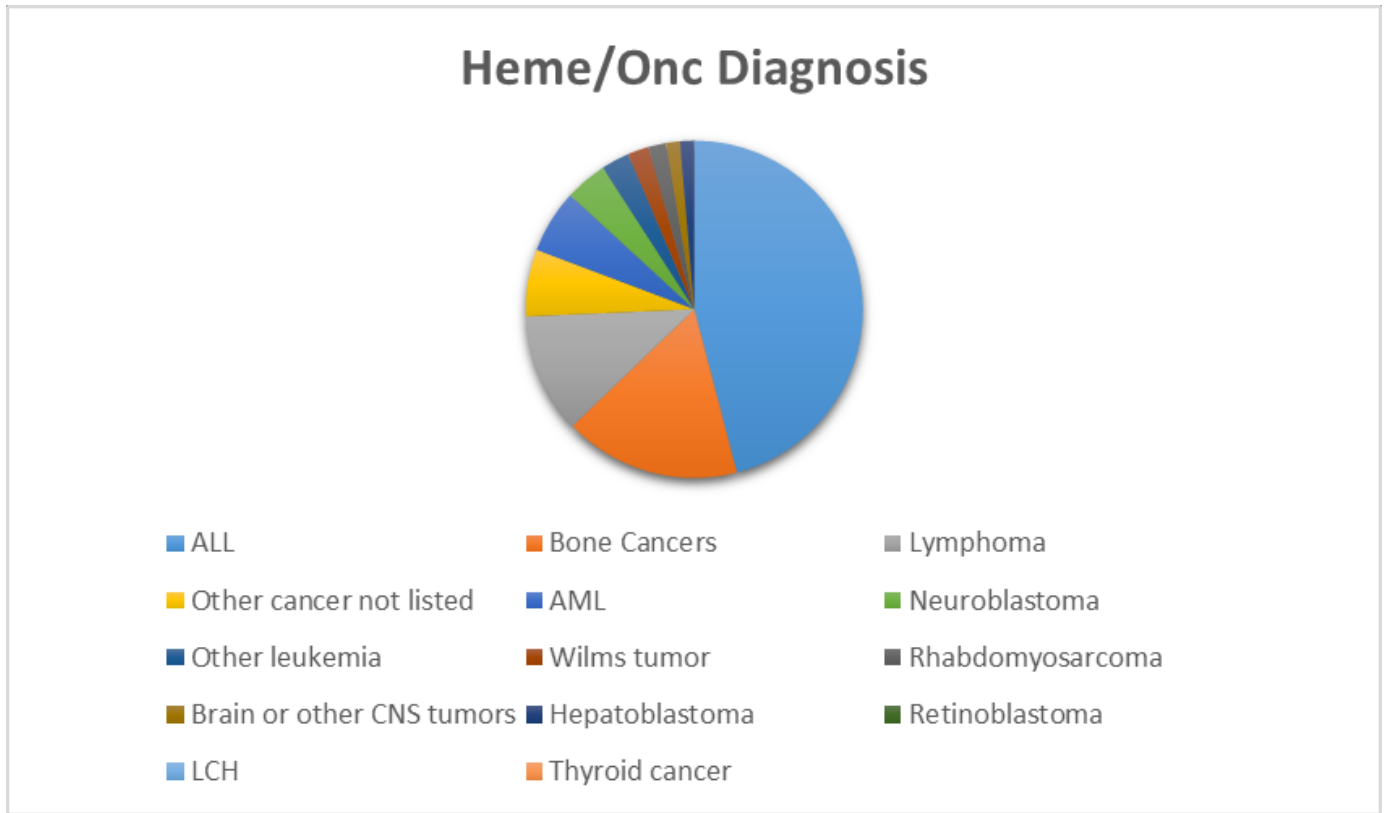


Figure 4.

Proposed Dental Risk Assessment Questionnaire for Patients Beginning Cancer Therapy.

Question	Answer	Score
<i>To be answered by the patient or parent:</i>		
Has your child ever seen a dentist before?*	Yes	1
	No	0
Has your child seen the dentist within the last year?*	Yes	1
	No	0
Has your child ever had dental x-rays taken?	Yes	1
	No	0
Does your child have more than 1 sweet drink a day?	Yes	0
	No	1
Has your child ever had a cavity?	Yes	0
	No	1
Does your child have a cavity that needs filled?*	Yes	0
	No	1
Does your child have a toothache?	Yes	0
	No	1
Does your child currently have braces or a retainer cemented in their mouth?*	Yes	0
	No	1
<i>To be answered by the physician:</i>		
Is this child at a greater risk for mucositis due to treatment?*	Yes	0
	No	1
Total		9[!]

[!] A score of 5 or more is an indication that therapy could begin with minimal concern for unmet dental treatment needs.

* Warrants urgent consult.

Table 1.

Demographic information for newly diagnosed pediatric oncology patients who received an inpatient baseline dental evaluation at Seattle Children's Hospital from Jan. 1, 2013 to Dec. 31, 2016.

		N (%)
<u>Age</u>	Mean (standard deviation)	9.91 (6.57)
	Median (interquartile)	8.88 (3.97, 14.95)
	0-5 years	113 (38%)
	6-11 years	58 (20%)
	12-17 years	95 (32%)
	18+ years	30 (10%)
		
<u>Gender</u>	Male	157 (53%)
	Female	139 (47%)
		
<u>Residency</u>	In-state	272 (92%)
	Out of state	24 (8%)
		
<u>Insurance Status</u>	Private	164 (55%)
	Public/Medicaid	132 (45%)
	None	0 (0%)

Table 2.

A. Medical Comorbidities for newly diagnosed pediatric oncology patients who received an inpatient baseline dental evaluation at Seattle Children's Hospital from Jan. 1, 2013 to Dec. 31, 2016.

	Total
None	232 (78%)
Other	40 (14%)
Asthma	14 (5%)
ADHD	9 (3%)
Trisomy 21	7 (2%)
Autism Spectrum Disorder	6 (2%)
Other genetic abnormality/syndrome	3 (1%)
Seizure disorder	1 (0.3%)
History of organ transplant	1 (0.3%)

B. Hematologic/Oncologic diagnosis for newly diagnosed pediatric oncology patients who received an inpatient baseline dental evaluation at Seattle Children's Hospital from Jan. 1, 2013 to Dec. 31, 2016.

	<i>Age</i>					<i>Gender</i>	
	TOTAL	0-5 years	6-11 years	12-17 years	18+ years	Male	Female
<i>Oncology Diagnosis</i>	N (%)						
ALL	136 (46%)	68	32	24	12	74 (47%)	62 (45%)
Bone Cancers	50 (17%)	2	9	27	12	31 (20%)	19 (14%)
Lymphoma	34 (11%)	6	8	16	4	17 (11%)	17 (12%)
Other cancer not listed	19 (6%)	9	1	9	0	8 (5%)	11 (8%)
AML	18 (6%)	5	4	8	1	7 (4%)	11 (8%)
Neuroblastoma	12 (4%)	10	0	2	0	4 (3%)	8 (6%)
Other leukemia	8 (3%)	3	0	5	0	4 (3%)	4 (3%)
Wilms tumor	6 (2%)	3	2	1	0	2 (1%)	4 (3%)
Rhabdomyosarcoma	5 (2%)	1	1	2	1	5 (3%)	0 (0%)
Brain or other CNS tumors	4 (1%)	3	0	1	0	2 (1%)	2 (1%)
Hepatoblastoma	4 (1%)	3	1	0	0	3 (2%)	1 (1%)
TOTAL	296 (100%)	113 (38%)	58 (20%)	95 (32%)	30 (10%)	157 (53%)	139 (47%)

Table 3.

Dental variables by age for newly diagnosed pediatric oncology patients who received an inpatient baseline dental evaluation at Seattle Children's Hospital from Jan. 1, 2013 to Dec. 31, 2016.

	<i>Age (years)</i>					p-value
	TOTAL	0-5	6-11	12-17	18+	
<i>N (%)</i>	296 (100%)	113 (38%)	58 (20%)	95 (32%)	30 (10%)	
<i>Dental Home</i>						<0.01
Yes	243 (82%)	73 (65%)	56 (97%)	92 (97%)	22 (73%)	
No	46 (16%)	35 (31%)	2 (3%)	3 (3%)	6 (20%)	
Not recorded	7 (2%)	5 (4%)	0 (0%)	0 (0%)	2 (7%)	
<i>Last appointment</i>						<0.01
0-6 months	141 (48%)	41 (36%)	31 (53%)	64 (67%)	5 (17%)	
6-12 months	50 (17%)	13 (12%)	14 (24%)	14 (15%)	9 (30%)	
12+ months	26 (9%)	6 (5%)	2 (3%)	7 (7%)	11 (37%)	
Never	35 (12%)	33 (29%)	2 (3%)	0 (0%)	0 (0%)	
Not recorded	44 (15%)	20 (18%)	9 (16%)	10 (11%)	5 (17%)	
<i>Cariogenic diet</i>						0.01
Yes	141 (48%)	66 (58%)	22 (38%)	47 (50%)	6 (20%)	
No	95 (32%)	29 (26%)	22 (38%)	32 (34%)	12 (40%)	
Not recorded	60 (20%)	18 (16%)	14 (24%)	16 (17%)	12 (40%)	

<i>History of caries</i>						<0.01
Yes	120 (41%)	19 (17%)	30 (52%)	52 (55%)	19 (63%)	
No	112 (38%)	55 (49%)	22 (38%)	30 (32%)	5 (17%)	
Not recorded	64 (22%)	39 (35%)	6 (10%)	13 (14%)	6 (20%)	
History of Dental trauma						
<i>History of Dental trauma</i>						0.2
Yes	37 (13%)	15 (13%)	11 (19%)	6 (6%)	5 (17%)	
No	192 (65%)	74 (66%)	33 (57%)	69 (73%)	16 (53%)	
Not recorded	67 (23%)	24 (21%)	14 (24%)	20 (21%)	9 (30%)	
Caries present						
<i>Caries present</i>						0.3
Yes	54 (18%)	19 (17%)	10 (17%)	15 (16%)	10 (33%)	
No	236 (80%)	92 (81%)	46 (79%)	79 (83%)	19 (63%)	
Not recorded	6 (2%)	2 (2%)	2 (3%)	1 (1%)	1 (3%)	
Radiographs taken						
<i>Radiographs taken</i>						<0.01
Yes	62 (21%)	7 (6%)	14 (24%)	23 (24%)	18 (60%)	
No	234 (79%)	106 (94%)	44 (76%)	72 (76%)	12 (40%)	
Oncology treatment Start						
<i>Oncology treatment Start</i>						<0.01
Before consult	62 (21%)	9 (8%)	15 (26%)	26 (27%)	12 (40%)	
After consult	234 (79%)	104 (92%)	43 (74%)	69 (73%)	18 (60%)	

<i>Dental treatment Indicated</i>						<0.01
Yes	85 (29%)	20 (18%)	14 (24%)	34 (36%)	17 (57%)	
No	211 (71%)	93 (82%)	44 (76%)	61 (64%)	13 (43%)	
<i>Treatment Location</i>						<0.01
Clinic	55 (19%)	1 (1%)	9 (16%)	30 (32%)	15 (50%)	
OR	24 (8%)	15 (13%)	5 (9%)	2 (2%)	2 (7%)	
Dental Home	4 (1%)	2 (2%)	0 (0%)	2 (2%)	0 (0%)	
Recall SCH	1 (0.3%)	1 (1%)	0 (0%)	0 (0%)	0 (0%)	
Recall Dental Home	1 (0.3%)	0 (0%)	1 (2%)	0 (0%)	0 (0%)	
Missing	211 (71%)	94 (83%)	43 (74%)	61 (64%)	13 (43%)	

Table 4

A. Presence of orthodontic appliances found in newly diagnosed pediatric oncology patients who received an inpatient baseline dental evaluation at Seattle Children's Hospital from Jan. 1, 2013 to Dec. 31, 2016.

Orthodontic appliances				
	None	Fixed	Removable/Space Maintainers	Missing
N (%)	258 (87%)	30 (10%)	7 (2%)	1 (0.3%)

B. Types of orthodontic appliances found in newly diagnosed pediatric oncology patients who received an inpatient baseline dental evaluation at Seattle Children's Hospital from Jan. 1, 2013 to Dec. 31, 2016.

Types of orthodontic appliance				
	Braces	Retainer/Space maintainer	Palate Expander	Other
N%	13 (35%)	22 (59%)	1 (3%)	1 (3%)

C. Types of orthodontic appliances, across ages of those newly diagnosed pediatric oncology patients who received an inpatient baseline dental evaluation at Seattle Children's Hospital from Jan. 1, 2013 to Dec. 31, 2016.

Types of orthodontic appliances, row percentages sum to 100%					
	Total	Age			
		0-5 years	6-11 years	12-18 years	18+ years
Braces	13 (35%)	0	0	12	1
Retainer/Space maintainer	22 (59%)	0	2	12	8
Palate expander	1 (3%)	0	1	0	0
Other	1 (3%)	0	0	1	0
TOTAL	37 (100%)	0 (0%)	3 (8%)	25 (68%)	9 (24%)

Table 5.

Timing of dental consultation and start date of cancer therapy for newly diagnosed pediatric oncology patients who received an inpatient baseline dental evaluation at Seattle Children's Hospital from Jan. 1, 2013 to Dec. 31, 2016.

<i>Oncology treatment Start</i>	Age Mean (SD)	Age Median (IQR)	N (%)	One-sample T-test Confidence Interval for After consult Percentage	One-sample T-test p-value
Before consult	13.10 (±6.54)	13.83 (8.83, 16.97)	62 (21%)	(74%, 84%)	<0.01
After consult	9.07 (±6.33)	7.34 (3.76, 14.07)	234 (79%)		

Table 6.

Odds of immediate dental needs between those who saw the dentist within 12 months of consult, versus those who have not for newly diagnosed pediatric oncology patients who received an inpatient baseline dental evaluation at Seattle Children's Hospital from Jan. 1, 2013 to Dec. 31, 2016.

		Last visit		
		W/in 12 months	Outside 12 months	Not Recorded
Dental Home	Yes	190	19	34
	No	1	42	3
	Not Recorded	0	0	7

		Treatment Indicated		Unadjusted Odds Ratio	Robust CI	p-value
		Yes	No			
Yes, Dental Home	Yes	51	139	3.75	(1.43, 9.84)	0.01
	No	11	8			
	Not Recorded	10	24			

Table 7.

Frequency of immediate needs with orthodontic appliances compared to other dental need for newly diagnosed pediatric oncology patients who received an inpatient baseline dental evaluation at Seattle Children's Hospital from Jan. 1, 2013 to Dec. 31, 2016.

		Treatment indicated		Unadjusted Odds Ratio	Robust CI of OR	p-value
		Yes	No			
Fixed orthodontic appliances	Yes	26	4	22.8	(7.66, 67.9)	<0.01
	No	59	207			

Table 8.

A. Location of dental treatment following cancer therapy initiation for newly diagnosed pediatric oncology patients who received an inpatient baseline dental evaluation at Seattle Children's Hospital from Jan. 1, 2013 to Dec. 31, 2016.

		Treatment location	
		Operating room/General anesthesia	Clinic
Consult date	Before therapy	2	19
	After therapy	22	36

		Treatment indicated		Confidence Interval	p-value
		Yes	No		
Consult date after therapy	Operating room/General anesthesia	22 (38%)	0 (0%)	(49%, 75%)	0.07
	Clinic	36 (62%)	0 (0%)		

B. Location of non-orthodontic dental treatment following cancer therapy initiation, for newly diagnosed pediatric oncology patients who received an inpatient baseline dental evaluation at Seattle Children's Hospital from Jan. 1, 2013 to Dec. 31, 2016.

		Treatment location	
		Operating room/General anesthesia	Clinic
Consult date	Before therapy	2	11
	After therapy	22	19

		Treatment indicated		Confidence Interval	p-value
		Yes	No		
Consult date after therapy	Operating room/General anesthesia	22 (54%)	0 (0%)	(30%, 62%)	0.65
	Clinic	19 (46%)	0 (0%)		

Bibliography

- AAPD Guideline on Caries-risk Assessment and Management for Infants, Children, and Adolescents. (2017/2018). *Pediatric Dentistry*. 39(6): 197-204.
- AAPD Guideline on Dental Management of Pediatric Patients Receiving Chemotherapy, Hematopoietic Cell Transplantation, and/or Radiation Therapy. (2017/2018). *Pediatric Dentistry*. 39(6):380-388.
- AAPD Policy on the Use of Silver Diamine Fluoride for Pediatric Dental Patients. (2017/2018). *Pediatric Dentistry*. 39(6):51-53.
- ASCO Answers – Dental and Oral Health. (2017).
https://www.cancer.net/sites/cancer.net/files/asco_answers_dental_oral_health.pdf.
- Carrillo C, Vizeu H, Soares-Júnior LA, Fava M, Filho VO. (2010). Dental Approach in the Pediatric Oncology Patient: Characteristics of the Population Treated at the Dentistry Unit in a Pediatric Oncology Brazilian Teaching Hospital. *Clinics*. 65(6):569-573.
- daFonseca, M. Chapter 18: Childhood Cancer. in The Handbook of Pediatric Dentistry (Fourth Edition) Nowak AJ, Casamassimo PS. (eds) (2011). American Academy of Pediatric Dentistry. P. 223-231.
- Elad S, Garfunkel AA, Or R, Michaeli E, Shapira MY, Galili D. (2003). Time limitations and the challenge of providing infection-preventing dental care to hematopoietic stem-cell transplantation patients. *Supportive Care Cancer*. 11:674-677.
- Elad S, Thierer T, Bitan, M Shapira MY, Meyerowitz C. (2008). A decision analysis: The dental management of patients prior to hematology cytotoxic therapy or hematopoietic stem cell transplantation. *Oral Oncology*. 44(1):37-42.

- Harris PA, Taylor R, Thielke R, Payne J, Gonzalez NG, Conde JG. (2009). Research electronic data capture (REDCap) – A metadata-driven methodology and workflow process for providing translational research informatics support, *J Biomed Inform.* Apr;42(2):377-81.
- Hong CHL, Napeñas JJ, Hodgson BD, Stokman MA, Mathers-Stauffer V, Elting LS, Spijkervet FLK, Brennan MT. (2010). A systematic review of dental disease in patients undergoing cancer therapy. *Supportive Care in Cancer*, 18(8):1007-1021.
- Kanuga S, Sheller B, Williams BJ, Mancl L. (2012). A one-year survey of inpatient dental consultations at a children's hospital. *Special Care in Dentistry.* 32(1): 26-31.
- Kierce EA, Boyd LD, Rainchuso L, Palmer CA, Rothman A. (2016). Association between Early Childhood Caries, Feeding Practices and an Established Dental Home. *J Dent Hyg.* 90(1): 18-27.
- Lockhart, PB. (2009). Incidence of Acute Oral Sequelae in Pediatric Patients Undergoing Chemotherapy. *Pediatric Dentistry.* 31(5):420-425.
- National Institute of Dental and Craniofacial Research. (2009). Oncology Pocket Guide to Oral Health: Prevention and management of oral complications.
<https://www.nidcr.nih.gov/sites/default/files/2017-09/oncology-guide-oral-health.pdf>.
- National Institutes of Health. (2003). A national call to action to promote oral health : A public-private partnership under the leadership of the Office of the Surgeon General. (NIH publication ; no. 03-503). Rockville, Md.]: U.S. Dept. of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institutes of Health.
- Noone AM, Howlader N, Krapcho M, Miller D, Brest A, Yu M, Ruhl J, Tatalovich Z, Mariotto A, Lewis DR, Chen HS, Feuer DJ, Cronin KA (eds). (2018). SEER Cancer Statistics Review, 1975-2015, National Cancer Institute. Bethesda, MD,

https://seer.cancer.gov/csr/1975_2015/, based on November 2017 SEER data submission, posted to the SEER web site, April 2018.

Perry M, Sheller B, Velan E, Brundige K. (2015). Applying the concept of standard work to inpatient dental consultations. University of Washington.

Savage MF, Lee LY, Kotch JB, Vann WF. (2004). Early preventive dental visits: Effects on subsequent utilization and costs. *Pediatrics*, 114(4):E418-23.

Sheller B, Williams BJ. (1996). Orthodontic management of patients with hematologic malignancies. *Am J Orthod Dentofacial Orthop*, 109(6):575-580.

Seattle Children's Hospital. Statistics and Outcomes. (2016).

<http://www.seattlechildrens.org/clinics-programs/cancer/statistics-outcomes/>>.

Ward E, DeSantis C, Robbins A, Kohler B, Jemal A. (2014). Childhood and adolescent cancer statistics, 2014. *CA: A Cancer Journal for Clinicians*, 64(2): 83-103.