Nutrition Related Clinical Decision Making of Pediatric Oncology Nurses

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NUTRITION RELATED CLINICAL DECISION MAKING OF PEDIATRIC

ONCOLOGY NURSES

a dissertation

by

AMANDA J. LULLOFF

submitted in partial fulfillment of the requirements

for the degree of

Doctor of Philosophy

May 2018

NUTRITION RELATED CLINICAL DECISION MAKING OF

PEDIATRIC ONCOLOGY NURSES

Abstract

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Purpose: The purpose of this study is to investigate staff nurses' clinical decision making (CDM) regarding pediatric oncology patients' nutritional status.

Background: Malnutrition, both under- and over-nutrition, in children can lead to significant morbidity and even mortality. Pediatric cancer patients are at high risk for malnutrition secondary to the disease process and treatment side effects; malnutrition in pediatric oncology patients is associated with poorer outcomes. Pediatric oncology nurses, with frequent and consistent contact with patients, are in an ideal position to assess nutritional status. Early identification and intervention for nutritional concerns in patients has been shown to improve outcomes. However, research on the quality of pediatric oncology nurses' CDM regarding nutritional status does not exist.

Methods: A web-based survey was distributed to members of the Association of Pediatric Hematology Oncology Nurses; it was comprised of three sections: a demographic data collection form, pediatric oncology nutrition related vignettes, and the New General Self-Efficacy Scale. The vignettes were rated on a one to five scale with one being under-nourished and 5 being over-nourished. Participants were asked to report their confidence in their rating and select cues in the vignette supporting the rating. A multi-level regression analysis was utilized

to assess the quality of nurses' CDM, the confidence of the nurses' CDM, and the factors associated with CDM.

Results: No nurse or organizational factors could be identified as useful in predicting the accuracy of the participants' nutritional rating; however, nurses were significantly likely to under-rate the vignette when comparted with the expert panel's rating. Nurses were significantly likely to select fewer cues supportive of nutritional rating than the expert panel.

Conclusions: Further research regarding nutritional assessment and nurses' clinical decision making is warranted. Evidence-based guidelines for nutritional assessment of pediatric oncology patients should be developed and implemented to ensure this patient population receives the highest quality of care.

Key Words: pediatric, oncology, nurse, nursing, clinical decision making, nutrition

Acknowledgements

I would like to thank my dissertation chair, Dr. Judith A. Vessey. The guidance and mentorship you provided throughout not only my dissertation, but also my professional development, has been life changing. I really appreciate all the advice and encouragement over the course of the years we worked together.

I would also like to thank Dr. Susan Kelly-Weeder, Dr. Matt Gregas, and Dr. Lisa Bashore my committee members. You each brought something unique and valuable to this experience. Every comment and suggestion not only made my dissertation better, but also helped me to refine how I think. You have helped to shape my future.

I want to thank my classmates Meredith, Karen, Nancy, Julie, Danielle, and Eileen. You challenged me and inspired me through coursework and beyond. The support, encouragement, brainstorming, venting sessions, and keeping me on task really helped me to move forward and shape this work.

Finally, I want to thank my family, friends, and colleagues-too many to name-who listened, supported, and kept me grounded. I also want to acknowledge the pediatric oncology patients I have cared for, who continue to inspire me.

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CHAPTER 1

Overview of the Study

Introduction

Adequate nutritional intake is imperative in childhood to achieve optimal growth and development (Black et al., 2008). Excessive (over-nutrition) or deficient (under-nutrition) nutritional intake can lead to life-limiting or life-threatening morbidities (Meacham et al., 2005). Children with cancer have unique disease processes and receive aggressive treatments putting them at high risk for malnutrition in addition to other severe side effects (Hooke et al., 2011). Nurses provide a holistic approach to care and have frequent interactions with patients. As a result, they are well positioned to assess for malnutrition in pediatric oncology patients and make clinical decisions regarding interventions to eliminate or mitigate its severity.

Statement of the Problem

Currently there is no gold standard for nutritional assessment of pediatric cancer patients, and the quality of nurses' clinical decisions regarding assessment of nutritional status in the absence of any such standard, is unknown. Weight, weight-for-height, and body mass index are the most commonly used measurements in pediatrics. However, these measures are likely to be unreliable in the pediatric oncology population secondary to edema, hydration status, tumor mass, and amputations (Bauer, Jürgens, & Frühwald, 2011). Little is known about

the clinical utility of other anthropometric techniques such as mid-upper arm circumference and triceps skinfold or biochemical markers such as albumin and total protein for determining nutritional status in pediatric patients with cancer. Nurses, who comprise 54% of all healthcare providers, are likely to spend the most time interacting with patients and families with chronic conditions in health care settings (Page, 2004). Frequent, serial interactions with patients and families places the nurse in the best position to assess for emerging problems with nutritional status and initiate early interventions. Therefore, it is important to investigate the quality of nurses' clinical decision making (CDM) regarding nutritional assessment to ensure the best possible outcome for pediatric oncology patients.

Purpose

The purpose of this study is to investigate staff nurses' CDM regarding pediatric oncology patients' nutritional status.

Significance

Malnutrition, both under- and over-nutrition, in children has important clinical significance. Under-nutrition in children can lead to poor health outcomes including stunted growth, poor immune function, and altered cognitive development (Brown & Pollitt, 1996). Under-nutrition in children with cancer is particularly concerning because cancer treatment is also known to cause stunted growth, poor immune function, altered cognitive development, and malnutrition independent of current nutritional status (Hooke et al., 2011). Over-nutrition in

children can lead to sleep disorders, psychosocial difficulties, diabetes, hypertension, musculoskeletal disorders, and cardiovascular disorders (Meacham et al., 2005). Pediatric cancer patients may have increased risks for hypertension, treatment induced diabetes, musculoskeletal and cardiovascular disorders independent of their nutritional status (Kline, 2011). Both under- and over-nutrition in pediatric cancer patients are associated with decreased event-free survival (Orgel et al., 2014). The prevalence of malnutrition in pediatric cancer patients at diagnosis is estimated at 5-50% (Bauer et al., 2011; Zimmermann, Ammann, Kuehni, De Geest, & Cignacco, 2013); a large variation is due to differing definitions and assessment methods.

In addition to general nutritional considerations related to childhood and adolescence, pediatric patients with cancer have additional nutritional factors nurses must consider. Having a diagnosis of cancer and the subsequent treatment effects metabolism, and ultimately alters the nutritional requirements for patients (Ladas et al., 2005). Nausea, vomiting, constipation, and diarrhea are all common side effects of cancer treatments and have significant impact on a cancer patient's ability to take in and absorb adequate nourishment (National Cancer Institute, 2012). Certain cancers, such as Hodgkin's lymphoma, also release inflammatory byproducts; increasing inflammation leads to changes in carbohydrate metabolism and increased protein and lipid breakdown (Brinksma et al., 2012).

Malnutrition in cancer patients is known to lead to increased toxicity from chemotherapy, delays in cancer treatment, increased infections risks, and decreased quality of life (Nicolini et al., 2013). These delays in cancer treatment,

decreases in dosing of chemotherapy due to toxicity, and infections can all lead to higher mortality rates (Loeffen, Brinksman, Miedema, de Bock, & Tissing. 2015). At this time, it is unknown if malnutrition on its own, or synergistically with other factors, is contributing to these side effects of cancer treatment.

Assessment of nutritional status and quality CDM in pediatric oncology patients by nurses is imperative. Ongoing, frequent assessment of pediatric oncology patients at high-risk for malnutrition is ideal; delayed identification and CDM regarding interventions for nutritional alterations in children can lead to lifelong physical and cognitive impairments (Mahan & Escott-Stump, 2008). Malnutrition can also cause additional stress on caregivers as they must cope with trying to add calories to a child's diet who may be refusing to eat secondary to nausea or conversely decrease calories for a child that has an insatiable appetite secondary to steroids (Ladas et al., 2005; Sanner & Wallace, 2012; Selwood Ward, & Gibson, 2010).

There are several significant policy level implications related to the care of pediatric patients with cancer and their nutritional status. *Healthy People 2020* includes an objective for reducing the overall cancer death rate, increasing the proportion of cancer survivors who are living five years or more post-diagnosis, and improving the mental and physical health related quality of life of cancer survivors (U.S. Department of Health and Human Services, 2015). Malnutrition is known to lead to increased morbidity and mortality for pediatric cancer patients (Loeffen et al., 2015; Nicolini et al., 2013). Nurses performing early nutritional

assessments accompanied by high quality CDM regarding malnutrition, may assist in increasing the survival rate for pediatric cancer patients.

Healthy People 2020 declares a national health objective for the United States to improve health related quality of life and well-being for all people (U.S. Department of Health and Human Services, 2015). Malnutrition in cancer patients is known to adversely affect quality of life (Nourissat et al., 2008; Sala et al., 2012). Children with cancer already have multiple factors with the potential to reduce health-related quality of life (Hamner, Latzman, Latzman, Elkin, & Majumdar, 2015; Harper et al., 2014), nurses assessing and making high quality clinical decisions for nutritional concerns may alleviate some of the distress.

The Association of Pediatric Hematology Oncology Nurses (APHON) has a position statement regarding the nursing practice of ambulatory pediatric oncology nurses (APHON, n.d.a). The position states pediatric hematology/oncology nurses must assure safe, effective, quality care for patients in the ambulatory setting. The nursing role includes the assessment of overall patient status and disposition of patients. Nutritional status is part of overall patient status, and providing quality care for these patients includes assessment and CDM about this and other aspects of the patient's health status.

Research Questions/Aims/Hypothesis

The research questions to be addressed by the proposed study are:

1. How accurately do pediatric oncology nurses assess patient nutritional status?

Aim: Determine how accurately nurses make clinical decisions regarding pediatric oncology patients' nutritional status based on clinical vignettes.

2. Which nurse or organization specific factors affect the accuracy of pediatric oncology nurses' CDM?

Aim: Determine if there are nurse or organizational specific factors that affect pediatric oncology nurses' CDM.

Hypothesis: The accuracy of nurses' CDM will vary based on experience as measured by either educational or years of practice, with more experienced nurses making more accurate decisions.

3. What patient cues do pediatric oncology nurses' consider when making clinical decisions about a patient's nutrition assessment?

Aim: Determine the number of presented nutritional patient cues nurses select when making clinical decisions and if the nurses' selected cues are correlated with the experts' selected cues.

4. Which nurse or organizational factors affect patient cue selection when making clinical decisions about a patient's nutritional status?

Aim: Determine if there are nurse or organizational specific factors that affect cue selection.

Hypothesis: Nurse cue selection will vary based on the experience as measured by either educational or years of practice, of the nurse. More experienced nurses will identify and utilize a greater number of cues.

Definitions

The variables and concepts in this study are defined using the current literature. For the purpose of this study, the following definitions are used:

1. *Cachexia*: a cancer related nutrition disorder is defined as a complex metabolic syndrome associated with underlying illness and characterized by loss of muscle with or without loss of fat mass. The prominent clinical feature of cachexia is weight loss in adults (corrected for fluid retention) and growth failure in children (excluding endocrine disorders) (Evans et al., 2008).

2. *Clinical decision making:* a cognitive process requiring a broad knowledge base, accurately identifying patient problems, choosing between at least two possible alternatives, and following through on the choice with the expectation of specific outcome in a supportive environment.

3. *Height/Length:* height is used for children age 2 years or older who are able to stand and length is used for children less than 2 years or those children unable to stand (World Health Organization (WHO, 2008)). For ease of reference in this text, height will be used throughout with the assumption that the correct measure for the child, height or length, will be used in clinical practice.

4. *Malnutrition*: a state of deficient or excessive nutrition that does not meet or exceeds the metabolic needs of the body creating adverse outcomes.

5*. Nutritional Status:* The state of being well-nourished, at risk for malnourishment, or malnourished.

6. *Over-nutrition*: a state of excessive intake, more than body requirements.

7. *Nurse:* Unless otherwise specified, nurse refers to an individual who has been licensed as a Registered Nurse (RN). Nurse may also apply to an individual licensed as an Advanced Practice Nurse (APRN) who is employed in an RN position.

8. *Under-nutrition*: a state of deficient intake, less than body requirements.

9. *Self-efficacy:* Confidence in the ability to accomplish a task successfully (Bandura, 2010)

Assumptions

Several assumptions are necessary in order to conduct this study. First, nurses who choose to participate in the survey are interested in advancing or enhancing their practice and/or promoting the health of their patients; therefore, they will respond to the survey questions as accurately and honestly as possible. This assumption is supported as participants are volunteers who can withdraw at any time and responses are anonymous.

It is also assumed nurses who work regularly with pediatric oncology patients have previously assessed patients with varying levels of malnutrition; the clinical vignettes represent familiar patterns from their clinical practice. Nurses are educated about clinical nutrition and how to assess signs and symptoms of nutritional deficiencies. Since malnutrition is a frequent occurrence with pediatric oncology patients, a nurse working regularly with this population should have clinical experience assessing nutritional status.

Summary

Malnutrition during cancer treatment in pediatric patients is a negative prognostic indicator and produces a reduction in quality of life. Nurses have the ability to assess for malnutrition and implement interventions, reducing or eliminating negative sequelae. This study will explore the clinical decisions nurses make regarding the assessment of nutritional status in pediatric oncology patients. Understanding the quality of clinical decisions made by nurses will help determine if patients are being supported to achieve the best possible outcomes.

CHAPTER 2

Review of the Literature

Adequate nutrition in children is required for survival; each year

approximately 3 million children worldwide under the age of five years have

deaths that are attributable to under-nutrition (Requejo et al., 2015). Florence

Nightingale, in *Notes on Nursing*, describes the taking of food as critically

important to the health of patients (Nightingale, 1860). Since that time, multiple

studies have confirmed the importance of nutrition in both healthy and sick

children and youths of all backgrounds (Anjos et al., 2013; Mehta et al., 2012,

Yen, Quinton, & Borowitz, 2013). Acute effects of poor nutritional status are seen

related to patients' clinical courses; affecting prognosis, length of stay,

readmissions, health-related quality of life and other factors (Agarwal et al.,

2013).

Because of the significant impact of nutrition on health and healing,

assessment of the patient's nutritional status should be a routine procedure

conducted by all nurses. For pediatric nurses, it is even more critical. Young

patients have not yet reached their full growth and neurological development;

without proper nutrition, growth and development may be delayed or permanently

stunted (Black et al., 2008). Nurses must be vigilant assessors, educators, and

advocates to promote the health of children.

Currently there is no gold standard for the nutritional assessment of

children with cancer. It is unknown how well, or even if, most nurses are

currently assessing nutritional status in these patients. One of the main indicators of nutritional status is Body Mass Index (BMI), as all children being treated for cancer have their height and weight verified prior to chemotherapy. Moreover, the *Medicare and Medicaid EHR Incentive Program* requires pediatric patients to have recorded height and weight, with calculated and displayed BMI and growth charts for children 2-20 years (Centers for Medicare and Medicaid, 2010). Pediatric oncology nurses, with their easy access to this information and frequent interactions with patients at all stages of their treatment (pre-diagnosis, during curative treatment or palliation, and survivorship), inpatient and in clinic, are well positioned to assess for emerging health problems and initiate early interventions. However, no studies to date describe the factors nurses consider, in the absence of a gold standard, to make clinical decisions about patient's nutritional status. Malnutrition and clinical decision making are the major concepts for this study and are further explored.

Malnutrition

Definitions

There is no one accepted definition of malnutrition. Malnutrition can either be under-nutrition, insufficient protein-energy intake to meet the demands of the body, or over-nutrition, excess intake leading to an increase in adipose tissue (Joosten & Hulst, 2011). Malnutrition can also appear in a well-nourished child if one or more vital nutrients are not present in adequate amounts to meet bodily needs. For the purpose of this discussion, the term malnutrition will refer to a state of deficient or excessive nutrition that does not meet or exceeds the

metabolic needs of the body creating adverse outcomes. The terms *under-nutrition* will be used to represent a state of deficient malnutrition and o*ver-nutrition* will be used to represent a state of excessive malnutrition. *Cachexia*, a cancer related nutrition disorder, is defined as a complex metabolic syndrome associated with underlying illness and characterized by loss of muscle with or without loss of fat mass. The prominent clinical features of cachexia are weight loss in adults (corrected for fluid retention) and growth failure in children (excluding endocrine disorders.) (Evans et al., 2008).

In the general pediatric population there are several commonly used indicators for malnutrition, usually based on growth parameters. In pediatrics height is used for children age 2 years or older who are able to stand and length is used for children less than 2 years or children unable to stand (World Health Organization [WHO], 2008). For simplicity in this text, the word height will be used to represent the appropriate measure for the child whether height or length. The WHO has developed 12 standards of growth for children up to five years old that include: 1) height-for-age, 2) weight-for-age, 3) weight-for-height, 4) BMI-for-age, 5) head circumference-for-age, 6) arm circumference-for-age, 7) subscapular skinfold-for-age, 8) triceps skinfold-for-age, 9) motor development milestones, 10) weight velocity, 11) height velocity, and 12) head circumference velocity (WHO, 2013). The WHO uses these standards singularly or in combination to define malnutrition. The first four indicators appear to be the most commonly used standards worldwide with general pediatric populations; weight-for-age is used the most frequently (de Onis et al., 2012). In pediatric oncology

research BMI is the frequently used indicator (Hingorani et al., 2011; Orgel et al., 2014; Zimmermann et al., 2013).

Moderate under-nutrition is defined as weight-for-height and/or height-for-age of between two and three standard deviations below the median score for the reference population. Severe under-nutrition is a weight-for-height and/or height-for-age greater than three standard deviations below the median score (WHO, 1999). Moderate over-nutrition is defined as BMI at or above the 85th percentile to the 95th percentile for age and sex matched peers with severe over-nutrition (obesity) defined as above 95th percentile (Centers for Disease Control and Prevention [CDC], 2015a). These standards provide some guidance, but they were developed primarily to identify malnutrition in infants and children up to five-years old who are otherwise healthy, not as an assessment of individuals with significant illnesses such as cancer.

These standards may be inadequate for pediatric oncology patients since weight can change with fluid shifts and tumor burden, thus not truly reflecting nutritional status. There is currently no consensus regarding either how to identify pediatric oncology patients at risk for malnutrition or diagnose those that have malnutrition.

Incidence & Prevalence

Malnutrition in the pediatric oncology patient can develop as part of the cancer process or as a result of cancer treatment. Prevalence in the literature is variable since the definition and criteria for malnutrition varies (Bauer et al., 2011; Brinksma et al., 2012) as well as if the population had heterogeneous or

homogenous cancer diagnoses. At diagnosis, the incidence of malnutrition for pediatric oncology patients ranges from 5-50% (Bauer et al., 2011; Sanner & Wallace, 2012; Zimmermann et al., 2013). This wide range also be related to method of measurement chosen to identify malnutrition. A study from India demonstrated the mechanism for measuring malnutrition can alter rates by more than 10% within the same sample. The researchers found that in newly diagnosed pediatric patients ($n = 690$) ages six months to 18 years (median age 9.04 years) with heterogeneous cancer diagnoses the incidence of under-nutrition is 30% using weight-for-age, 31% height-for-age, 35% weight-for-height, and 41% for BMI, and 3% were over-nourished using BMI (Srivastava, Pushpam, Dhawan, & Bakhshu, 2015). This study also found children with solid tumors and children from rural areas were more likely to be malnourished. Association with children living in rural areas was hypothesized to be related to socioeconomic factors as well as differences in rural women's education and rural sanitation practices. Children with solid tumors presenting with malnutrition is consistent with other studies (Garófolo, Lopez, & Petrill, 2005; Zimmermann et al., 2013); hypothesized to be related to delayed presentation and more advanced disease at diagnosis.

Prevalence of malnutrition during treatment is not well defined in the literature (Brinksma et al., 2012). Studies on pediatric malnutrition during active cancer treatment report a range of 0-50% prevalence (Brinksma et al., 2012; Sanner & Wallace, 2012). The prevalence varies due to different operational definitions of malnutrition, different sub-populations of cancer patients being

studied, and different standards of care around nutritional interventions. The WHO standards are frequently used as evaluation criteria but another common approach is a 5% weight loss from baseline (Bauer et al., 2011). As children are growing, and thus should be gaining weight, a weight loss of 5% or more is usually seen as clinically significant. Zimmerman and colleagues (2013) in a retrospective chart review from Switzerland found a 6% rate of under-nutrition at diagnosis, 22% after 30 days, 36% after 60 days, and 47% by end of treatment for all types of pediatric cancer. Loeffen and colleagues (2014) in a secondary analysis of heterogeneous cancer patients found 5% under-nourished and 7.1% over-nourished at diagnosis with 21% of patients having significant weight loss and 10% having significant weight gain during therapy. A Children's Oncology Group study (D9803) of Rhabdomyosarcoma (solid tumor) patients ages 2 to 20 years ($n = 488$) found 10% under-nourished and 24% over-nourished at diagnosis; 37% lost significant weight within 24 weeks (Burke et al., 2013). A Swiss study of children with mixed diagnoses ($n = 327$) less than 18 years old followed for a median of 263 days reported 5.8% of these children were under-nourished at diagnosis, with a rapid increase to 47% during therapy (Zimmermann et al., 2013).

It is important to note that the risk of malnutrition does not end when treatment is completed. Adult survivors of childhood cancer who are in their 20s-30s are significantly more likely to be underweight by BMI then the general population with a small cohort being more likely to be obese (Meacham et al., 2005). This is of concern when considering management protocols during

treatment for acute cancer. It should be noted, however, data for this study were collected from participants diagnosed between 1970 and 1986 and the self-reported data was obtained between 1995 and 1996. Treatment regimens have changed considerably since that time and additional study should be done to validate these findings.

Causes/Risk Factors

Under-nutrition is most likely to be found in advanced disease, unfavorable histology, body depletion at diagnosis, or secondary to antineoplastic therapy (Bauer et al., 2011). Under-nutrition is also more common in diagnoses involving changes of physiology, either through the tumor blocking anatomical pathways or major surgical interventions of any part of the gastrointestinal tract and those that cause changes in metabolism. Some literature suggests cancer cells' main source of energy is aerobic metabolism of glucose--significantly higher than normal cells demand. This renewal of glucose is created at a high energy cost through the Cori cycle potentiating malnutrition of the cancer patient (Inculet, Peacock, Gorschboth, & Norton, 1987; Roh, Ekman, Jeevanandam, & Brennan, 1984). Certain tumors also release inflammatory byproducts; increased inflammation leads to changes in carbohydrate metabolism and increased protein and lipid breakdown (Brinksma et al., 2012). The children at highest risk of under-nutrition have cancer diagnoses including advanced-stage neuroblastoma, Wilms tumor, rhabdomyosarcoma, osteosarcoma, Ewing sarcoma, solid tumors of the head and neck, medulloblastoma, acute myeloid leukemia (AML), relapsed

leukemia and lymphoma, as well as children who have undergone hematopoietic stem cell transplant (Bauer et al., 2011; Sanner & Wallace, 2012).

Treatments that predispose pediatric oncology patients to a risk of over-nutrition include cranial or total body irradiation, extensive brain surgery, prolonged immobility and prolonged use of steroids (Sanner & Wallace, 2012). These treatments are more likely to be used in children diagnosed with acute lymphoblastic leukemia (ALL) and medulloblastoma. Regardless of the type of cancer, obesity at diagnosis in pediatric oncology patients is associated with poorer prognosis than normal weight patients (Co-Reyes, Li, Huh, & Chandra, 2012; Ladas et al., 2005). The reasons for the poorer prognosis are unknown, but could be due to differences in metabolism, distribution of lipophilic drugs within the body, poorer overall health, genetics or other factors.

A third cause of under-nutrition in the pediatric oncology population results from side effects of treatment or symptoms of the cancer. The most common side effects contributing to under-nutrition include: diarrhea, constipation, nausea, vomiting, malabsorption, mucositis, organ toxicity-especially liver and kidney, pain, fatigue, early satiety, xerostomia, loss of taste, and learned food aversions. All of these can lead to reduced intake and/or reduced absorption of necessary nutrients.

Psychosocial issues play a role as parents/caregivers and the child can become very focused on food intake as an attempt to control a situation that feels out of control (Ladas et al., 2005; Sanner & Wallace, 2012; Selwood et al., 2010). Psychosocial issues may lead to either over-nutrition or under-nutrition. A child

that feels very out of control may refuse to eat, as what is consumed may be the one area where the child feels in control. Or, a child may demand and consume more food as a way to control parents' behaviors. Parents may, out of fear the child will not eat enough, offer food much more frequently than usual, and may offer foods they would not usually offer in order to entice a child to eat. This may lead to more consumption of higher calories and less nutritious food. Pediatric oncology patients with ALL with parents who are overprotective, provide inconsistent discipline, and provide for emotional feeding are all positively correlated with increased junk food consumption (Williams, Lamb, & McCarthy, 2015), especially during the steroid phase of treatment.

A nutritional issue unique to cancer patients is cachexia. Up to 80% of patients diagnosed with advanced stage cancer will experience cachexia and it plays a role in up to 20% of deaths (Gullett, Mazurak, Hebbar, & Ziegler, 2011). Of pediatric patients with progressive or advanced disease up to 40% will experience cachexia (Couluris et al., 2008).

Cachexia is characterized by loss of fat and muscle. This is in contrast to prolonged fasting and under-nutrition which leads to gradual weight loss of body fat as lean muscle is mostly maintained. Cachexia causes early satiety, weight loss, and weakness. Cachexia may be caused by altered production of cytokines and/or compounds secreted by the tumor, altered resting energy expenditure and/or alterations in carbohydrate, protein and/or fat metabolism (Tisdale, 2002). Few studies exist fully exploring its causes. Cachexia is particularly troubling

since increasing caloric intake alone is not usually sufficient to prevent, reverse, or slow the process (Bauer et al., 2011; Ladas et al., 2005).

Effects of Malnutrition

Under-nourishment can have multiple negative effects on the body of otherwise healthy people, especially in young children who are at high risk for rapid nutritional depletion secondary to smaller nutritional stores and higher metabolic needs. Effects include: 1) impaired function of the immune system, 2) loss of muscle mass, 3) stunted growth that may be permanent, 4) compromised wound healing, 5) fatigue, 6) higher risk of dehydration, 7) altered drug metabolism, 8) unfavorable response to chemotherapy and treatment delays, 9) impairment of respiratory function as muscle wasting occurs, and 10) alterations in heart rate, blood pressure, body temperature, and decreased quality of life (Bauer et al., 2011; Porth & Matfin, 2009; Rogers, Gilbertson, Heine & Henning, 2003). Pediatric patients undergoing hematopoietic stem cell transplant were more likely to have high-grade, acute graft-versus-host disease if they were under-nourished (Hudgkin, et al., 2016). Pediatric oncology patients are more vulnerable than otherwise healthy children to the effects of malnutrition as the cancer and/or treatment may create these same effects, independent of nutritional status. In summary, malnutrition compounds the effects of cancer and its treatment.

Under-nutrition can affect the physical and functional growth and development of the brain extensively from the prenatal period until 2 years old, but also continuing to negatively influence brain growth in school age children. Changes include alterations in neurological development of certain areas like the

hippocampus, changes in myelination of neurons, and/or changes in neurotransmitter levels (Bryan et al., 2004). These changes can have major, lifelong impacts on the cognitive and intellectual functioning of the individual including resulting in motor, cognitive, and neurodevelopmental impairments. The deficits may vary depending on the extent and timing of the malnutrition. One of the areas at greatest risk from infancy through young adulthood is the myelination of the neurons of the frontal lobes. The frontal lobes are responsible for higher order thinking such as problem solving and focusing attention. Nutrition insufficient to support this process can lead to a disruption in these abilities (Bryan et al., 2004). Deficiencies of specific nutrients can cause defects. For example, deficiency of Omega-3 can affect vision in infants and B_{12} deficiency can affect spatial ability and short term memory (Bryan et al., 2004).

Under-nourished patients also experience decreased survival. In a group of pediatric AML patients, those who were under-nourished were less likely to survive than those of normal weight (HR= 1.85, p= 0.006, 95% CI 1.19, 2.87) (Lange et al., 2005). Under-nourished ALL patients also have poorer event-free survival (HR= 1.33, p= 0.005, 98% CI 0.97, 1.83) (Orgel et al., 2014). Those who remained under-nourished for at least 50% of pre-maintenance phase of treatment had poorer event-free survival (HR= 2.30, p< 0.001, 95% CI 1.46, 3.63); those who at diagnosis were under-nourished but achieved normal weight for at least 50% of pre-maintenance treatment had similar event-free survival as those who were diagnosed at normal weight and maintained normal weight for at least 50% of pre-maintenance treatment (Orgel et al., 2014). Finally, under-nourished

patients undergoing hematopoietic stem cell transplant had a higher 100-day mortality then well-nourished patients (Hudgins et al., 2016).

Over-nourishment in pediatric cancer patients is equally problematic. Potential short term complications from over-nutrition include sleep disorders, psychosocial difficulties and hypercholesterolemia; long term complications include diabetes, hypertension, musculoskeletal disorders, cardiovascular disorders, as well as increased risks of mortality (Meacham et al., 2005). During treatment for cancer, normal weight and overweight children can have skeletal muscle wasting that may be hard to detect as the child otherwise appears well-nourished. There is also risk for undetected nutritional depletion of micronutrients due to decreased oral intake or excessive losses through vomiting and/or diarrhea (Meacham et al., 2005).

Pediatric osteosarcoma patients with high BMIs at diagnosis have significantly worse 5-year overall survival than those with normal BMIs (HR = 1.6, p< 0.005, 95% CI 1.14, 2.24) (Altaf et al., 2013). Obese osteosarcoma patients were also found to have a higher risk of wound complications such as arterial thrombosis (OR= 9.4, P= 0.03) (Hingorani et al., 2011). Obese pediatric patients with AML have higher therapy related complications and poorer survival (HR= 1.88, p< 0.001, 95% CI 1.99, 6.10) then their normal weight peers (Lange et al., 2005). ALL patients who were over-nourished at diagnosis had poorer event-free survival than their normal weight peers (HR= 1.40, p= 0.005, 98% CI 1.13, 1.73) (Orgel et al., 2014). The trend of obese AML and ALL pediatric patients having poorer survival is continuing to be supported (Amankwah et al.,

2016; Elissa et al., 2017; Orgel et al., 2016). Over-nourished ALL patients who remained over-nourished for at least 50% of pre-maintenance treatment had poorer survival than normal weight peers (HR= 1.43, p<0.001, 95% CI 1.04, 1.96); patients who at diagnosis were over-nourished but maintained normal weight during at least 50% of pre-maintenance treatment had similar survival to patients who were diagnosed and maintained normal weight (Orgel et al., 2014).

Implications

The majority of chemotherapy is dosed on the patient's body weight or body surface area. When the patient is overweight these calculations can sometimes lead to a larger dose than suggested for adults. In addition, some chemotherapeutic agents are lipophilic which may cause increased or prolonged toxicity that does not occur in normal weight patients. Lipophilic drugs are attracted to adipose tissue, if a patient has extra fat tissue it may alter the distribution, absorption and metabolism of the drug (Blouin & Warren, 1999). In addition, alkaline drugs have increased binding to proteins in obese patients; resulting in less free drug and thus producing less pharmacologic effect (Rogers et al., 2005). Due to their higher binding, alkaline drugs may also be excreted more slowly leading to prolonged pharmacological effects (Rogers, Meacham, Oeffinger, Henry, & Lange, 2005). Some oncologists have attempted to reduce toxicity by reducing doses for obese patients (Bauer et al., 2011). However, studies show dose reductions in obese, adult patients can lead to inferior outcomes (Rosner et al., 1996). The effect of such dose reductions is currently unknown in the pediatric population.

Nutritional issues can persist into survivorship. Female survivors of ALL and central nervous system tumors are more likely be obese than non-childhood cancer survivors; whereas other cancer survivors are more likely to be underweight (Meacham et al., 2005). Survivors with abnormally low BMIs include females who had Hodgkin lymphoma, Wilms tumor, and bone malignancies without amputations. Male survivors are at increased risk for being underweight if they were treated for central nervous system tumors, Hodgkin lymphoma, Non-Hodgkin lymphoma, Wilms tumor, neuroblastoma and soft tissue sarcomas (Meacham et al., 2005). Additional factors leading to decreased BMI for female survivors of childhood cancer include total body irradiation and use of alkylating agents. For males, additional risk factors for low BMI include being less than 4 years of age at diagnosis, abdominal radiation, and the use of alkylating agents when given with anythracyclines. Low body weight in childhood cancer survivors persisted even after controlling for some potential genetic/family variables. When compared with healthy siblings, cancer survivors were more likely to be underweight and less likely to be obese (Meacham et al., 2005).

Assessment of Nutritional Status

Assessing nutrition in the pediatric oncology population in critical, although currently no standard exists. There is agreement that pediatric oncology patients should receive nutritional screening at diagnosis with referral to a registered dietician if the patient is determined to be at risk (Cherry, 2011; Mosby, Barr, & Pencharz, 2009). But what data are collected in the assessment, how

patients are determined to be at risk, and how often assessments should be repeated varies widely in practice.

 As previously discussed, the most common and sensitive indicators of nutritional status in healthy children are anthropometric measures. However, it should be noted that some, if not all, of these measurements can be unreliable in the pediatric oncology population secondary to edema, hydration status and/or large, solid tumor masses (Bauer et al., 2011). Measurement error affects the determination of nutritional status. This is of even greater risk in young children whose measurements are smaller and who may or may not cooperate when staff attempt to obtain anthropometrics. A study of healthy children found variation in data collection could explain over 20% of regional variation in BMI z-scores in children ages 4-5 years and 4-5% of the variation in children ages 10-11 years (Townsend, Rutter, & Foster, 2011). Only with high quality staff training and ongoing reinforcement of competency will these measurements be reliable (WHO, 2006). White, Davies, and Murphy (2011) found the strongest correlation in pediatric oncology patients between anthropometric data collected and percent body fat, when compared to air displacement plethysmography, using the equation "body fat percentage = (1.4 x Biceps skinfolds [mm]) + (0.16 x percent ideal body weight) -1" (p. 718).

Laboratory values can be an important indicator of nutritional status, but are subject to variations in fluid status and organ function. Serum albumin and prealbumin can be used as markers for visceral protein status (American Academy of Pediatrics [AAP], 2009). Albumin has a half-life of 21 days, while

prealbumin has a shorter half-life of 2-3 days. With its shorter half-life, prealbumin is often used as a marker for acute nutritional insufficiency with albumin used as a measure more long-term deficiencies. However, both albumin and prealbumin are acute phase reactant proteins and as such not specific to nutrition. In pediatric oncology patients they may be more reflective of fever, infection, or chronic metabolic stress than loss of nutritional status (AAP, 2009).

Transferrin values reflect both iron and protein status. Transferrin's half-life is 8 days, but levels are influenced by acute inflammation, malignancies, and liver disease (Mahan & Escott-Stump, 2008). Retinol-binding protein may be monitored as an indication of nutritional status; it has been shown to decrease in states of under-nutrition (Mahan & Escott-Stump, 2008). The half-life is 12 hours. This protein is also a negative, acute-phase protein; it will be altered in a state of inflammation. Retinol-binding protein values will be further altered in the presence of Vitamin A deficiency (Mahan & Escott-Stump, 2008).

Leptin is a peptide that also may be used as an indicator of nutritional status, or risk for altered nutritional status. Leptin is synthesized in adipose tissue and plays a role in lipid metabolism as well as acting as a signal to increase satiety and energy expenditure (AAP, 2009). Deficiency of leptin or leptin receptors is rarely the cause of obesity in healthy children, though its interaction in children with cancer is unclear. Children with ALL have showed decreased leptin levels when compared with healthy controls (Moschovi et al., 2010) and children with ALL have a higher likelihood of being obese (Meacham et al., 2005; Touyz et al., 2016; Withycombe et al., 2014). Children who have had cranial radiation as part

of their treatment have demonstrated increased leptin levels (Brennan et al., 1999).

Even with all the possible laboratory tests available, no one test is a "gold standard" for diagnosing malnutrition. However, a persistent change in any one or more of these values may be suggestive of a change in nutritional status (Cherry, 2011; Ladas et al., 2005; Mosby et al., 2009). Periodic monitoring of these values should be considered. In addition, electrolytes should also be monitored closely in children being treated for cancer; changes in intake, increased output through diarrhea/vomiting, chemotherapy, and/or antibiotics are all known to alter these serum chemistry values (AAP, 2009).

To determine risk of malnutrition, several screening tools have been developed and trialed in pediatric oncology patients. One specifically designed for pediatric cancer patients is the screening tool for childhood cancer (SCAN) (Murphy, White, Viani, & Mosby, 2016). This tool has demonstrated a high level of reliability (0.90, 95% CI 0.78,1.00; p<0.001), sensitivity (Score ≥3 100%, 95% CI 76,100), and negative predictive value (100%, 95% CI 76, 100). Those screened as "at risk of malnutrition" by the SCAN had significantly lower z score weights ($p = 0.001$), BMI ($p <0.001$), and fat mass index ($p = -0.04$) that those screened as "not at risk of malnutrition". Other standardized tools that have been studied in the pediatric population include STRONGkids (Huysentruyt et al., 2013), Prognostic Nutrition Index (PNI) (Wakita, Fukatsu, & Amagai, 2011), Subjective Global Assessment (SGA) (Secker & Jeejeebhoy, 2007) and St. Jude's Algorithm (Sala et al., 2012). However, none of them have been used consistently

in studies within the pediatric oncology population and rarely include clinical outcomes. All these tools mostly focus on identifying children at risk for under-nutrition without criteria for over-nutrition. Their psychometric properties in the population of interest is unknown.

Interventions

The primary goals for nutrition intervention in pediatric oncology patients are to provide for optimal growth and development and maximize daily functioning. Ensuring adequate nutrition in pediatric oncology patients can lead to better tolerance of chemotherapy and radiation, decreased risks for infection, improved immunologic status, increased quality of life and potential for better overall outcomes (Ladas et al., 2005; Selwood et al., 2010). Nurses, having frequent contact with patients, are ideally positioned to consistently screen patients in order to identify problems and implement interventions in a timely manner. Identifying potential or actual problems early may limit the short- and long-term side effects experienced as well as prevent the need for more invasive interventions when the problem is severe.

There are currently several nutritional interventions for under-nutrition in the pediatric oncology population: special diets/supplements that emphasize the needed/missing nutrients; appetite stimulants; enteral feedings delivered via a nasogastric, nasojejunal, gastrostomy or jejunostomy tubes; and parenteral nutrition (Bauer et al., 2011; Gullett et al., 2011; Selwood et al., 2010). Early feeding interventions have been shown to be associated with improved patient

outcomes including lower rates of infection and shorter hospital stays in critical

adult patients (Marik & Zaloga, 2001).

All nutrition interventions should start with dietary counseling, explaining

what the patients' intake needs are and how best to achieve those needs while

incorporating the patients' personal preferences. If there is only a mild disruption

in intake, nutritionally complete supplements may be recommended in addition to

what patients are already taking orally. Unfortunately, supplementation tends to

not be readily accepted by pediatric patients secondary to taste. This approach is

only sufficient for the mildest of losses as patients are often unable to consume

enough to make up severe deficiencies (Bauer et al., 2011; Ladas et al., 2005)

Medicinal appetite stimulants play a role in increasing the caloric intake of

pediatric oncology patients. There are currently several available agents, but a

paucity of research exists as to which has the best outcomes in pediatric patients.

Some of the more common medications include megestrol acetate,

tetrahydrocannabinol (THC), and cyproheptadine hydrochloride. The mechanism

of action of megestrol acetate is not clearly understood but it is known to

stimulate appetite and increase weight gain but can have potentially life-

threatening adrenal suppression (Couluris et al., 2008; Gullet et al., 2011). THC is

known to influence the endocannibinoid system and is thought to increase

appetite and quality of sleep and relaxation while decreasing nausea. It is usually

well tolerated with adverse side effects not differing from placebo (Brisbois et al.,

2010). Cyproheptadine hydrochloride is a serotonin and histamine antagonist and

has been found to stimulate weight gain. This agent is usually well tolerated with the main side effect reported as somnolence (Couluris et al., 2008).

Ladas and colleagues (2005) stated "the use of TF [enteral tube feedings] has been studied in other populations and is preferred over PN [parenteral nutrition] due to its proven efficacy while decreasing risk for infections and costs" (p.380). In small studies, enteral tube feeding has also been found to be effective in the pediatric oncology population. Multiple studies offer support that enteral tube feeding is safe and effective in pediatric oncology patients leading to weight increase or stabilization, fewer days of hospitalization, fewer infections, and lower costs when compared with parenteral nutrition (den Broeder et al., 2000; Mathew et al., 1996; Parbhoo, Tiedemann, & Catto-Smith, 2011). Requirements for enteral tube feedings are an intact, functioning gastrointestinal tract, and patients cannot have severe nausea, vomiting and/or diarrhea. However enteral tube feeding-especially nasogastric feeding-can be challenging to implement due to patient, family, and caregiver concerns about the insertion, discomfort, and visibility of the tube (Cohen, Wakefield, Tapsell, Walton, & Cohen, 2017; Montgomery, Belongia, Schulta, Mulberry, & Nugent, 2016). Despite this resistance, enteral feeding has been found to be a safe and effective way to nourish pediatric oncology patients (Trimpe, Shaw, Wilson, & Haberman, 2017).

Parenteral nutrition should be used when the gastrointestinal tract is not intact or is not functioning adequately. It can also be used when nausea, vomiting or diarrhea is severe enough to prohibit enteral feeds or the patient is on gut rest for conditions such as typhlitis or severe pancreatitis. Parenteral nutrition should

only be initiated if inadequate nutrition is expected to last at least one week and patients receiving it must be closely monitored. Providers can customize their prescriptions to contain nutrients necessary to address a patient's particular deficiencies. Parenteral nutrition must be carefully monitored and central lines must be diligently cared for. Parenteral nutrition may contribute to severe electrolyte imbalances, liver toxicity, and central line infections. Parenteral nutrition also has been implicated in symptoms of nausea, early satiety and decreased oral intake (Bauer et al., 2011; Ladas et al., 2005).

Interventions for over-nourished pediatric oncology patients are equally challenging. Just like under-nourished patients, over-nourished patients should receive dietary counseling regarding how best to meet their nutritional needs. If the patient is capable, regular exercise should be encouraged. Patients should be assessed to see if underlying psychosocial issues such as anxiety and depression are playing a role in the excessive intake. Children who are over-nourished secondary to hypothalamic dysfunction are especially challenging since there is no standard for pharmacological or surgical intervention (Co-Reyes et al., 2012; Ladas et al, 2005). This is an area in need of more research. One study found success in reducing the weight gain in children with brain tumors at high risk for hypothalamic obesity (Rakhshani et al., 2010). The patients attended a comprehensive clinic that involved the entire family working with a dietician, behavioral psychologist, neuropsychologist, exercise consultant and endocrinologist. These patients had less weight gain once entering the program than they did prior to entry (8.5%/year (range 3.4 to 14.0) versus 21.4% (15.8-

32.0.) and had higher health related quality of life (63.7 ± 18.4 to $71.3 \pm 13/3$, *p* <0.017).

Clinical Decision Making

Clinical decision making (CDM) is a particularly salient topic in nursing as there are 19.3 million nurses worldwide making clinical decisions every time they interface with patients and families (WHO, 2011). The frequency of decisions made by nurses varies, and in some critical care settings one decision is made every 30 seconds (Bucknall, 2000); in other acute settings one decision can be made every 10 minutes (Thompson et al., 2000). Nursing is "the protection, promotion, and optimization of health and abilities, prevention of illness and injury, alleviation of suffering through the diagnosis and treatment of human response, and advocacy in the care of individuals, families, communities, and populations" (American Nurses Association, n.d.). A nurse must use CDM to fulfill their prescribed roles, and as such decision making should be seen as an essential nursing function; therefore, investigating the CDM done by nurses is an imperative of practice oriented research (Harbison, 2001).

Definition

CDM is a cognitive process requiring a broad knowledge base, accurately identifying patient problems, choosing between at least two possible alternatives, and following through on the choice with the expectation of a specific outcome and conducted in a supportive environment (Bakalis & Watson, 2005*;* Noone, 2002; O'Neill, Dluhy, & Chin, 2005; Thompson, Aitken, Doran, & Dowding,

2013; Twycross & Powls, 2006). CDM, critical thinking, clinical judgement, and diagnostic reasoning are all similar/related mental activities that nurses use for patient care interventions (Tanner, 2006*; Benner, Tanner, Chesla, 2009*; Facione & Facione, 2008)*. Critical thinking* has been defined as:

> 1) disciplined, self-directed thinking which exemplifies the perfections of thinking appropriate to a particular mode or domain of thinking. 2) Thinking that displays mastery of intellectual skills and abilities. 3) The art of thinking about your thinking while you are thinking in order to make your thinking better: more clear, more accurate, more defensible. (Paul, 1995, n.p.).

Clinical judgement can be defined as "interpretation or conclusion about a patient's needs, concerns, or health problems, and/or the decision to take action (or not), use or modify standard approaches, or improvise new ones as deemed appropriate by the patient's response" (Tanner, 2006, p. 204). *Diagnostic reasoning* is a cognitive process in which cues are collected and analyzed, problems identified, a diagnosis is determined, and a plan is formed (Kassirer, 1989; Nurjannah, Warsini, & Mills, 2013; Rajkomar & Dhaliwal, 2011). *Critical thinking* is a process used along with clinical judgement and diagnostic reasoning in order to make quality clinical decisions. As demonstrated, these concepts are all related and sometimes they are used interchangeably in the literature, describing the cognitive processes of making choices in a clinical setting (Harbison, 2001; Rashotte & Carnevale, 2004).

Significance

Pediatric inpatients are harmed by medical care at a rate of 54.9 harms per 1,000 patient days; with 45% of the harms classified as potentially or definitely

preventable (Stockwell et al., 2015). To reduce harms and improve quality, it is imperative to better understand and improve nurses' decisions (Thompson et al., 2013). When caring for pediatric patients, the ability to make quick and accurate judgements and decisions are necessary (Lauri & Salanterä, 2002) as pediatric patients tend to more rapidly deteriorate than adult patients. Clinical decisions made by nurses positively or negatively influence patient outcomes.

Despite the importance of CDM in pediatrics, a search of the literature revealed only a few articles describing pediatric or oncology nurses' decisions. Several pediatric CDM articles focused on the CDM styles and processes employed by pediatric nurses (Choi & Kim, 2015; Twycross & Powls, 2006). However, describing the processes nurses use to make decisions does not aid in understanding if nurses in practice are making quality decisions; descriptive research is needed to establish required nursing decision tasks, while evaluating what decisions are made well, and which could be better (Harbison, 2001).

A study of nurses' CDM and pain management, with a population of over 50% oncology nurses, found that CDM of nurses can determine if optimal pain management is achieved (Ferrell, Eberts, McCaffery, & Grant, 1991). A study of pediatric nurses ($n = 695$) found novice, experienced and expert nurses assessed pain intensity in children similarly, but experienced nurses were more likely to feel confident in their assessment and more inclined to administer narcotics (Hamers, van den Hout, Halfens, Abu-Saad, & Heijltjes, 1997). Nurses' CDM when presented with a simulated patient determines which patient problems are

addressed; inaccurate decision making can lead to not addressing actual problems or addressing non-problems (Junnola, Eriksson, Salanterä, & Lauri, 2002).

Factors of CDM

Nurses' CDM occurs within a complex, multi-layered context (Dowding el al., 2016). Major groups of factors in CDM include personal characteristics of the nurse, the organizational milieu, patient characteristics, and environmental factors (ten Ham, Ricks, Rooyen, & Jordan, 2017). Personal characteristics of the nurse affecting CDM include nursing experience (Chung, 2005; Ludwick, Meehan, Zeller, & O'Toole, 2008), clinical knowledge training and education (Benner et al., 2009; Bjørk & Hamilton, 2011), self-confidence (Hart, Spiva, & Mareno, 2014), self-efficacy (Choi & Kim, 2015) and demographic factors such as age, race, and gender (Bjørk & Hamilton, 2011; Hoffman, Donoghue, & Duffield, 2004). Experience was the dominant factor in nurses' appraisal of cues and their evaluation (ten Ham et al., 2017). Expert nurses discern a wider range of cues and are more adept at clustering the cues to make quality clinical decisions (Hoffman, Aitken, & Duffield, 2009). Several of the studies describing personal characteristics of the nurse affecting CDM were qualitative in nature (Chung, 2005; Ludwick et al., 2008); qualitative studies reflect nurses' beliefs about important factors in decision making, but there may be other factors nurses are unaware of, or they feel are socially unacceptable to discuss. Several studies reported nursing characteristics relevant to CDM used tools that were standardized (Bjørk & Hamilton, 2011; Choi & Kim, 2015; Hart et al., 2014);

however, none of these studies sought to describe the quality of decisions made by nurses and not all of these tools have been psychometrically tested.

Organizational factors were found to influence CDM, particularly the dynamics of the interdisciplinary team and the availability of resources such as guidelines, policies and protocols (Currey & Worrall-Carter, 2001; Ludwick et al., 2008; Searle & McInerney, 2008). One study demonstrated inexperienced nurses who receive support and collaboration from more experienced nurses make better quality decisions in the intensive care setting (Currey & Botti, 2006). Nurse staffing was found to affect nurses' CDM; however, it was not just the number but also the experience and quality of the nurses who were staffed that changed the CDM workload for nurses (Bucknall, 2003). Financial factors play a role in CDM. When certain interventions require approval or physical equipment is limited/unavailable, nurses have to alter their CDM process to adjust for the limited resources (Bucknall, 2003). Due to the qualitative nature of these studies, nurses reported what they believed to be important organizational factors influencing their own CDM (Currey & Worrall-Carter, 2001; Ludwick et al., 2008; Searle & McInerney, 2008). It is possible the nurses are unaware of other factors that also affect CDM or over-emphasize factors that play a small role. Other studies employed an observational design (Bucknll, 2003; Currey & Botti, 2006), however, even trained observers may not be able to fully understand the effect of different factors in CDM.

The environment of care influences CDM beyond just organizational factors. The number of interruptions a nurse experiences affects the capacity for

CDM as does the amount of time available to make the decision (Chung, 2005). A supportive environment and physical layout of the facility contributes or detracts from quality CDM (Currey & Worrall-Carter, 2001). Nurses reported that cramped physical environments can be disruptive to their CDM, and being in isolation, physically separated from other health care providers, led to increased autonomy in CDM as collaboration was physically prohibited (Bucknall, 2003). Similar to organizational factors, the majority of studies on the environment of care were also qualitative in design with the same limitations as previously identified (Chung, 2005; Currey & Worrall-Carter, 2001).

Patient factors including their physical, clinical and psychosocial status influence the nurse's CDM (Currey & Botti, 2006; Lavelle & Dowling, 2011). Bucknall (2003) found critical care nurses reported the patient's clinical condition strongly affected their CDM. The presenting patient problem determined the types, speed and complexity of decisions; patients presenting with unusual problems slow CDM, as nurses are less confident in their decisions. The more critical and unstable the patient, the more decision-making will be accelerated in an attempt to stabilize their condition. In addition, family factors, such as attitudes and preferences were demonstrated as playing a role in CDM (Ludwick et al., 2008). Patient factors affecting CDM are the most direct, identifiable and explainable, and ideally the most important.

Model of CDM

A myriad of models and theories pertaining to decision making, in a professional context exist in the mid- and practice levels of theory. A summary of

the models is available in Table 1. Limitations for models not selected include,

failure to account for the environment in which the decision is being made,

mathematical based models for which no probabilities currently exist for concepts

to factor into the model, and failure to incorporate both the intuitive and cognitive

aspects of nursing.

Table 1.

Decision Making Models

Model	Summary	Strengths	Limitations
Wolf's Model (Wolf, 2013)	Explains the environment within which decisions are made; visualized as a series of three concentric rings The core-critical reasoning, moral agency and knowledge of the decision maker The immediate-relationships between nurses and other healthcare providers The influential-institutional and healthcare environment factors	Developed to describe nursing CDM Emphasizes the ethical aspect to CDM	Hasn't been tested outside of the emergency setting Ethnographic studies of the model was based on, and sample the model was tested against, are not representative of the diversity of emergency nurses in practice
Brunswick Lens Model (Brunswick, 1955)	Probabilistic theory allowing calculation of the accuracy of decision making in light of the available cues Compares the importance the decision maker assigns to each of the cues presented with the actual importance of the cues	Objective analysis of decision making	Was not developed to specifically describe nurses' decision making Actual probability of cues and outcomes may be unknown limiting utility of model

General Model of Classification (Buckingham and Adams, 2000)	Based on hypothetico-deductive approach, decision trees, and pattern recognition Decision maker chooses feature vectors from all the available pattern vectors, converts the feature vectors into psychological representation of the phenomenon, leading to classification of the situation, with output being the nursing action	Developed to describe nursing CDM	Fails to account for any factors outside of patient cues and nurses' ability to distinguish and process patient cues such as the environment of care and policies and procedures Depicts decision making as a linear process
Clinical Decision Making Model (O'Neil, Dluhy, & Chin, 2005)	Based on hypothetico-deductive approach and pattern recognition Pre-encounter cues and working knowledge, anticipating and controlling for risks, standard provision of nursing care, client and situation specific concerns and modifications, leading to hypothesis generation and nursing action.	Developed to describe nursing CDM Includes nurse, patient, and environmental factors affecting CDM	Depicts CDM as a linear process

This study utilizes the Clinical Decision Making Model (CDMM) (O'Neill et al., 2005). There are strengths and weaknesses associated with the CDMM for this study. This model was developed specifically with nursing CDM as a focus, it is directly applicable to the population of interest. As a nursing model, it incorporates the complex, rapidly changing environment in which nurses make clinical decisions. It also accounts for nurse specific factors, such as experience and education level, which are known to influence decision making. The model

allows for consideration of patient preferences and individualized needs, which

can significantly alter the decision a nurse may have otherwise made. The

weakness of the model is it appears to assume the CDM process proceeds mostly

in a linear fashion and one decision at a time, which can be true, but in times of

rapidly changing patient status this may not be the case.

CDMM (Figure 1) was created to describe nursing CDM and is based on

the   hypothetico-deductive approach and pattern recognition; elements of the

social judgement theory and the cognitive continuum can also be applied. First the

different fundamental theories and models that are foundational to this model will

be discussed, followed by specifics of the CDMM.

Figure 1. *Clinical Decision Making Model* Adapted from O'Neill el al. (2005)

| Patient data | Salient concerns | *Modified by situation and tailored by "knowing the patient"* | Hypothesis generation |

Standard nursing care

Hypothesis selection

Working Knowledge

Clinical patterns

Anticipating risk to the patient

Nursing action
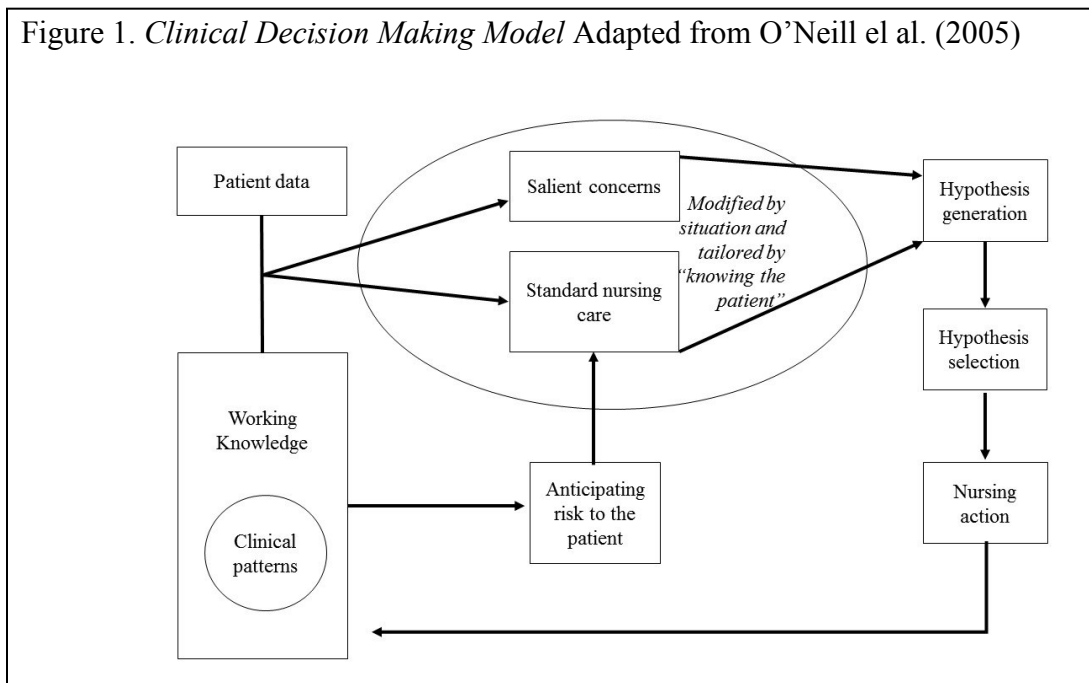
The social judgement theory describes judgement as occurring within the

environment of the decision being made (Hammond, Stewart, Brehmer, &

Steinmann, 1975). Decision making cannot be separated from the social context

of the situation and the decision maker. The social judgement theory concept is represented by the circle within CDMM, indicating the decision is modified to fit the situation.

The cognitive continuum theory (Hammond, 1981) states there are two processes of decision making, the intuitive/emotional and the cognitive/logical. While specific decisions may utilize one or the other, the two processes are not mutually exclusive and occur along a continuum with many decisions incorporating both intuitive and cognitive aspects. The cognitive continuum is not directly represented in the CDMM, but can be applied to the working knowledge and clinical patterns in the pre-encounter representation. Recognizing clinical patterns is an automatic, intuitive process that comes with experience and expertise (Benner, 1984). Working knowledge of a nurse would also necessarily include an understanding of policies, procedures, and the scientific method; all lending themselves to cognitive/logical processes.

The hypothetico-deductive approach describes decision making as a set of steps (Elstein, Shulman, & Sprafks, 1978). The first step is selecting cues from the environment to consider from all possible cues (the ability to select cues varies based on the experience and abilities of the decision maker). The decision maker then generates hypotheses. The next step involves actively seeking more cues to confirm or discredit the hypotheses. The decision maker then selects the best hypothesis and considers the risks and benefits related to the implementation in the context of the situation. Finally, the decision making process is complete and the intervention is initiated. The hypothetico-deductive approach is

represented in the CDMM by the arrows, linking the different steps of the decision making process.

CDM, as explained by the CDMM (O'Neill et al., 2005), contains pre-encounter data, anticipating and controlling for risks, standards of nursing care, situational and client modifications, and hypothesis generations. CDM starts with pre-encounter data. Pre-encounter data which includes everything the nurse brings to the decision before ever meeting the patient, including any written or verbal information received about the patient and the working knowledge of the nurse. The working knowledge includes the nurse's educational and experiential background. Anticipating and controlling for risks are additional concepts in the CDMM.

Risks are attributes of the situation or person that increase the probability of adverse health outcomes. In the CDMM, the nurse assesses for risks and implements nursing actions to reduce risks. Interventions are targeted at reducing the most likely and/or most harmful risks. Standard nursing care is based on institutional policies and procedures and the practice habits of the nurse. Standard nursing care is selected, implemented and modified based on "knowing the patient". A portion of standard nursing care, such as placing all patients meeting certain criteria on fall risk, is also part of anticipating and managing risks. Situational and client modifications occur during every decision. The situation, such as the overall acuity on the unit and the nurse's patient load, the number of times interrupted, and the collaboration of the health care team, can all influence the decision. Client's preferences and individual needs are also considered when

deciding between alternative options. Hypothesis generation is an integral part of the CDMM. The nurse assesses all the patient related cues, develops a hypothesis based on those cues, and then looks for more information to confirm or discredit the hypothesis. A nurse's ability to assess and categorize patient cues leading to hypothesis generation varies based on nurse and environment specific factors. Once the hypothesis is selected, the nurse implements action. The outcome of the implementation is assessed, and becomes part of the nurse's working knowledge for future decisions.

The Study Method

This study employed a descriptive design exploring pediatric oncology nurses' CDM regarding nutritional assessment. The survey contained several vignettes describing the nutritional status of a pediatric oncology patient, and asked the nurse to rate if the patient is at nutritional risk. This method has not been used previously in pediatric oncology research, but it has been used in CDM research and with other nursing populations.

Hamers and colleagues (1997) studied novice, experienced, and expert pediatric nurses pain making decisions using a vignette design. This study found novices and expert nurses came to the same assessment of pain, but made different decisions about intervention and had differing confidence levels about their decisions. Expert nurses gave feedback that the vignettes were very close to clinical cases. Junnola and colleagues (2002) used a computer based vignette to explore nurses' CDM regarding patient admissions and how nurses determine the focus of the nursing care plan. This study found a significant correlation between

information acquisition and patient problems identified. Usher, Baker, and Holmes (2010) used clinical vignettes to explore nurses' and physicians' CDM related to the use of 'as needed' medications in mental health settings. This research highlighted variation in practice associated with which drug, when and how much to administer to patients. Stamp (2012) did not use full vignettes, but did use patient profiles to assess nurse practitioner CDM regarding coronary heart disease risk assessment; finding nurse practitioners weighted risk factors differently than physicians and had only moderate insight into their own CDM process. Meeks-Sjostrom (2013) used a vignette study design to assess emergency department nurses' CDM regarding elder abuse. This study found nurses who identified more assessment cues and had more years working as a registered nurse were more likely to act on cases of suspected elder abuse. Thompson and Adderley (2015) used vignettes to compare and contrast generalist community nurses' CDM to tissue viability specialists to determine if the specialists provided added value. This study found the specialists identified more true positive cases and has less variation in their assessment of patient cues.

Almost two decades of research have used vignettes as a way to explore nurses' CDM in different populations and related to different nursing tasks. All of the studies have the same limitation, responses to vignettes may not correlate exactly with decisions made in clinical practice. However, the options are limited for presenting nurses with a standardized clinical case and asking them to respond. Having actors participate as standardized patients is one method that has been explored in other areas of CDM (Badger et al., 1995; Terry, Hiester, &

James, 2007) with some success. However, in these studies, standardized patients were used to assess conditions that are not visible such as depression, headache or irritable bowel. Pediatric oncology patients often have visual differences such as paleness and alopecia, those factors may be manipulated for a child actor; however, it would be unethical to manipulate a child actor's body to appear under- or over-nourished. Moreover, the efficacy of pediatric standardized patients has not been explored. Vignettes offer the best option for a standardized presentation to nurses to assess their CDM.

Summary

Both under- and over-malnutrition pose a demonstrated risk to pediatric oncology patients. Nurses are well positioned to assess and intervene early if a risk of or actual malnutrition is identified. However, assessment and intervention require quality CDM. No identifiable research to date has looked at pediatric oncology nurses' CDM regarding the assessment of patients' nutritional status. Investigating these decisions is imperative to better understand nursing practice for these patients and to help ensure quality care with the best possible outcomes.

CHAPTER 3

Method

Introduction

This chapter describes the study methods used in the current investigation including the design, setting, sample, measures, study procedures, data analytic plan, and human subjects considerations. The study aims were to: 1) determine how accurately nurses make clinical decisions regarding pediatric oncology patients' nutritional status, 2) determine if there are nurse or organization specific factors affecting pediatric oncology nurses' clinical decision making (CDM), 3) determine which patient cues nurses select when making nutritional clinical decisions, and 4) determine if there are nurse or organization specific factors affecting pediatric oncology nurses' cue selection.

Study Design

This descriptive study utilized survey methodology to explore pediatric oncology nurses' CDM. The focus of the CDM is nurses' nutrition assessment and was explored primarily through patient vignettes. This method has been previously used studying pediatric and oncology nurses' CDM (Ferrell et al., 1991; Hamers et al., 1997; Junnola et al., 2002).

Setting

The survey was conducted electronically. Internet surveys are a useful mode for targeting specific professional groups (Dillman, Smyth, & Christian, 2009). Access to electronic surveys was not an anticipated issue as registered nurses (RNs) currently in clinical practice must possess the ability to utilize multiple formats of electronic communication. The *American Recovery and Reinvestment Act of 2009* required all healthcare providers to convert to electronic health care records by January 1, 2014 to maintain Medicare and Medicaid eligibility; the majority of clinical nurses have been using electronic health records for at a minimum of two years to document their patient care at the time of the study. Many health care institutions also require nurses to have institutional emails and utilize Internet-based learning platforms for required nursing education. Nurses are well acclimated to electronic utilization.

Sample

The population of interest was pediatric oncology staff nurses in clinical practice. The sampling frame was a convenience sample of registered staff nurses who were members of the Association of Pediatric Hematology Oncology Nurses (APHON); the survey indicated it could be shared by participants with other pediatric oncology nurses. To be included nurses had to provide direct clinical care to pediatric oncology patients for an average eight or more hours per week. At the time of recruitment, APHON had approximately 3,700 members, of which 1,500 indicated their primary role was as a staff nurse (N. Wallace, personal communication, March 17, 2016.). An average response rate for web-based

surveys is 34% (Cook, Heath, & Thompson, 2000) so the estimated response was 510. A power analysis to determine required sample size is reported in Table 4, page 60.

Inclusion Criteria

The following criteria were established for participants to be included in the study. There were no specific exclusion criteria, beyond not meeting the inclusion criteria.

1. Licensed RN or advanced practice registered nurse (APRN) providing direct care as a staff nurse to pediatric oncology patients as this study seeks to understand staff nurses' CDM.

2. A nurse working eight or more hours per week providing direct care to pediatric oncology patients. This criterion was established with the intention of including nurses who consistently interact with and care for pediatric oncology patients.

3. The ability to read and write in English. The survey was in English and the vignettes also were written and rated in English.

4. Nurse willing to consent to participate in the study. This criterion is established to help ensure protection of human subjects.

5. Access to the Internet as the distribution method is electronic.

Instrumentation

The key measures of this study are listed in Table 2 and fit within the theoretical CDM model adapted from O'Neil, Dulhy and Chin (2005). These are

shown in Figure 2, page 49. The independent variables included patient data and

patient cues that are presented in the vignette; working knowledge of the nurse:

the nurse's education, experience, and personal factors such as self-efficacy; and

standard nursing care, including organizational factors such as collaboration and

policies and procedures. The dependent variable was the nursing action, as

measured by the vignette scoring.

Table 2.

Key Variables and Related Measures

Variable(s)	Measure
Accuracy of CDM	Random assignment of 5 of 10 Vignettes, 5-point Likert scale ranging from under-nourished to over-nourished.
Patient cue selection	"Hot Spot" on/off selection of patient variables (see Table 3)
Nurse and organizational factors affecting CDM and patient cue selection	Demographic form
	New General Self-Efficacy Scale
	Confidence in CDM. Sliding scale 0-100%.

Figure 2. Study Variables in the *Clinical Decision Making Model* adapted from O'Neil et al. (2005)
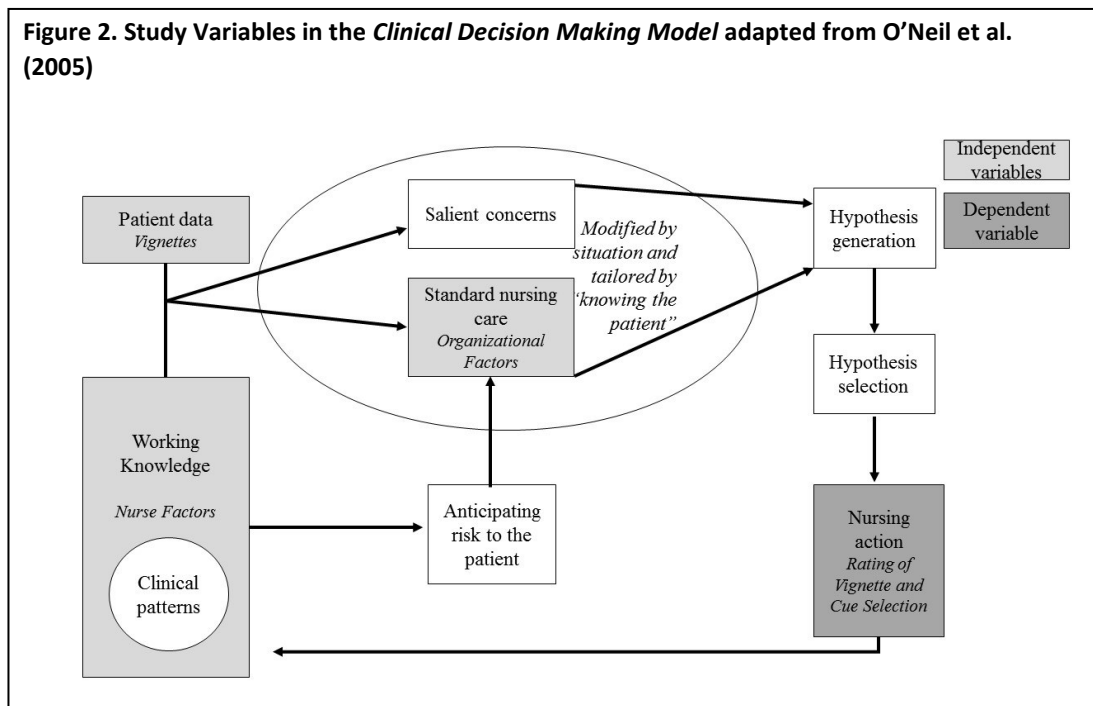
Demographic Form. Demographic information describing nurse and organizational related factors that could affect nurse CDM was collected using an investigator-derived demographic form (Appendix C). Nurse related factors include: age, years of nursing experience, years of pediatric oncology nursing experience, education level, an active member in Children's Oncology Group (COG) nursing discipline, and professional certifications. These variables were proxies for clinical knowledge, training, and nursing experience; all known to affect nurses' CDM (ten Ham et al., 2017). Organizational related factors captured institution resources available nurse staffing (Bucknll, 2003), and perceived health care team collaboration (Currey & Botti, 2006). All these variables have been demonstrated to affect nurse CDM.

Employment region, institutional size, membership in the COG and institutional Magnet® recognition were also assessed. COG is the world's largest childhood and adolescent cancer research organization. Membership includes over 200 of the leading children's hospitals and cancer centers including institutions in Australia, Europe, New Zealand, and North America (COG, n.d.). Magnet® recognition is awarded to hospitals that fulfill the requirements of quality patient care and nursing excellence and innovation (American Nurses Credentialing Center, 2016).

New General Self-Efficacy Scale (NGSE). Confidence (Hart et al., 2014) and self-efficacy (Choi & Kim, 2015) have been demonstrated to have an effect on nurses' CDM. The NGSE (Chen, Gully, & Eden, 2001) (Appendix D) is a tool that measures general self-efficacy. Self-efficacy was defined as confidence in the ability to accomplish a task successfully (Bandura, 2010). A general self-efficacy measure was chosen to determine if a person's propensity for mastery and success affected their CDM. The NGSE was selected due to its brevity, reliability, validity, and ability to predict specific self-efficacy (self-efficacy an individual feels in a specific situation) in a variety of contexts (Chen et al., 2001).

The NGSE was developed in an attempt to have a valid, but shorter measure of general self-efficacy then what was currently available, such as the *Self-Efficacy Scale* (Sherer et al., 1982) containing 23 items, with a subscale for General Self-efficacy containing 17 items. The NGSE contains only 8 items and has good internal reliability. One psychometric study using principal components analysis reported Cronbach's alphas of 0.87, 0.88, and 0.85 for three separate

administrations to the same sample; a second study reported Cronbach's alphas of

0.86 and 0.90 in two separate administrations to a second sample and the final

study 0.85 and 0.86 in two different administrations to a third sample. The test-

retest reliability coefficients in one study were $0.65_{t1\text{-}t2}$, $0.66_{t2\text{-}t3}$, and $0.62_{t1\text{-}t3}$, in

the second study was 0.67, and in the third study was 0.86 (Chen et al., 2001).

Two samples, one in the spring and one in the fall semester, were combined into

one sample of 316 upper level psychology undergraduates. The other sample was

323 upper level psychology undergraduates, 77% female with approximately one-

third not working, one-third working part time, and one-third working full time.

The third sample was 34 Israeli organizational behavior graduate students. This

sample was used to test the instrument's validity in another culture and language.

Choi and Kim (2015) established the NGSE's content validity by

comparing it to the *Self-Efficacy Scale* (Sherer et al., 1982) and the *Rosenberg*

Self-Esteem Measure (Rosenberg, Schooler, Schoenback, & Rosenberg, 1995).

The *Rosenberg Self-Esteem Measure* was included as self-esteem is often

considered a related construct to self-efficacy and the researchers wanted to

ensure the NGSE measured the distinct construct of self-efficacy. Two panels

were given definitions of self-efficacy and self-esteem and asked to sort items

from the three measures into categories of self-efficacy, self-esteem, or other. The

NGSE had 98% and 87% of items sorted as self-efficacy, 2% and 11% as self-

esteem, and 0% and 3% as other. These items outperformed the *Self-Efficacy*

Scale, having more items sorted as self-efficacy, fewer items sorted as self-esteem

or other. The *Rosenberg Self-Esteem Measure* had the highest number of items

sorted as self-esteem, and fewest sorted as self-efficacy. These results provide credence to self-esteem and self-efficacy as being two separate constructs, and the NGSE having stronger validity than the *Self-Efficacy Scale* in measuring self-efficacy. The NGSE was correlated with 10 difference occupational specific self-efficacy scales. The score for each occupational scale and the score for the NGSE were correlated and found to be positive and significant (r= 0.15 to 0.43, *p* < 0.001). This provides support that general self-efficacy is related to occupational specific self-efficacy. All of these trends were stable even when tested in a different national culture and language (Israeli/Hebrew) suggesting there may be some universal understanding of general self-efficacy.

Quality and Confidence of CDM. To investigate the quality of CDM in nurses, multiple pediatric oncology patient vignettes were developed with signs and symptoms of varying nutritional statuses supported from the literature (Table 3). Appendix E contains the different levels used for each of the dimensions.

Table 3.

Nutritional Variables

Dimensions	Rationale for inclusion
Activity level	Required to estimate caloric needs (CDC, 2015b)
Affect	Psychological cue for nutritional status (Macht, 2008)
Age	Biological cue for nutritional status (Huhmann & August, 2008)
Albumin	Biochemical cue of nutritional status (Bowman et al., 1998)
Appearance	Medical cue of nutritional status (Pacheco-Acosta et al., 2014)
BMI	Anthropometric cue of nutritional status (WHO, 2015)

Bowel movement	Output cue for nutritional status (Grant & Kravitis, 2000)
Diagnosis	Medical cue for nutritional status (Co-Reyes et al., 2012)
Diet	Social or medical cue for nutritional status (Mantos et al., 2011)
Dietary intake	Input cue for nutritional status (Cherry, 2011)
Growth	Anthropometric cue of nutritional status (Bowman et al., 1998)
Height	Anthropometric cue of nutritional status (Bowman et al., 1998)
Nausea	Symptom cue for nutritional status (Grant & Kravitis, 2000)
Pain	Symptom cue for nutritional status (Grant & Kravitis, 2000)
Sex	Social and biological cue for nutritional status (Pirouznia, 2001)
Socioeconomic status	Social cue for nutritional status (Co-Reyes et al., 2012)
Treatment phase	Treatment cue for nutritional status (Zimmerman et al., 2013)
Triglyceride	Biochemical cue of nutritional status (Friedland, Nemet, Gorodnitsky, Wolach, & Eliakim, 2002)
Weight	Anthropometric cue of nutritional status (Bowman et al., 1998)
Weight loss/gain	Anthropometric cue of nutritional status (Bowman et al., 1998)

Nurses were asked to decide if the patient presented in the vignette was well-nourished, at risk for malnourishment (over- or undernourished), or actually malnourished on a Likert scale. The vignettes were validated by a panel of expert pediatric oncology registered dieticians, a pediatric oncology RN, and a pediatric oncology epidemiologist. The nurses' ratings were correlated with the experts'

ratings to explore the quality of nurses' decisions. Empirically based vignettes further evaluated through expert opinion is currently the 'gold standard' for validation. This approach has been used to validate clinical vignettes used in prior nursing CDM research (Griffin, Polit, & Byrne, 2007; Thompson & Adderley, 2015; Usher et al., 2010; Valente, 2010; Yang & Thompson, 2010).

After rating each vignette, the nurse was asked to indicate how confident they were of the rating from 0%-100%. Confidence in CDM has been similarly measured in previous nursing studies (Yang & Thompson, 2010), finding that experienced nurses tend to be overconfident in their decisions, with less experienced nurses being under-confident.

Patient Cue Selection. The patient vignettes were presented using the "Hot Spot" question design in Qualtrics®. Hot spot is a question type that allows participants to select regions of an image. The vignettes were converted from a document to an image for uploading into Qualtrics®. All cues presented were built into the vignette as separate, defined regions. Nurses were asked to select, by clicking, the patient cues they utilized to support their clinical decision.

Study Procedures

Phase one of the study focused on the development of the patient vignettes. The vignettes were developed by the primary investigator highlighting variables affecting nutritional status supported in the literature using the factorial study design described by Bauer et al. (2009). Initially 15 vignettes were developed.

They were then piloted by non-pediatric oncology nurses through convenience sampling to assess survey fatigue, length of time to complete vignettes, clarity of vignettes, whether the instructions for survey design features ("Hot Spot" and Likert scales) were understood by participants, and completion rate. During the pilot, nurses received a random selection of 10 of the 15 vignettes.

After initial piloting and editing, the vignettes were validated by the expert panel ($n = 5$); three registered dieticians, one master's prepared nurse, and one epidemiologist all specializing in pediatric oncology. Each expert panelist was shown the vignette in the same online format utilized with the participants. The experts then rated each of the 15 vignettes. After each expert rated the vignettes individually, the primary investigator attempted to schedule a meeting with the experts to review the range of individual ratings and determining a consensus answer for each scenario. Similar expert consensus panels have been used in other nursing CDM studies (Thompson & Adderley, 2015). However, due to conflicting schedules and time zones, the consensus meeting was unable to be scheduled.

Alternatively, the Delphi Method (Keeney, Hasson & McLaren, 2000) was used to reach consensus. The rounds were all completed electronically with feedback indicating where the experts agreed and where they did not, including the nature of the disagreements. Three full rounds were conducted to achieve consensus on the rating of the vignette and cue selection. At the end of three rounds, consensus was achieved for ratings on 10 of the 15 vignettes. The 5 remaining vignettes were discarded. There was no agreement on a few of the cues

after three rounds. The cues that failed to reach consensus were not scored for participants in accuracy analysis. The expert panel was reimbursed for their time with $50 gift certificates.

Phase Two of the study started with review and approval from the Boston College Institutional Review Board (IRB) to survey registered nurses (Appendix A). Recruitment for the study was through an APHON membership email blast. The initial email contained an introduction to the study and a link to participate. A follow up email occurred seven days after the initial one, thanking those who have participated, reminding those who have not yet participated to please consider doing so, and again providing the link. This two-step notification is a variation on Dillman and colleagues (2009) tailored design method of surveys. Informed consent was obtained at the beginning of the survey, requiring participants to indicate they consented prior to proceeding to the survey. An incentive for participation was offered to participants after completing the survey; the participant could choose to enter their contact information to be entered into a raffle for one of five $50 gift certificates.

Demographic questions related to inclusion criteria followed the consent. If the participant answered a question indicating they did not meet inclusion criteria, the survey terminated with a screen thanking them for their willingness to participate, and informing them about their ineligibility. If the participant did meet the necessary conditions to participate, they were permitted to proceed. A progress bar indicated how close participants were to completion, the ability to go back to previous vignettes was allowed. When participants reached the final page

of the survey, they were given an opportunity to be redirected to another site to anonymously enter the raffle for gift certificates. The gift certificates were distributed as planned at the close of data collection.

Analytic Plan

Summary statistics of the sample were produced representing the demographics of the participants. Total number of participants, frequencies for categorical variables, and range, mean, median, and standard deviation for continuous variables on the demographic questionnaire were calculated and reported.

The first aim, *determine how accurately nurses make clinical decisions regarding pediatric oncology patients' nutritional status*, analysis plan included descriptive statistics of the nurses' rating of the vignette. The range, mean and standard deviation were reported. The expected results (based on experts' rating) were then compared with the observed result (nurses' rating). The percent correct were reported, as were the range, mean, and standard deviation of difference scores from the experts. Significance was tested using a mixed-effect model. The vignette scoring difference from the experts was the outcome, nurse effects were considered fixed effects, and individual vignettes as the primary predictors.

The second aim, *determine if there are nurse or organization specific factors that affect pediatric oncology nurses' decision making*, analysis plan included a mixed-effect model. Mixed-effect was chosen as there were repeated measures for each participant. Initially all the nurse factors and the nurses' perception of organizational factors were entered as predictor variables in the

model (nurse-factors: location, age, degree, certification, years of experience, hours worked per week, practice setting, self-efficacy, confidence; organization factors: size of institution, COG membership, Magnet® status, policies, resources, staffing and team collaboration) with the outcome variable being the rating difference from the experts. However, this initial model was not significant. The analytic plan was then modified to an exploratory approach, entering each factor into the model individually to assess for significance. First level of the mixed-effects model was the vignettes; the second level of the model included the nurses. Nurse factors of degree, certification, experience, self-efficacy, confidence, nationality, age, and practice setting were entered as fixed effects.

Following the same above procedures, a second model was analyzed with the outcome variable being confidence in decision making. The first level remained comprised of the vignettes, with the second level comprised as the nurses.

The third aim, *determine the number of presented nutritional cues nurses select when making clinical decisions and if nurses' selected cues are correlated with the experts' selected cues*, analysis plan included descriptive statistics of the number of cues nurses selected, range, mean and standard deviation of cues selected were reported. The expected results (experts' rating) were compared with the observed result (nurses' rating). The range, mean and standard deviation of the difference between expert and participant cue selection were reported. Significance was tested using a mixed-effect model. The difference from the

experts' number of cues selected were the outcome, nurse effects were considered fixed effects, and individual vignettes were the primary predictors.

The forth aim, *determine if there are nurse or organizational specific factors that affect cue selection,* analysis plan included a mixed-effect model. Mixed-effect was chosen as there were repeated measures for each participant. Initially all the nurse factors and the nurses' perception of organizational factors were entered as predictor variables in the model (nurse-factors: location, age, degree, certification, years of experience, hours worked per week, practice setting, self-efficacy, confidence; organization factors: size of institution, COG membership, Magnet® status, policies, resources, staffing and team collaboration); the outcome variable was the difference from the experts' number of cues selected. Again the model was not significant. An exploratory approach was then utilized entering each factor individually into the model to determine significance. The first level of the mixed-effects model was the vignettes; the second level of the model was the participants.

The approach for missing data was to eliminate any participants that did not complete all items in the data set. Two data sets were used, one that contained participants that had completed all of the demographic data, rated every vignette, and scored their confidence in the rating. A second, smaller data set was developed containing participants who had completed all the demographic data, rated every vignette, scored confidence in every rating, and selected cues to support their rating.

Power Analysis to Determine Sample Size. The power analysis assumed a linear-mixed model with eight covariates, the difference scores between experts and participants as the response and nurse specific effects modeled as random effects. The analysis also assumed a common standard deviation equal to one which meant the effect sizes listed below are in standard deviation units- comparable to Cohen Effect Sizes. The significance level was set at 0.05. The table below gives the sample size needed to achieve 80% power.

Table 4.

Mixed Level Power Analysis

Effect Size	Significance	Power	Sample Size
0.15	0.05	0.80	110
0.125	0.05	0.80	192
0.1	0.05	0.80	252

Given the projected sample size of 512, the study should have been well-powered. Due to the potential variability in responses, the proposed sample was not reduced.

Protection of Human Subjects

Every effort was made to protect the confidentiality of participants and their data. Participants were not required to provide their name and IP addresses were not collected. Only research team members and members of the dissertation committee had access to participant data which were stored electronically in

Qualtrics® and an encrypted, password protected laptop. All data were reported in aggregate only. Participation was fully voluntary, and participants were able to withdraw from the study at any time; there were no penalties for withdrawing or skipping questions. Participants were provided with contact information for the primary investigator, dissertation supervisor and the IRB to address any questions or concerns. The gift certificate for participation raffle followed established procedures to maintain confidentiality of participants.

Risk to Subjects. The risk related to participants was minimal. As with all studies, participants may have perceived some inconvenience related to the time spent on the survey. Some participants may have experienced discomfort if they perceived themselves to not be knowledgeable about a portion of their clinical practice; this risk was deemed to be minimal as nurses are frequently confronted with the limits of their knowledge, and are tasked with finding ways to increase their knowledge in order to practice safely. The possibility exists that any information transmitted over the Internet could have been intercepted. In order to minimize the risk, a professional, password protected electronic research compliant survey platform (Qualtrics®) was utilized.

Benefits of Participation. There were no direct benefits for participation in the study. But the participant may have experienced some gratification in knowing they helped further scholarly work in pediatric oncology nursing research and practice.

Recruitment and Informed Consent

Nurses were emailed a letter inviting them to participate in an online survey related to pediatric oncology nutritional assessment. The consent was the first page of the online survey and included the study purpose, risks and benefits of participation, directions for accessing the survey, the principal investigator's contact information, the dissertation supervisor's contact information and the Office for Research Protections, Boston College contact information (Appendix B). Participants indicated consent by checking a box and continuing to the survey.

<div align="center">

Summary

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This chapter describes the descriptive study's methods designed to evaluate the accuracy of pediatric oncology nurses' CDM regarding nutritional assessment. Information on the sample, instrumentation, procedures, analytic plan, and protection of human rights is presented. This methodology was developed to answer the questions proposed in Chapter 1.

CHAPTER 4

Results

Introduction

This descriptive study examined nurses' clinical decision making (CDM) regarding the nutritional status of pediatric oncology patients. Nurse and organizational factors were explored as predictors of accuracy for nutritional ratings and cue selection. Accuracy was determined by comparing the participants' response to the expert panel consensus rating as described in Chapter 3, under study procedures, page 55. Nurse confidence and its relationship to their CDM was also explored. The results of the data analyses are presented in this chapter.

Data Preparation

Data collection was open from July 12th, 2017 until September 20th, 2017. Since there had been no responses in 14 days and over 300 participants had consented, data collection was closed. Following data collection cessation, data was exported from Qualtrics® (Seattle, WA) into a Microsoft Excel (Redmund, WA) spreadsheet for instrument scoring. Data were then analyzed using SPSS for Windows v. 24 (SPSS Inc./Chicago, IL). Prior to statistical analysis, data were examined for missing values. Two data sets were created. The first data set included all participants who had complete demographic data, nutritional ratings,

and confidence scores. The second data set, a subset of the first, included only participants with complete nutritional cue selection data. Thus, participants with missing data were excluded from the study. There were many participants who had complete data for everything but the cue selection, and it was decided to consider those participants for analysis of the ratings and confidence data, but exclude them in the cue selection analysis due to the missing data.

Characteristics of the Study Sample

The total number of eligible participants who met inclusion criteria and consented to the study was 318; representing 45 states in the United States and 5 Canadian provinces. The data set used to analyze vignette nutritional ratings and confidence scores contained complete data for 136 participants from 37 states in the United States. The second set of data, a subset of the first, used to analyze cue selection contained complete data for 94 participants; with 32 states represented. Table 5, page 65, contains the continuous demographic variables that were measured for all participants who responded (not a complete data set), the rating/confidence data set, and the cue selection data set. The variables measured include: age, number of professional certifications, years worked as a registered nurse (RN), years worked as a pediatric oncology RN, number of hours worked per week, average number of patients cared for per shift, average number of pediatric oncology patients cared for per shift, safety culture, and the total for the New General Self-Efficacy scale (NGSE). Age was included as a variable representing personal experience. Years as an RN, years as a pediatric RN, and hours worked per week were included as a measure of nursing experience. The

average number of patients per shift and average number of pediatric patients per shift were included as a measure of workflow and experience. Safety culture was included as a proxy for available resources and teamwork. The NGSE was included for the role self-efficacy plays in decision making.

The variable, safety culture, represents three different environmental factors on a five-point Likert scale from strongly disagree (1) to strongly agree (5). The three items are listed in question 17 on the demographic form (see Appendix C). The NGSE contains eight items; individual items are listed in Appendix D.

Table 5.

Continuous Demographic Variables

Demographic Variables	Min	Max	*M*	*Mdn*	*SD*
Age					
Total participants	22	69	40.25	37	11.349
Rating data	23	69	39.41	37	11.098
Cue data	23	69	39.51	37	11.439
Number of Certifications					
Total participants	0	4	1.66	2	1.121
Rating data	0	4	1.68	2	1.066
Cue data	0	4	1.66	2	1.121
Years RN					
Total participants	0	42	14.83	12	10.591
Rating data	1	41	14.93	12	10.475
Cue data	1	41	15.29	12	10.807
Years Pediatric Oncology RN					
Total participants	0	37	11.91	10	8.997
Rating data	1	36	12.25	10	8.941
Cue data	1	35	12.50	10	8.865
Hours worked per week					
Total participants	8	52	35.53	36	6.919
Rating data	8	52	34.62	36	7.651
Cue data	8	52	34.46	36	7.911
Average # Patients per shift					

Total participants	1	15	4.26	4	2.232
Rating data	1	15	4.29	3	2.396
Cue data	1	15	4.32	3	2.592
Average # Pediatric Oncology patient per shift					
Total participants	1	15	3.63	3	2.275
Rating data	1	15	3.57	3	2.292
Cue data	1	15	3.71	3	2.495
Safety Culture					
Total participants	2	15	11.93	12	2.386
Rating data	4	15	12.18	12	2.209
Cue data	4	15	12.18	12	2.259
NGSE					
Total participants	6	40	33.31	32	4.221
Rating data	25	40	33.51	32	3.370
Cue data	25	40	33.63	32	3.615

Multiple categorical, demographic variables were measured including the participant's highest obtained nursing degree, type of institution, practice setting, type of certification, Children's Oncology Group (COG) membership, Magnet® accreditation, and if their work setting had a dedicated pediatric oncology registered dietitian. Nursing degrees ranged from a diploma to a doctorate degree (see Table 6). Degree was included to assess if educational preparation contributed to nutritional assessment. Those with advanced degrees that prepared them as an advanced practice registered nurse (APRN) were reviewed to explore if nurses with advanced clinical training and roles affected their nutritional assessment abilities.

Table 6.

Education of Participants

Demographic variables	Diploma	Associate's degree	Bachelor's degree	Master's degree	DNP	PhD	APRN
Total participants ($n = 256$)	13	13	190	28	3	1	16
Rating Data ($n = 136$)	3	5	111	13	3	1	8
Cue Data ($n = 94$)	2	3	74	11	3	1	7

The type of institutions where participants were employed was also examined. Three different types of institutions were identified: a free-standing pediatric hospital or clinic, a pediatric hospital or clinic within an adult hospital or clinic, and a hospital or clinic that had both pediatric and adult care programs. The practice setting within the institution was also assessed. There were three main types of settings reported: inpatient, outpatient, and both inpatient and outpatient. These variables were assessed to determine if the practice environment contributed to nutritional CDM (see Table 7, page 68).

Table 7.

Type of Institution and Practice Setting

Demographic variables	*n*	Pediatric	Pediatric within adult	Combined pediatric and adult	*n*	In-patient	Out-patient	Both
Total participants	234	135	81	18	239	134	83	21
Rating data	136	84	41	11	136	79	45	12
Cue data	94	60	25	9	94	56	30	7

Organizational factors were also considered. Participants were asked if the institution they worked for had Magnet® accreditation, COG membership, if the nurse was a member of the nursing discipline in COG, and if the institution had a dedicated pediatric oncology registered dietician (see Table 8). These variables were explored as a proxy for resources and environment of care where the participants were employed.

Table 8.

Organizational Factors

	n	Magnet®	*n*	COG	*n*	COG nursing discipline	*n*	RD
Total participants	226	159	238	109	209	109	229	124
Rating data	136	96	136	120	136	61	136	70
Cue data	94	65	94	85	94	47	94	48

The nurses were asked their certification/certificate status. There were six primary certifications/certificates the participants had obtained: Association of Pediatric Hematology/Oncology Nurses (APHON) Chemotherapy Biotherapy Provider, APHON Chemotherapy Biotherapy Instructor, Bone Marrow Transplant Certified Nurse (BMTCN®), Certified Pediatric Oncology Nurse (CPON®), Certified Pediatric Hematology Oncology Nurse (CPHON®), and Certified Pediatric Nurse (CPN®). The credential CPON® is available by renewal only, and all new certifications for pediatric oncology nursing must be CPHON®. The credentials CPHON® and CPON® are mutually exclusive; it is possible to hold all the other certifications/certificates at the same time. The certificates and certifications reported by participants is displayed in Table 9. Certifications were assessed to determine if measures of nursing expertise and excellence played a role in CDM regarding nutritional status.

Table 9.

Certificates and Certifications Reported

	(*n*)	Provider	Instructor	BMTCN®	CPON®	CPHON®	CPN®
Total Data	194	133 (69%)	31 (16%)	5 (3%)	53 (27%)	67 (35%)	53 (27%)
Rating Data	113	89 (79%)	25 (22%)	4 (4%)	20 (18%)	50 (44%)	37 (33%)
Cue Data	77	61 (79%)	16 (21%)	3 (4%)	12 (16%)	37 (48%)	21 (27%)

Ratings Data

Analysis of the participants' nutritional status ratings was performed ($n =$ 136). Each of the participants was randomly presented with 5 of 10 vignettes. Vignettes were rated on a 1 to 5 scale: 1 = under-nourished, 2 = at risk for under-nourishment, 3 = well nourished, 4 = at risk for over-nourishment, and 5 = over-nourished. The mean, and standard deviation for participant ratings of nutritional status of the patient presented in each vignette is listed in Table 10. The differences between the participants' rating range and the expert rating range, means and standard deviations are also presented. Negative numbers represent the participants who chose a rating below the expert, while positive numbers indicate that participants chose a rating above the experts. The experts' rating for the vignette is listed next to the vignette number. Across vignettes the range of different ratings between the participants and the experts was -3 to 3 ($M = -0.25$, $SD = 0.94$).

Table 10, page 71, demonstrates participants rated the vignettes lower than the experts for six out of the ten vignettes (note: vignette 2 and 7 participants were unable to rate lower than the expert due to the floor effect of the vignette). The standard deviation in ratings and difference ratings decreases as the vignette becomes increasingly under-nourished.

Table 10.

Descriptive Statistics of Rating Data

Vignette	n	Ratings M	Ratings SD	Rating Diff Min	Rating Diff Max	Rating Diff M	Rating Diff SD
1 (2)	63	2.14	0.82	-1	2	0.14	0.82
2 (1)	72	1.64	0.76	0	3	0.64	0.76
3 (4)	66	2.97	0.74	-2	1	-1.03	0.74
4 (4)	67	3.03	0.85	-2	1	-0.97	0.85
5 (2)	68	1.94	0.73	-1	1	-0.06	0.73
6 (2)	67	1.75	0.75	-1	1	-0.25	0.75
7 (1)	65	1.37	0.49	0	1	0.37	0.49
8 (3)	76	3.03	0.78	-1	1	0.03	0.78
9 (2)	69	1.58	0.58	-1	1	-0.42	0.58
10 (4)	67	2.94	0.89	-3	0	-1.06	0.89

The differences in ratings between the experts and participants were further explored for normalcy. The histogram of the data are presented in Figure 3. The data appears to be normally distributed indicating a primary assumption of linear models was not violated.

Figure 3. Difference in Rating Between Participant and Experts
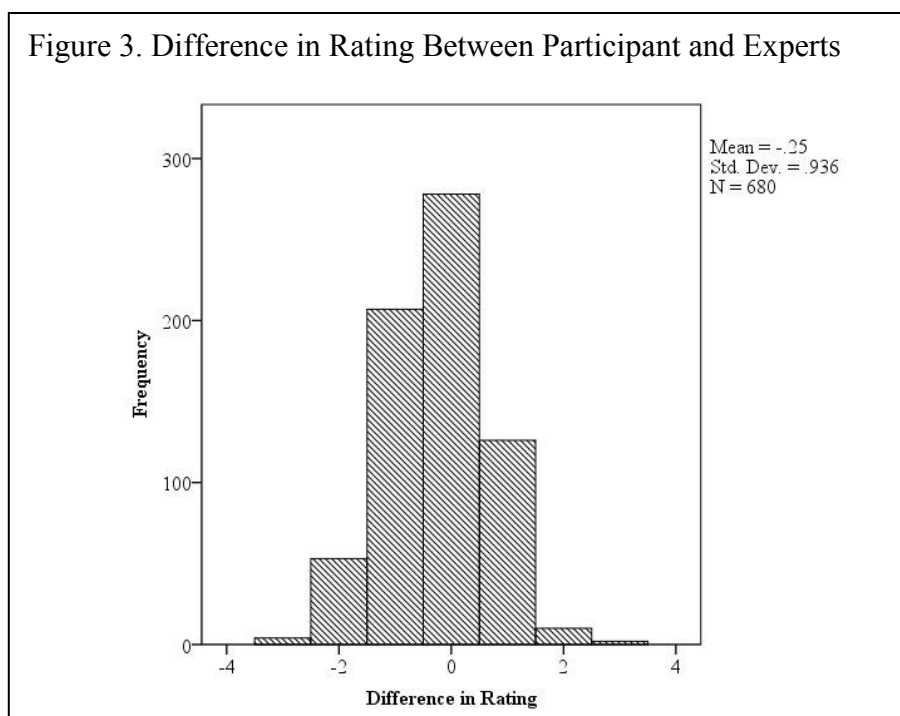
The absolute differences in rating between the participants and experts are shown in Table 11. The differences in ratings represent the sum of difference of the participants' ratings from the expert rating, regardless of direction. The difference in rating rate represents the differences in rating divided by the number of participants who rated the vignette. Under-rated and over-rated variables represent the frequency participants chose ratings below or above the experts. Vignettes 2 and 7 had the lowest possible rating by the experts, hence it was not possible for the participants to choose a rating lower than the experts. Across vignettes the range of absolute differences in ratings between the participants and the experts was 0 to 3 ($M = 0.70$, $SD = 0.67$). This table further demonstrates participants were more likely to have errors on vignettes when the vignettes represented a well- or over-nourished patient. Over-rated and under-rated columns

were included to provide information about direction of that error, more

commonly occurring in under-rated than over-rated vignettes.

Table 11.

Absolute Differences of Rating Data

Vignette	*n*	Diff rating	Diff rating rate	Under-rated	Over-rated
1 (2)	63	35	0.56	13	18
2 (1)	72	46	0.64	N/A	36
3 (4)	66	70	1.06	51	1
4 (4)	67	73	1.09	50	4
5 (2)	68	36	0.53	20	16
6 (2)	67	41	0.61	29	12
7 (1)	65	24	0.37	N/A	24
8 (3)	76	46	0.61	22	24
9 (2)	69	35	0.51	32	3
10 (4)	67	71	1.06	45	0

Confidence Data

Using the same data set as the ratings, participants' confidence in their

nutritional CDM was analyzed. Confidence was measured on a 0 to 100 percent

scale. The range, mean, and standard deviation for each vignette are reported in

Table 12. Across vignettes the range of confidence in ratings was 10 to 100 ($M =$

70.06, $SD = 18.13$). Confidence was measured to determine if the participants'

confidence affected the accuracy of their CDM. The range and standard deviation

of confidence scores was relatively large; the mean of 70% confidence indicates

overall participants were not highly certain of their CDM regarding nutrition.

Table 12.

Confidence Statistics

Vignette	*n*	Confidence Min	Confidence Max	Confidence *M*	Confidence *SD*
1 (2)	63	20	100	68.10	17.05
2 (1)	72	20	100	70.44	18.40
3 (4)	66	35	100	66.12	18.43
4 (4)	67	20	100	72.10	18.07
5 (2)	68	31	100	71.07	17.81
6 (2)	67	10	100	68.72	20.39
7 (1)	65	20	100	75.65	18.32
8 (3)	76	30	100	70.16	16.04
9 (2)	69	20	100	70.38	18.08
10 (4)	67	20	100	67.75	18.02

Confidence in ratings was further explored for normalcy. The histogram of the data is presented in Figure 4. The data appears bimodal and skewed to the right. The most common rating was 50%, indicating a large number of nurses believe their accuracy on rating nutritional status is just as likely to be wrong as it is right. Considering the impact nutrition plays in health, this is concerning. Due to the lack of normalcy, any linear model must be interpreted with caution.

Figure 4. Confidence in Nutritional Rating

Mean = 70.06
Std. Dev. = 18.126
N = 680

(y-axis: Frequency; x-axis: Confidence in Rating)
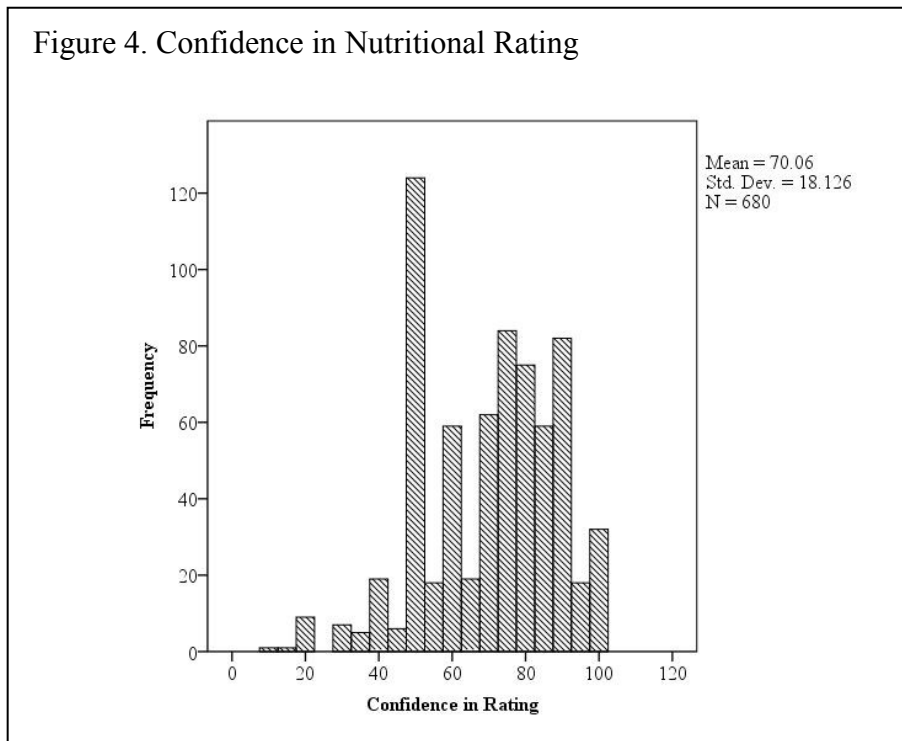
Cue Selection Data

Analysis of cue selection occurred on the subset of the rating and confidence dataset in which participants had selected one or more cues for five vignettes ($n = 94$). Cues were selected as either "on" indicating the cue supported the rating selection or "off" indicating the cue did not support the rating. Descriptive statistics of overall cues selected for the 10 vignettes are presented in Table 13. The range, mean, and standard deviation for each vignette are reported. The number in parenthesis indicates the total number of cues available to be selected within that vignette; the column, expert cues, contains the number of cues the expert selected for that vignette. The differences between participant cue selection compared to the expert total cue selection is also reported. Across vignettes the differences in cue selection between the participant and the experts were 1 to 16 ($M = 8.44$, $SD = 2.46$). This table displays participants selected far

fewer cues than the experts did, across vignettes regardless of the rating of the vignette, the overall cues available in the vignette, and the number of cues the experts selected. The difference in cue selection between the participants and the experts on average, is larger than the number of total cues selected by the participants.

Table 13.

Cue Selection Statistics

Vignette	*n*	Expert Cues	Cues Min	Cues Max	Cues *M*	Cues *SD*	Cue Diff Min	Cue Diff Max	Cue Diff *M*	Cue Diff *SD*
1 (22)	41	9	2	16	5.85	3.39	4	12	7.68	1.80
2 (22)	45	11	3	16	6.91	3.18	4	11	7.42	1.84
3 (26)	46	11	1	17	6.52	3.72	4	16	9.57	2.55
4 (24)	48	13	1	16	6.21	3.92	3	14	9.71	2.10
5 (21)	49	12	1	14	6.31	3.53	2	12	8.63	2.23
6 (19)	50	10	1	13	6.26	2.67	3	10	7.10	1.81
7 (23)	40	15	4	15	9.50	3.00	3	13	7.70	2.61
8 (20)	60	12	1	15	6.10	3.09	3	13	8.80	2.10
9 (18)	47	17	4	16	8.32	3.25	1	13	8.68	3.25
10 (12)	46	24	1	14	7.50	3.62	3	16	8.89	2.69

Differences in cue selection were further explored for normalcy. The histogram of the data are presented in Figure 5. The data appears to be normally distributed. A normal distribution indicates there is expected variety of responses among the participants, and on this variable there is not a violation of normalcy.
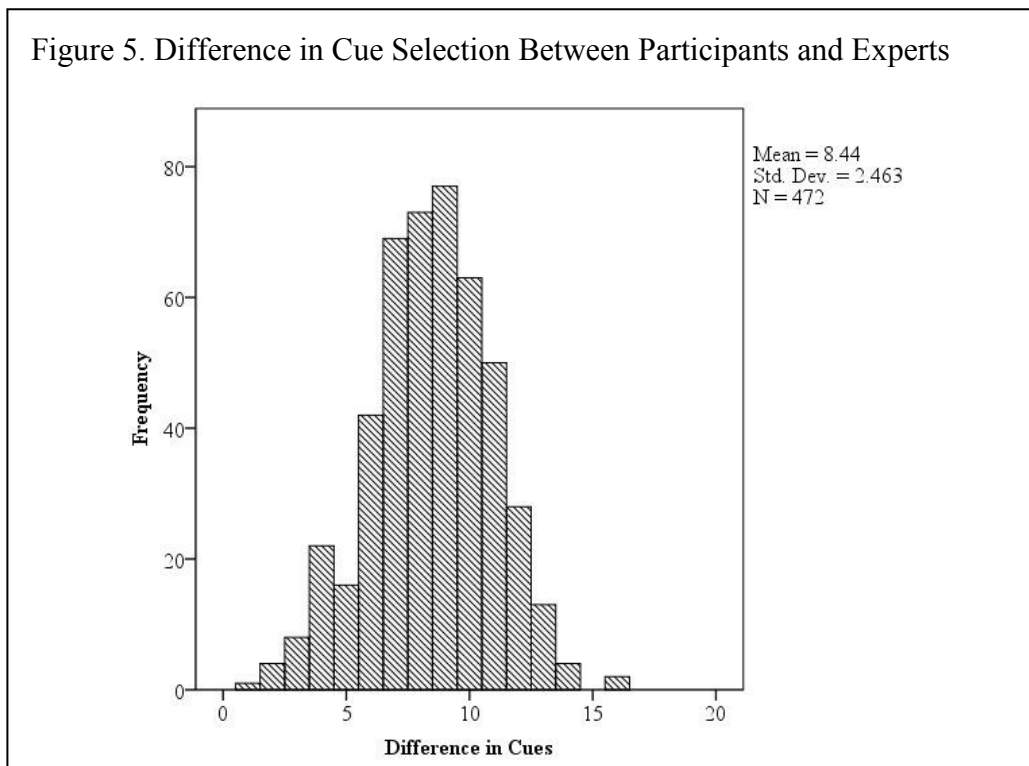
Figure 5. Difference in Cue Selection Between Participants and Experts

Mean = 8.44
Std. Dev. = 2.463
N = 472

Frequency (y-axis)
Difference in Cues (x-axis)

Research Question 1. How accurately do pediatric oncology nurses assess patient nutritional status?

The aim of Research Question 1 was to determine how accurately nurses make clinical decisions regarding pediatric oncology patients' nutritional status based on clinical vignettes. Tables 6 and 7 report the differences in participants' and experts' ratings, or the accuracy of ratings. These data are displayed in Figure 6 in order of vignette rating, from the experts' lowest nutritional rating to highest nutritional rating. Vignettes 2 and 7 were rated by experts as under-nourished. As this was the lowest possible rating, participants were unable to choose a rating below the experts rating; because of this vignettes 2 and 7 were removed from Figure 6. Vignettes 1, 5, and 6 were rated by the experts as at-risk for under-nutrition. Vignette 8 was rated as well-nourished. Vignettes 3, 4, and 10 were

rated as at-risk for over-nutrition. Figure 6 displays in all but two of the vignettes

(1 and 8) the mean difference in rating is below the experts' rating; and the more

nourished the patient presented in the vignette became, the greater the mean

difference in rating becomes.

Figure 6. Accuracy of Participant Rating
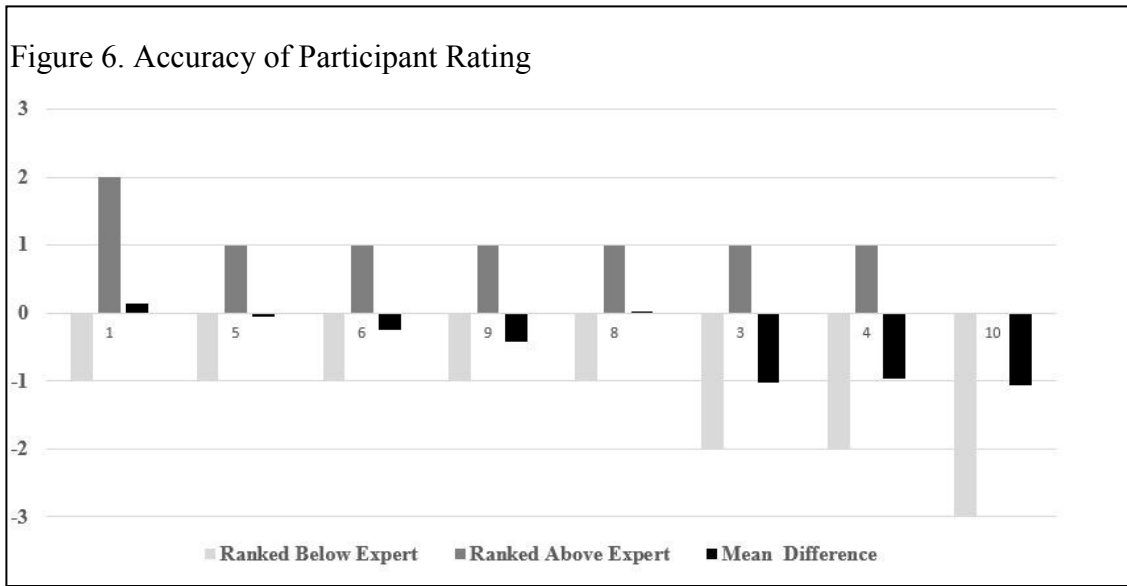
To further explore ratings, an independent-sample t test was applied to

compare the difference between the participants' and experts' ratings based on if

the vignette was rated as under-nourished or over-nourished. The difference,

regardless of direction (Table 11) was used to determine if participants were more

or less likely to be accurate based on if the vignette represented an under- or over-

nourished patient. The two samples were vignettes the experts had rated as under-

nourished or at-risk of under-nourishment and vignettes the expert rated as well-

nourished or at-risk of over-nourishment (see Table 14). There was a significant

difference for under-rated vignettes ($M = 36.17$, $SD = 7.40$) and other vignette (M

$= 65.0$, $SD = 12.73$) conditions; $t (3) = -4.59$, $p = 0.002$. Participants were more

likely to be accurate when the patient was under-nourished than well- or over-nourished.

Table 14.

Under- Versus Over-Nourished Differences

Vignette	Under-nourished Rating Difference	Vignette	Well-nourished Rating Difference	Vignette	Over-nourished Rating Difference
1	35	8	46	3	70
2	46			4	73
5	36			10	71
6	41				
7	24				
9	35				

In addition, another independent sample *t* test was completed removing vignette 8 (well-nourished vignette) from the analysis. The two groups are under-nourished and at-risk for under-nourishment compared to at-risk of over-nourishment. There was a significant difference between vignettes the experts' rated as being under-nourished ($M = 36.17$, $SD = 7.36$) and vignettes rated at-risk of over-nourishment ($M = 71.33$, $SD = 1.53$) conditions; $t(3) = -7.93$, $p = <0.001$. Nurses' accuracy was significantly improved when the vignette represented an under-nourished patient versus an over-nourished patient.

Research Question 2. Which nurse or organization specific factors affect the accuracy of pediatric oncology nurses' CDM?

The aim of Question 2 was to determine if there are nurse or organization specific factors that affect pediatric oncology nurses' CDM. It was hypothesized

the accuracy of nurses' CDM would vary based on experience as measured by either education or years of practice, with more experienced nurses making more accurate decisions.

A linear mixed model regression analysis was used to analyze the accuracy of nutritional ratings. Analyses were applied to account for the within-subject's correlations since each participant responded to five individual vignettes. Only participants with complete data were included in the analysis ($n = 136$, representing 680 vignettes).

Initially all variables were explored and entered into a model with the dependent variable being the difference in participant nutritional ratings from the expert ratings. The model was found to be non-significant. Out of necessity the analysis was altered to be exploratory in nature. It was unknown which factors would be significant in participants' CDM.

The variables were then entered individually into the model and included demographic variables (see Appendix C), the NGSE items (see Appendix D) and researcher created variables. The researcher created variables including "under-rated"; this is a variable coding all vignettes rated below the experts' rating 0 and ratings equal to or greater than the experts' rating 1. The number of certifications was a sum of the number of individual certifications the participant selected. CPON® or CPHON® was created and included participants who had either CPON® or CPHON® credentials; individuals can hold either credential, but not both, as they represent the older and newer focus of the certification. Safety culture was a variable created by summing selections for safe number of patients,

safe acuity of patients and good team collaboration. NGSE was created as the sum of the individual items of the scale.

Results are reported in Table 15. Variables with a $p < 0.05$ are highlighted. Significant variables include: the specific vignette, under-rated score, practice setting, and access to a pediatric oncology registered dietician. (Table 15 also includes description of individual variables with the dependent variable being the accuracy of cue selection and confidence in nutritional rating.) For the rating data, there were only two variables that were significant, both related to the work environment of the participants.

Table 15.

Demographic and Organizational Variables

Variable	Rating Diff p-value	Cue Selection Diff p value	Confidence p value
Vignette	0.000	0.000	0.039
Under-rated	0.000	0.002	0.470
Confidence	0.927	0.721	
State	0.675	0.526	0.268
Age	0.643	0.314	0.068
Highest degree	0.791	0.110	0.019
APRN	0.499	0.590	0.012
Certified	0.791	0.369	0.571
Number of Certifications	0.947	0.046	0.400
Chemotherapy/Biotherapy provider	0.773	0.109	0.806
Chemotherapy/Biotherapy instructor	0.667	0.167	0.400
CPON	0.577	0.834	0.500
CPHON	0.425	0.333	0.698
CPON or CPHON	0.243	0.271	0.918
BMTCN	0.682	0.146	0.163
CPN	0.939	0.180	0.252
Years as RN	0.561	0.299	0.036
Years as pediatric RN	0.834	0.161	0.050
Hours worked	0.076	0.021	0.430

# of patients	0.792	0.905	0.106
# Pedi Onc patients	0.912	0.348	0.058
Type of institution	0.317	0.961	0.273
Practice setting	0.048	0.747	0.373
Magnet® Hospital	0.344	0.749	0.496
COG	0.322	0.568	0.800
COG nursing	0.428	0.532	0.248
Pediatric Oncology RD	0.042	0.230	0.174
Safe # of patients	0.853	0.194	0.024
Safe acuity of patients	0.464	0.282	0.208
Collaborates well	0.585	0.111	0.782
Safety culture	0.250	0.361	0.220
NGSE	0.942	0.251	0.002
Achieve goals	0.863	0.291	0.036
Will accomplish	0.923	0.561	0.078
Can obtain	0.240	0.148	0.009
Can succeed	0.824	0.291	0.010
Success overcome	0.615	0.020	0.065
Confident	0.289	0.099	0.007
Do tasks well	0.223	0.908	0.275
Can perform	0.880	0.346	0.049

Analysis of the accuracy of rating data was completed using a linear mixed method model. The dependent variable was the difference in rating between the experts' ratings and the participants' ratings. In an effort to remove highly correlated variables, variables that were sub-variables were excluded (i.e. years as pediatric oncology RN was not included since years as an RN was inclusive of pediatric oncology RN years). The included variables were: state of residency, highest obtained nursing degree, if the nurse was an APRN, type of institution, practice setting, if the institution had Magnet® status, if the institution was a member of COG, if the institution employed a pediatric oncology registered dietician, if the number of patients was safe, if the acuity of patients was safe, if the healthcare team collaborated well, the confidence in the rating, age of the

nurse, number of certifications of the nurse, number of years the nurse had been an RN, the number of hours worked per week, and the score on the NGSE.

The variable with the highest p value was removed and the model was reviewed for significance. This procedure was repeated removing the variable with highest p value until only significant variables remained. For the dependent variable rating accuracy, all variables were removed except for the final remaining variable, the institution employing a pediatric oncology registered dietician. (F (1, 132) = 3.74, p = 0.026).

Based on the significant difference between vignettes that contained under-nourished ratings and those with well- and over-nourished ratings, an additional model was analyzed with the dependent variable being "under-rated". This variable coded vignettes rated under-nourished and at-risk for under-nutrition as 0 and vignettes that were rated as well-nourished or at-risk for over-nutrition as 1. In an effort to remove highly correlated variables, variables that were sub-variables were excluded. The included variables were: state of residency, highest obtained nursing degree, if the nurse was an APRN, type of institution, practice setting, if the institution had Magnet® status, if the institution was a member of COG, if the institution employed a pediatric oncology registered dietician, whether the number of patients was safe, whether the acuity of patients was safe, whether the healthcare team collaborated well, the confidence in the rating, age of the nurse, number of certifications of the nurse, number of years the nurse had been an RN, the number of hours worked per week, and the score on the NGSE. The initial model was not significant. Next the variable with the

highest p value was removed and the model was reviewed for significance. This procedure was repeated removing the variable with highest p value until only significant variables remained. For the dependent variable under-rated, all variables were removed except the final variable, the institution employed a pediatric oncology registered dietician. (F (1, 132) = 3.58, p = 0.031).

Confidence in the nutritional rating was also analyzed. Initially all individual variables were entered with the dependent variable being confidence. In an effort to remove highly correlated variables, variables that were sub-variables were excluded. The included variables were: state of residency, highest obtained nursing degree, if the nurse was an APRN, type of institution, practice setting, if the institution had Magnet® status, if the institution was a member of COG, if the institution employed a pediatric oncology registered dietician, if the number of patients cared for was safe, if staffing for the acuity of patients was safe, if the healthcare team collaborated well, confidence in the rating, age of the nurse, number of certifications of the nurse, number of years the nurse had been an RN, the number of hours worked per week, difference in nutritional rating between expert and participant, and the score of the NGSE. The initial model was not significant. Again an exploratory analysis was performed to individually explore variables related to CDM (see Table 15, page 81). Variables that were proxies for more experience and the self-efficacy scores, were the variables that were significant in relation to confidence.

Next the variable with the highest p value was removed and the model was reviewed for significance. This procedure was repeated removing the variable

with highest *p* value until only significant variables remained. For the dependent

variable confidence, the significant model is reported in Table 16 and includes

highest nursing degree obtained and safe number of patients. Coefficients are

listed in Table 17. As the level of degree increases, so does the confidence of the

nutritional rating. However, the participant's experience of caring for a safe

number of patients does not follow a linear increase or decrease in confidence

ratings.

Table 16.

Confidence Mixed Model

Variable	Numerator df	Denominator df	F	p value
Intercept	1	124	391.27	<0.001
Highest Degree	6	124	2.49	0.026
Safe number of patients	4	124	2.48	0.047

Table 17.

Coefficients in Confidence Model

Variable	Estimate	t	p value
Intercept	58.71	5.30	<0.001
Diploma	29.28	2.11	0.37
AD of ADN	16.88	1.31	0.194
BS or BSN	12.63	1.17	0.246
MS or MSN	22.34	1.94	0.054
DNP	26.42	1.89	0.062
PhD	41.29	2.23	0.028
Other	Baseline		
Strongly Disagree	-0.16	0.99	0.989
Disagree	5.92	0.26	0.257
Neither Agree nor Disagree	-11.89	0.02	0.024
Agree	-4.74	0.12	0.117
Strongly Agree	Baseline		

In addition, a Pearson's correlation was calculated to explore the relationship between confidence and difference in ratings between the participants and experts. There was no correlation between the two variables ($r = 0.01$, $n = 680$, p = 0.893).
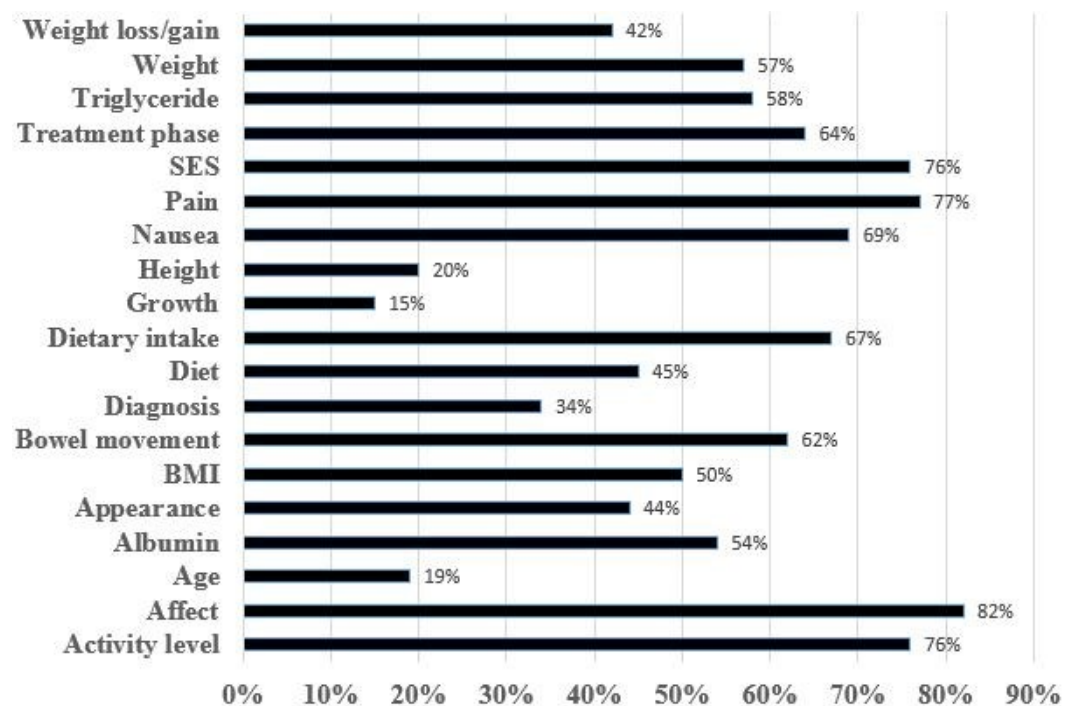
Research Question 3. What patient cues do pediatric oncology nurses' consider when making clinical decisions about a patient's nutrition assessment?

The aim of Research Question 3 was to determine the number of nutritional patient cues nurses selected when making clinical decisions and if the nurses' selected cues were correlated with the experts' selected cues.

Table 13 displays the number range, mean, and standard deviation of the cues participants selected in each vignette as well as the difference in participant cue selection when compared to the expert selection.

Cue selection for the individual nutritional variables of interest was examined. The nutritional cues of interest are described in Appendix E First, the nutritional variables of interest were examined within individual vignettes; then combined across vignettes. The percent reported indicated the percentage of participants' whose cues selection matched the experts' cue section as a measure of accuracy for cue selection (see Figure 7). The patient's sex is not reported as a variable of interest secondary to the experts being unable to reach consensus if the cue should be selected as being supportive of a nutritional rating or not. Overall accuracy of cue selection across the nutritional variables of interest was 54.63%.

Figure 7. Participant Cue Selection Accuracy

Variable	Accuracy
Weight loss/gain	42%
Weight	57%
Triglyceride	58%
Treatment phase	64%
SES	76%
Pain	77%
Nausea	69%
Height	20%
Growth	15%
Dietary intake	67%
Diet	45%
Diagnosis	34%
Bowel movement	62%
BMI	50%
Appearance	44%
Albumin	54%
Age	19%
Affect	82%
Activity level	76%

Accuracy of cue selection was further explored based on if the cue was selected as "on" (contributing to the nutritional rating in the vignette) or "off" (not contributing to the nutritional rating in the vignette). The accuracy for each nutritional variable of interest is listed in Table 18, page 88. Across variables accuracy for cue selection when the variable was 'on' (supportive of the nutritional rating) ranged from 16 to 75 ($n = 16$, $M = 48.06$, $SD = 18.64$) and when the variable was 'off' (did not support the nutritional rating) ranged from 53 to 99 ($n = 10$, $M = 75.90$, $SD = 15.42$). An independent sample t test was performed to explore if there was a difference in accuracy if the cue was on versus when the cue is off; $t (24) = -4.23$, $p = <0.001$, Participants were significantly more likely to match the experts when the cue was off than when the cue was on.

Table 18.

On or Off Cue Accuracy

Variable	Expert On	Expert Off
Activity level	62%	87%
Affect	n/a	89%
Age	19%	n/a
Albumin	n/a	53%
Appearance	35%	72%
BMI	49%	n/a
Bowel movement	59%	83%
Diagnosis	33%	n/a
Diet	47%	n/a
Dietary intake	75%	n/a
Growth	16%	n/a
Height	25%	n/a
Nausea	73%	57%
Pain	68%	81%
Socioeconomic status	31%	99%
Treatment phase	46%	80%
Triglyceride	n/a	58%
Weight	57%	n/a
Weight loss/gain	42%	n/a

Research Question 4. Which nurse or organizational factors affect patient cue selection when making clinical decisions about a patient's nutritional status?

The aim of Question 4 was to determine if there are nurse or organizational specific factors that affect cue selection. It was hypothesized nurse cue selection will vary based on the experience as measured by either educational background or years of practice of the nurse. More experienced nurses will identify and utilize a greater number of cues.

Initially all variables were entered with the dependent variable being difference in cue selection between the participants and the experts. In an effort to remove highly correlated variables, variables that were sub-variables were excluded. The included variables were: state of residence, highest obtained nursing degree, if the nurse was an APRN, type of institution, practice setting, if the institution had Magnet® status, if the institution was a member of COG, if the institution employed a pediatric oncology registered dietician, if the staffing for the number of patients was safe, if the staffing for the acuity of patients was safe, if the healthcare team collaborated well, the confidence in the rating, age of the nurse, number of certifications of the nurse, number of years the nurse had been an RN, the number of hours worked per week, difference in nutritional rating between expert and participant, and the score on the NGSE. The initial model was not significant.

An exploratory analysis was then performed, entering each variable into the model individually (see Table 15, page 81). The number of certifications and hours worked, representing both nursing excellence and experience, were the only significant variables in this analysis. A large number of variables that have been known to be significant in other CDM studies were not significant for accuracy of cue selection for nutritional status.

Next the variable with the highest p value was removed and the model was reviewed for significance. This procedure was repeated removing the variable with highest p value until only significant variables remained. For the dependent variable difference in cue selection, the significant model is reported in Table 19

and includes the variables state of residency, highest obtained nursing degree, type of institution, if Magnet® accredited, safe staffing for acuity of patients assigned, difference in nutritional ratings between the participants and experts, age of the participants, number of certifications, years as an RN, and number of hours worked per week. Coefficients are listed in Table 20.

Table 19.

Cue Selection Mixed Model

Variable	Numerator df	Denominator df	F	p value
Intercept	1	43.53	15.29	<0.001
State	31	45.41	2.43	0.003
Highest Degree	6	43.78	3.44	0.007
Institution	3	44.70	4.30	0.009
Magnet	1	45.63	4.98	0.031
Safe Acuity	4	44.57	6.46	<0.001
Rating Difference	1	420.24	9.49	0.002
Age	1	43.49	8.19	0.006
Number of Certification	1	43.72	7.44	0.009
Years as RN	1	43.49	8.42	0.006
Hours worked per week	1	43.75	18.94	<0.001

Table 20.

Cue Selection Coefficients

Variable	Estimate	t	p value
Intercept	13.23	4.44	<0.001
Alabama	-2.91	-1.20	0.237
Arizona	-2.01	-1.80	0.079
Arkansas	-0.77	-0.52	0.607
California	-3.96	-4.68	<0.001
Colorado	-1.09	-1.24	0.223
Delaware	0.91	0.63	0.530
District of Columbia	-0.75	-0.70	0.487
Florida	-1.66	-1.45	0.155
Georgia	-1.12	-1.16	0.252

Idaho	-3.63	-1.49	0.137
Illinois	-2.41	-2.23	0.031
Indiana	1.30	0.95	0.347
Iowa	-3.59	-2.99	0.005
Kansas	-1.87	-1.29	0.205
Louisiana	-0.64	-0.56	0.577
Maryland	-7.03	-3.34	0.002
Massachusetts	-1.70	-2.36	0.023
Michigan	-0.23	-0.23	0.822
Minnesota	-1.97	-2.05	0.046
Missouri	-0.81	-0.57	0.572
New Jersey	-2.77	-2.54	0.015
New York	-3.60	-3.45	0.001
North Carolina	-0.14	-0.14	0.892
North Dakota	-0.21	-0.13	0.894
Oregon	-2.28	-1.87	0.068
Pennsylvania	-1.34	-1.20	0.235
Tennessee	-0.28	-0.32	0.753
Texas	-0.33	-0.44	0.665
Vermont	-2.95	-1.98	0.054
Virginia	-2.70	-2.22	0.032
Washington	-1.88	-1.81	0.078
Wisconsin	Baseline		
Diploma	-3.17	-1.34	0.188
AD or ADN	-6.33	-3.53	0.001
BS or BSN	-3.47	-2.23	0.031
MS or MSN	-3.06	-1.82	0.076
DNP	-4.00	-2.10	0.042
PhD	-7.73	-3.34	0.002
Other	Baseline		
Free Standing Pediatric	-1.28	-1.25	0.219
Combination Pedi and Adult	0.99	0.84	0.406
Pedi within an Adult	0.00	0.00	1.00
Other	Baseline		
Not Magnet	-0.94	-2.23	0.031
Magnet	Baseline		
Strongly Disagree	-0.23	-0.22	0.826
Disagree	1.76	3.06	0.004
Neither Agree nor Disagree	-0.43	-0.66	0.512
Agree	-0.91	-2.18	0.035
Strongly Agree	Baseline		
Rating Difference	-0.35	-3.08	0.002
Age	0.16	2.86	0.006
Number of Cert	0.45	2.73	0.009
Years as RN	-0.17	-2.90	0.006
Hours worked per week	-0.09	-4.35	<0.001

Figure 8 displays the average cue selection difference by state. This figure allowed further exploration of the reason for state of residency being included in the significant model (i.e. regional, population density). There was no discernable pattern that could explain why state of residence was significant.

Figure 8. Difference in Cue Selection by State
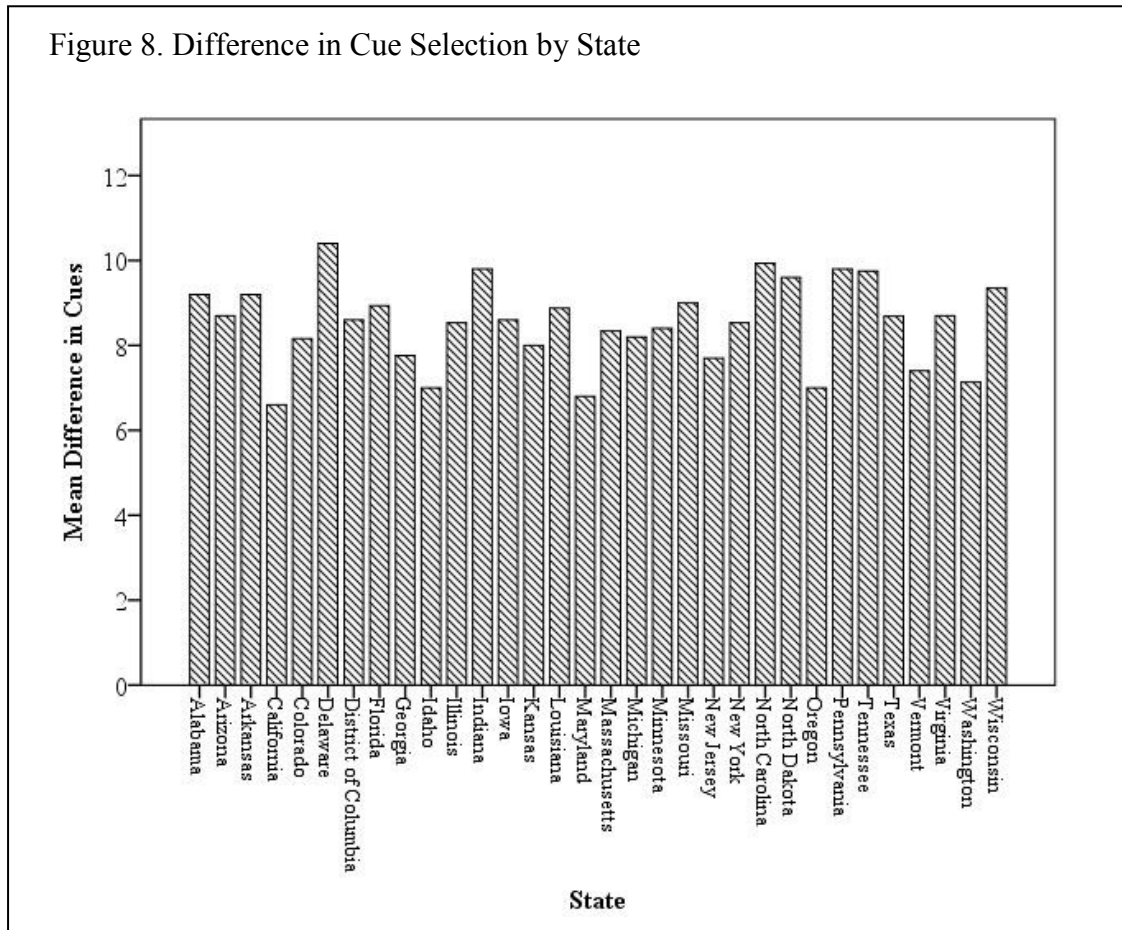
Summary

This chapter presented the study findings including demographic characteristics of the study sample and the results of the analysis for Research Questions 1, 2, 3, and 4. These questions explored the CDM of registered nurses regarding nutritional assessment of pediatric oncology patients, how confident

nurses are of those ratings, and the cues nurses select to support their nutritional ratings.

In summary, the results indicate that nurses tend to under-rate the nutritional status of pediatric oncology vignettes and have wider differences from experts on over-nourished vignettes than on under-nourished vignettes. There was no identifiable model of nurse and organizational factors to explain nurses' rating; however, a two-variable model with confidence as the dependent variable was created. A model for cue selection was created indicating participants were significantly less likely to be accurate when the cue was selected as "on". Overall, there was little correlation between participants' cue selection and experts' cue selection.

CHAPTER 5

Discussion

Introduction

The aims of this descriptive study were to determine: 1) how accurately nurses make clinical decisions regarding pediatric oncology patients' nutritional status, 2) if there are nurse or organizational specific factors that affect pediatric oncology nurses' clinical decision making (CDM), 3) how many and which of the presented nutritional patient cues nurses select when making clinical decisions and if the nurses' selected cues are correlated with experts' selected cues, and 4) if there are nurse or organizational specific factors that affect cue selection. This chapter will summarize the study findings, present and interpret the conclusions, and discuss the study's limitations. The implications for nursing, including clinical practice, research, and policy also will be addressed. Participants in the study were pediatric oncology nurses who regularly provide direct patient care. The expert panel was comprised of pediatric oncology registered dieticians, an epidemiologist researching nutrition in pediatric oncology patients, and an expert pediatric oncology registered nurse.

Characteristics of the Study Sample

Based on all the demographic and organizational factors, the participants in this study were somewhat younger, more educated, and worked in environments that were more likely to be high performing settings that endorse the provision of high quality pediatric oncology care. These factors make it likely

that the participants' knowledge and performance is at least as good, if not better, than the United States nursing population as a whole.

The participants included in the study were described in Chapter 4. There were no significant differences in demographics between total number of participants who responded and the two data sets analyzed, one for rating/confidence and the second for cue selection. Participant demographic information was compared to population based studies available in the literature.

With no comprehensive registry of nurses in the United States, it is difficult to determine demographics for this population. Average age ranges from 43.9 years old (DataUSA, n.d.) to 50 years old (American Nurses Association [ANA], 2014) for nurses in the United States. The vast majority of the nurses (n=237) who participated in this study were from the United States. The average age of total participants in the data set ranged from 39.41 years to 40.25 years. Although the participants were a little younger than overall national statistics for the nurses' mean age; it does not appear that this sample differed substantively from national norms.

According to the ANA (2014), 55% of the RN workforce has a bachelor's degree or higher. The average of participants reporting the highest nursing degree as a bachelor's degree ranged from 89.5% to 90%. The difference between the population and participants' average is significant ($t\,(2) = -12.70$, $p = 0.006$.) The participants in the study held higher nursing degrees on average than the population of nurses in the United States. Pediatric oncology nurses may hold

higher degree levels due to increasing preferences or demands by employers for nurses to have a minimum of a bachelor's degree (ANA, 2014).

Nurses who are educated to at least the bachelor's level may have a fuller understanding of the impact of research on clinical care, making them more likely to participate. In order for baccalaureate nursing schools to be accredited, the curriculum must contain content on developing and using evidence, including a preliminary understanding of research methods (Accreditation Commission for Education in Nursing, 2017; American Association of Colleges of Nursing, 2008). With a higher proportion of more educated nurses than the population, it is possible the participants were more knowledgeable and thus more able to rate and select cues accurately than the general population of nurses.

Certification of nurses was also explored. Participants in the study reported a certification rate of approximately 72%. It is difficult to compare participant certification rates to the general nursing population. There is no central registry of nurses by specialty; all nurses in the United States are licensed as generalists. In addition, there are multiple organizations that offer certification for nurses. The most common certifications reported by participants in this study were Certified Pediatric Oncology Nurse (CPON®)/Certified Pediatric Hematology Oncology Nurse (CPHON®) and Certified Pediatric Nurse (CPN®). The CPON®/CPHON® is offered by the Oncology Nursing Certification Corporation (ONCC) while CPN® is offered through the Pediatric Nursing Certification Board (PNCB). However, there are also other relevant certifications, such as the credential of board certified pediatric nurse from the American Nurses

Credentialing Center (ANCC). There are also multiple certifications nurses in the

United States population may hold that are not directly relevant to pediatric

oncology nursing, such as the Certified Flight Registered Nurse offered through

the Board of Certification for Emergency Nursing, but may contribute to nurses'

overall expertise.

Of the participants in the study, 10% to 14% had CPON®, 27% to 37% of

participants had CPHON®, 2% to 3% had BMTCN®, and 21% to 27% of

participants held the CPN® credential. There are approximately 2,850,000 nurses

in the United States (Bureau of Labor Statistics, 2016). The ONCC (2015) reports

total certification rates for 2016 to be 1,143 for CPON®, 1,898 for CPHON®, and

798 for BMTCN®. The PNCB states there are over 25,091 CPN®s (PNCB,

2017). Of the population of nurses in the United States, approximately 0.04%

have CPON®, 0.07% have CPHON®, 0.03% have BMTCN®, and 0.9% have

CPN®. This study has significantly higher percentage of nurses obtaining the

preceding certifications, however that does not confirm the sample is has a higher

certification rate than the general population of nurses. While it is not possible to

estimate the rate of certified nurses in the general nursing population, based on the

current study's overall certification rate above 70%, it is likely the rate of

certification among the participants is larger than the general nursing population.

Certified nurses are reported to have better outcomes on nurse-sensitive

indicators such as hospital associated infections (Boey, Xue, & Ingersoll, 2015)

and patient falls (Boyle, Cramer, Potter, & Staggs, 2015). Certified nurses have

also been shown to have superior knowledge regarding pain assessment and

management when compared to noncertified nurses (Beck et al., 2016). The relationship between CPON®, CPHON®, BMTCN®, and CPN® in relation to nurse sensitive indicators and knowledge is not known; future research should explore how these certifications are correlated with indicators of nursing excellence.

For organizational factors 66% to 71% worked at Magnet® institutions. There are 5,534 registered hospitals in the United States (American Hospital Association, 2018), currently 463 (8.4%) have Magnet® recognition (ANCC, 2018). Magnet® institutions have been found to have lower morbidity and mortality than non-magnet intuitions (Friese, Xia, Ghaferi, Birkmeyer, & Banerjee. 2015; Kutney-Lee et al., 2015). Thus, having a high proportion of nurses working in these institutions provides further support for the contention that the study sample is reflective of highly qualified nurses working in environments that embrace optimizing nursing care and patient outcomes.

The participants' employment at Children's Oncology Group (COG) member institutions was reported; 86% to 88% of participants worked at COG member institutions. There are more than 200 COG institutions in North America, Australia, New Zealand, and Europe (COG, n.d). It is unknown how many non-COG member institutions treat pediatric cancer patients or if being a member of COG has any effect on nursing competencies, including CDM. The primary initiatives of the COG nursing discipline are the development of instructional programs to further nursing knowledge regarding care of patients on clinical trials and clinical summaries to guide protocol-related nursing care (Landier, Leonard,

& Ruccione, 2013). In additional the nursing discipline supports protocol development and developing and evaluating patient and family educational materials. COG does not routinely evaluate nurse sensitive indicators; this is an area in need of further research.

A review of the demographic and organizational variables reported in this study indicate that the participants were highly knowledgeable and working in environments supportive of nursing excellence. Due to these factors, the participants likely performed better than what would be expected of nurses in the general United States population. In spite of participation from a high performing group, there were still significant deficiencies in CDM regarding nutritional assessment.

Research Question 1. How accurately do pediatric oncology nurses assess patient nutritional status?

The accuracy of pediatric oncology nurses' nutritional assessment was explored by reviewing the difference in nutritional ratings between the participants and the experts. While the mean scores of the participants' ratings were similar to the experts' ratings, there were considerable discrepancies noted in individual participant's scores, indicating significant differences in CDM between the experts and the participants. Accuracy in CDM has not been extensively explored in the nursing literature. This is the first study to explore accuracy of CDM regarding nutritional assessment that could be identified. The majority of nursing studies investigating decision making have focused on a specific clinical phenomenon with established best practices or guidelines specific to nursing care (Meeks-Sjostrom, 2013; Usher et al., 2010). In these studies, the

nurses rated the phenomenon similarly with the guidelines as explicated in the examples below.

Using a vignette design, Usher and colleagues (2010) investigated the administration of psychotropic medications in Australia and found greater than 75% of nurses chose answers which demonstrated current best practices. Meeks-Sjostrom (2013) reported that emergency nurses accurately rated vignettes of elder abuse (98%, 93%, 91% and 80% across four vignettes) according to current best practices. However, it is unknown if these studies are correlated to CDM in the absence of clinical guidelines or best practices, such as nutritional assessment. The accuracy of the study, 41%, was lower than reported in other accuracy studies. Further studies exploring if accuracy in the absence of best practices or clinical guidelines is also poor for other phenomenon; also further exploration considering if CDM improves when best practices or clinical guidelines are developed and implemented is warranted.

The most notable finding in this study regarding nurses' rating accuracy was that they were more likely to under-rate rather than over-rate the nutritional status of pediatric oncology patients. Of note, the experts rated two of the vignettes as the lowest possible rating; it was impossible for two of the ten vignettes to be under-rated by the study participants. There were no vignettes with the highest rating; hence it was always possible to over-rate nutritional status in a vignette. It is conceivable the results may have been even more extreme if it was possible to under-rate all vignettes.

In general, the average study participant rated the vignettes lower than the experts. Participants' under-rating of nutritional status increases as the nutritional status of the patient depicted in the vignette increases. Overall the accuracy of participants' ratings compared to the experts was poor as participants and experts agreed less than half (41%) the time. This is especially concerning recognizing that the participants in this study are likely performing better than the general nursing population. None of the variables correlated with CDM in other studies, such as experience and education level, correlated with performance in the study.

The most common error in rating was under-rating the nutritional status of the patient presented in the vignette, regardless of the degree of nutritional status being depicted. Cancer treatment causes multiple side effects that create risk for under-nutrition in patients, such as nausea, vomiting, diarrhea, and altered taste. Historically, it was difficult to control these side effects and many cancer patients were under-nourished. It is possible nurses, who are frequently assessing and intervening for these side effects, focus primarily on the cues representing these side effects while missing the cues that may indicate over-nutrition.

Assessing and intervening for malnutrition, both under-nutrition and over-nutrition, is imperative. Patients who are under-nourished have increased risk of morbidity and mortality (Hudgins et al., 2016; Lange et al., 2005; Orgel et al., 2014). Identifying patients as under-nourished when they are well-nourished may expose the patient to unnecessary interventions. However, failing to accurately identify when patients are over-nourished is equally problematic since being over-

nourished also increases morbidity and mortality (Altaf et al., 2013; Hingorani et al., 2011; Lange et al., 2005; Meacham et al., 2005).

Research Question 2. Which nurse or organization specific factors affect the accuracy of pediatric oncology nurses' clinical decision making?

The investigation of the organizational and nurse factors were not found to be significant in determining accuracy of nurses' CDM. There were no combination of nurse and organizational factors that predicted the accuracy of the participants' nutritional ratings of the child portrayed in the vignettes. This was an unexpected finding, especially in light of other studies identifying nurse factors such as experience, and organizational factors such as collaborative teamwork and access to educational resources, that have improved CDM (Benner, 1984; Gazarian, Henneman, & Chandler, 2010; Hamers et al., (1997).

In determining the lack of a significant model, there are a number of possibilities that may be implicated. It is possible the sample was too homogenous (i.e., high percentage of highly educated certified nurses, high percentage of Magnet® institutions) or the convenience sample was not representative, so the differences in nurse and organizational factors were not as apparent (Peterson & Merunka, 2014). It is also possible the overall nutritional assessment abilities of nurses are uniformly poor (Kalisch, Landstrom, & Williams, 2009; Rnanic, Hall-Lord, Bååth, & Larsson, 2008). Nursing students who attend accredited baccalaureate nursing programs receive some formal education on nutrition (American Association of Colleges of Nursing, 2008), but the curriculum tends to focus more on the components of nutrition (i.e., protein, fat, carbohydrates, vitamins, minerals) then applied clinical nutrition including assessments,

especially in the presence of illness. Lack of applied nutrition education, combined with a lack of standardized clinical guidelines for assessment, leaves nurses relying on other decision making strategies, such as intuition and experience, for nutritional CDM. In addition, nutritional assessment is not a routine part of most nurses' assessments. Nurses do routinely assess and document intake and output, however they do not routinely assess and document comprehensive nutritional status. These suppositions are supported by clinical practice experience. Anecdotally, there are multiple reports from pediatric oncology nurses they do not feel well prepared to assess nutritional status—both from a lack of education and limited clinical practice.

Confidence in the CDM of the participants was also explored. The most common confidence in rating score by participants was 50%, the average score for confidence in the nutritional rating was 70%. A 50% confidence rating implies the participants believe the odds of their rating being accurate is similar to the odds of being inaccurate. A mean of below 75% indicates the participants overall are closer to believing their accuracy to be uncertain (50%) than certain (100%). Confidence scores for the participants could be higher than the nursing population, not only due to the demographic factors previously discussed, but also due to self-selection. Of the total participants ($n = 318$), 51 (16%) dropped out of the study when first asked to rate nutritional assessment; possibly this drop-out was due to lack of confidence in nutritional assessment. Making errors in care has been found to be traumatic for nurses (Schelbred & Nord, 2007; Wolf, Serembus, Smetzer, Cohen, & Cohen, 2000). The fear of making an error, may have caused

nurses with lower confidence levels to drop out instead of proceed with the survey. This provides some support for the supposition that the reason a significant explanatory model of nurse and organizational factors contributing to nutritional ratings was not found; specifically, overall, nurses are uniformly not well prepared to conduct nutritional assessments (Kalisch, Landstrom, & Williams, 2009; Rnanic, Hall-Lord, Bååth, & Larsson, 2008).

Thee model that predicted confidence scores included--highest nursing degree obtained and a safe number of patients. Examining the coefficients, confidence levels based on academic preparation was high for diploma nurses, decreased in nurses who held a bachelor's degree, and then again increased for master's prepared nurses, and the highest levels were noted in nurses with doctoral degrees. The literature suggests more experienced nurses tend to be more confident in their decision making (Hamers et al., 1997; Lavelle & Dowling, 2011; Yang & Thompson, 2010). Actively employed diploma nurses are likely to be older and more experienced as there are few diploma programs remaining in the United States. Additionally, nurses with advanced degrees are also more likely to be experienced as it takes longer to get an advanced degree, and many nurses return for advanced degrees after a period of clinical practice. The literature further suggests nurses with master's degrees and those with five or more years in clinical practice had superior critical thinking skills (Chang, Chang, Kuo, Yang, & Chou, 2011). It may also be possible that nurses with advanced degrees had more exposure to nutritional content, although this is not generally a requirement of graduate nursing education programs.

The "safe number of patients" variable served as a proxy for safe practice environment with adequate resources. Having a safe number of patients allows nurses enough time to adequately assess, plan, intervene, and evaluate patients. In absence of a safe number of patients, nurse rush from task to task, failing to recognize subtle patterns required for accuracy of CDM. Not having the time to fully assess patients, and develop pattern recognition skills, may lead to decreased confidence. However, the direction of the safe number of patients variable is perplexing. There is no noticeable pattern that is supported by the literature or experiential evidence. It is possible that safe staffing in this model is statistically significant, but not clinically relevant.

While confidence may be significantly related to experience, it is not correlated with accuracy. The current study supports this finding as does evidence in the literature (Hamers et al., 1997; Lavelle & Dowling, 2011; Yang & Thompson, 2010). With more experience, nurses become more comfortable in their practice including their assessment and CDM. It is possible as the comfort level increases, the realization of the uncertainness associated with decision making diminishes, leading to higher levels of confidence. Benner, Hughes, and Sutphen (2008) noted that expert nurses had a greater sense of confidence in their situations and took less time to differentiate clinical problems than less experienced nurses. In addition, nurses are aware their decisions can have major effects, sometimes even life and death, on their patients (Schelbred & Nord, 2007; Wolf, Serembus, Smetzer, Cohen, & Cohen, 2000). It is possible experienced

nurses adopt confidence in their decisions as a means to cope with and feel some control over the inherent uncertainty that exists in providing patient care.

Overall, there were no identifiable nurse or organizational factors that predicted the accuracy of nurses' CDM. This finding was likely related to the poor accuracy in nurses' CDM regarding nutritional assessment. It is also possible that with a lack of best practice or standardized guidelines in nutritional assessment, access to more factors that have been known to contribute to improved CDM in other studies (such as advanced degrees, more experience, working for a Magnet® institution) cannot assist in improving the accuracy of the decision.

Research Question 3. What patient cues do pediatric oncology nurses consider when making clinical decisions about a patient's nutrition assessment?

Participants considered all the nutritional variables of interest, although to different degrees. Striking differences in cue selection were observed between the participants and the expert panel. For example, height, increase in height (growth), and age were considered supporting variables in less than 30% of the vignettes by the participants; however, the experts considered them to be supporting variables in 100% of the vignettes. Weight and weight loss were selected between 40% and 60% of the time by participants; experts selected those cues 100% of the time. The reason for this discrepancy is uncertain. It is possible that nurses in clinical practice fail to heavily rely on anthropometric data secondary to their experience with weight fluctuations in this patient population. Pediatric oncology patients' weight and changes in weight often are inaccurate

representations of true mass due to fluid shifts from hyper-hydration or high dose steroids, tumor burden or amputations (Bauer et al., 2011). It is possible nurses recognize that weight or changes in weight are often artificial due to multiple clinical side effects, thus it becomes routine to place little importance on these data.

Another interesting discrepancy between the participants and the expert panel was related to the importance of serum albumin as a nutritional cue. Participants selected serum albumin as a supporting nutritional cue 53% of the time, while the experts never selected serum albumin as supportive of nutritional status. Albumin is a controversial nutritional marker. It can be used as a marker for visceral protein status (American Academy of Pediatrics [AAP], 2009), however, albumin is affected by inflammation and may not be a good nutritional indicator in sick children (AAP, 2009; Bharadwaj et al., 2016). In addition, in a study of states of starvation albumin levels remained normal until the patient reached a body mass index of less than 12 or more than six weeks of starvation (Lee, Oh, Lee, & Finucane, 2015). The discrepancy of selecting serum albumin as a relevant cue may be related to the level of experience and expertise reflected in the expert panel. The conflicting views of albumin are more recent and the expert panel was more likely to have access to this information because of their immersion in nutritional literature which is less known to staff nurses. Another possibility is albumin levels are incorporated into some nutritional assessment tools which are used in clinical practice (Sala et al., 2012). Lastly, physicians continue to frequently rely on albumin levels as a gauge of nutritional status and

this practice may have influenced nurses' selection of this cue (Bharadwaj et al., 2016). Collectively, these findings are essential and indicate the need for improved educational support and the use of evidence-based practice as well as the need for drafting and routine review of policies and procedures specific to nutritional assessment to ensure the most up-to-date clinical practices are implemented.

Participants missed cues the experts had selected an average of 6.84 times and selected cues the experts did not an average of 1.6 times. There was a significance difference between missed cues and added cues by the participants. Participants were significantly more likely to select fewer cues than the experts than to add additional cues. This finding indicates nursing expertise requires the ability to simultaneously attend to and discriminate between numerous pieces of diverse data in making accurate clinical decisions. Accurate cue selection is essential to making accurate decisions.

Only in 16% of the vignettes did the participants and experts selected an equal number of cues. The reasons for this difference is unclear, but perhaps the experts were more aware of current research in nutritional support and all the cues that are relevant for the ratings. Nutritional assessment is a complicated process, requiring diverse knowledge, knowing the patient, and utilizing a variety of techniques in the absence of a standard guideline or assessment algorithm.

Participants considered a wide range of cues, picked fewer cues, and focused less on anthropometric data and more on laboratory data than the experts. The experts' cue selection was generally congruent with the current literature on

nutritional assessment. The difference in cue selection between the participants and the experts likely explains the erroneous nutritional ratings of the patients in the vignettes by the participants. If a participant was considering different cues as being particularly relevant in determining nutritional status, it stands to reason those different cues led to a different rating. Different ratings will lead to different- or lack of- interventions, increasing the patient's risk of morbidity and mortality.

Research Questions 4. Which nurse or organizational factors affect patient cue selection when making clinical decisions about a patient's nutritional status?

Nurse and organizational factors affecting cue selection were state of residence, highest nursing degree obtained, type of institution, Magnet® accreditation, safe staffing, rating differences between participants and experts, age of the nurse, number of certifications, years as a registered nurse, and the number of hours worked per week. An examination of the state of residence data, does not reveal any discernable pattern to explain the direction of the coefficients/or findings. States with the lowest difference in cue selection between the participant and the experts included states from different regions, as well as states with large pediatric cancer centers (California, Maryland, and Oregon). States with the highest average difference in cue selection (Delaware, Indiana, and North Carolina) also are different regions, and some contain large pediatric cancer centers. It is possible there may be other unknown explanatory factor for why the state data are part of the significant model, but likely the state in which

the nurses practice does not have clinical relevance were related to nutritional assessment.

In the cue selection model, associate's degree preparation and obtaining the doctorate of philosophy degree were predicted to have less differences between the experts and the participants for cue selection. Since the doctorate of philosophy is a research degree, it is not surprising participants with a doctorate in philosophy and current clinical experience would have the smallest difference in rating from the experts secondary to increased ability to access and interpret the research. It is unknown why the associate's degree prepared nurses would have the second smallest difference in rating, possibly this degree's more technical focus versus the more generalized knowledge development of the bachelor's leads to more accurate cue selection, or possibly it is a random factor without true clinical relevance.

Participants who worked in free-standing pediatric facilities had the fewest differences in cue selection when comparted to the experts, followed by a pediatric facility embedded within an adult facility, with the largest differences between participants and experts occurring in those who work in combination pediatric and adult facilities. This difference may be related to the type of education, training, and resources available at each institution. Free-standing pediatric centers are entirely devoted to the care of children; including the training and educating of nurses in the care of pediatric patients. For a pediatric facility within an adult facility, the institution likely has education, training, and resources dedicated to pediatric patients, but the institution must also put effort into creating

education, training and resources into adult and older adult populations; generally, a much larger and resource-intensive group of patients. Institutions that combine the care of pediatric and adult patients are likely to be smaller facilities, or larger facilities in more medically isolated areas, and overall resources may be fewer than larger or more metropolitan areas.

Contrary to the current literature, working at a non-Magnet® institution led to fewer differences between the experts and the participants for cue selection. This is an interesting and unexpected finding. Most nurses who participated in the study worked at Magnet® institutions as did the majority of experts. Magnet® facilities are championed for their efforts to bridge the gaps between nursing leadership and staff, evidence-based practice, and promoting critical thinking among their nurses. The unexpected finding in the study may be related to the sample; being highly educated and highly certified negated the differences usually found in Magnet® institutions.

For the factor of safe patient assignment in terms of acuity, the mean difference in scores between the participants and the experts decreased as the participants' feelings of safe patient assignment increased. The one exception was those who chose 'Disagree' (the second option, strongly disagree being the first option). 'Disagree' had a larger difference in cue selection between the experts and the participants than "Strongly Disagree". With the exception of 'Disagree', safer staffing correlated with improved cue selection. This finding may be related to nurses who have more reasonable workloads, have more time to fully assess patients when caring for them, and are thus better able to identify relevant cues.

Other studies have found decreased nurse to patient ratios leads to improved patient outcomes (Kalisch, Tschannen, & Lee, 2011; Sochalski, Konetzka, Zhu, & Volpp, 2008). It is possible these findings are related to the increased time nurses have to assess and select all cues required to make accurate clinical decisions.

As the age of the nurse increases, the accuracy of cue selection decreases. This seems contrary to the literature that supports experience correlating with improved assessment and outcomes (Hamers et al., 1997; Lavelle & Dowling, 2011; Yang & Thompson, 2010). However, looking at other factors in the model, as the number of years being a registered nurse increases the difference in cue selection between participants and experts decreases. Years as a nurse is a better predictor of experience than age alone; nursing as a profession has individuals from differing generations entering the workforce as new graduates. It is unknown why increasing age may lead to increasing differences. However, it is possible that older nurses may have been less comfortable using the "Hot Spot" cue selection process used in the online survey. The Hot Spot method requires the participant to use a computer mouse to selection portions of the test or image presented. This is not a method widely incorporated into online surveys but may be more intuitive to those who grew up with computer gaming or computers in the household.

Participants who worked more hours per week had less differences in cue selection from the experts than participants who worked fewer hours per week. This again may be another measure of experience as a nurse. Working more hours during a week indicates that the nurse is likely to see more patients, complete

more patient assessments, and make more clinical decisions in any given week. More experience allows for wider exposure to a variety of patient presentations; this can lead to a greater refinement of decision making skills.

Accurate cue selection is the foundation of accurate clinical decision making. If modifiable, nurse or organizational factors can be identified to predict more accurate cue selection and it may be possible to improve CDM. Similar to previous studies, experience plays a role in accurate cue selection. Experience is not a modifiable factor, but organizations should consider staffing plans that ensure the consistent presence of experienced nurses. Health care institutions need to ensure they provide appropriate pediatric education, training, and resources to support nurses so they can make the best possible clinical decisions. In addition, they need to ensure that nursing assignments are made with consideration of patient acuity.

Limitations

This study had several limitations. Recruitment through Association of Pediatric Hematology/Oncology Nurses (APHON) was not fully representative of the entire population of pediatric oncology nurses. Nurses who join professional organizations are more likely to be invested in improving their own knowledge and advancing professional development than non-members (DeLeskey, 2003; White & Olson, 2004). Self-selection bias from the APHON mailing list was likely as nurses who responded were more concerned with nutrition issues in pediatric oncology and/or furthering clinical practice than those who chose not to

respond. This sample was also not representative of the nursing population as a whole. This limits the generalizability of the study.

Every attempt was made to validate the patient vignettes, but this is the first time they were implemented. It is possible there were unidentified problems within the vignettes. In addition, vignette research in itself was a limitation to exploring nurses' clinical decision-making. Vignettes lack sensory experiences that are an integral part of assessment skills. Actually visualizing the patient provides a lot more nuanced information than the phrase "well appearing" or "appears ill". Hearing the patient's voice can provide cues about their strength or weakness or their psychological and physical states. Because participants' decisions were being made outside the clinical environment, they may not be fully representative of the clinical decisions nurses make in actual practice settings. Because the vignettes were lacking sensory information, they may not have captured a method of CDM that many nurses utilize--intuition. (Pearson, 2013). Scientific decision making is a systematic, cognitive process while intuition is based on perceptions and recognizing patterns of signs and symptoms.

Implications for Nursing

Implications for Clinical Practice

This study identified a major deficiency in the current clinical nursing practice of pediatric oncology nutritional assessment. Nurses are responsible for comprehensive assessment of patients' health in order to provide holistic care. Nutrition plays an important and central role in children's growth and development, additionally research is starting to demonstrate nutrition plays a

significant role in children with illness or injury. Nurses need to include nutritional status into their routine assessments and as a profession nursing must increase the education and training of nurses to improve nutrition assessment skills.

Pediatric oncology patients who are over-nourished or under-nourished have increased morbidity and mortality (Altaf et al., 2013; Hingorani et al., 2011; Hudgins et al., 2016; Lange et al., 2005;). They can face additional hospitalizations for nutritional intervention if malnutrition is not discovered in the early stages. Malnutrition can lead to immune compromise in an already highly immunocompromised population, as well as a decreased tolerance to their treatment. This population of patients is highly vulnerable due to both their disease and the treatments, ensuring they are adequately nourished during this time not only optimizes their growth and development, but it also improves their quality of life and contributes to their survival.

The finding that nurses in free-standing pediatric facilities had improved accuracy in their decision making suggests the need for specialized resources and knowledge in the work environment based on the population provided with care. It is not just the more welcoming colors and decorations of pediatric facilities that create better outcomes for children, it is the specialized training provided to, and knowledge base nurses possess, in these facilities. Nurses in pediatric facilities only deal with pediatric patients and become intimately familiar with their growth and development, special tactics needed to get comprehensive assessments, and communication techniques that can obtain the best data from young patients. They

also have available specialized resources dedicated to pediatric patients, such as registered dieticians that only work with ill children. The presence of a registered dietician dedicated to pediatric oncology patients was correlated with increased accuracy in this study.

This study also reinforces the need to keep experienced nurses at the bedside. Both the number of years as an RN and the number of hours worked per week were significant for accuracy in this study. Both those factors are proxies for the experience of the nurse. The Clinical Decision Making Model (O'Neill et al., 2005) supports this finding. The more experience the nurse has, the more refined the clinical patterns become as part of the nurse's working knowledge. As the clinical pattern recognition becomes more defined and more detailed, the nurse is able to better identify cues and select the correct hypothesis leading to nursing action affecting patient outcomes.

Implications for Future Research

The method used in this study has implications for future research. Using the factorial design method to create the vignettes, and the number of variables included in the factorial design, caused the overall rating of the vignettes to fall closer to the middle of the range. Using this method for vignette creation made it difficult to create vignettes at the extreme ends of the potential rating scale, as well as created multiple variable combinations that were not practical. Suggestions for future research is to base vignettes on actual patients that have already been nutritionally screened, choosing patients that had a variety of screening results, and then present those case studies to the experts for consensus

ratings. Another recommendation to move the vignette design closer to actual clinical decision making is to include a picture of the child in the vignette, or make the entire vignette a short video. Being able to see (and hear) the patient is a large part of assessment skills.

Another consideration for future research is the very low response rate for this online survey. The response rate was well below predicted. The online survey method may no longer be a highly effective means for obtaining participation in the study. One likely reason is survey fatigue; there are a large number of online surveys distributed to nurses through professional organizations, healthcare organizations, employers, and commercial interests. Another possible reason for the poor response rate discovered after discussing with several nurses who had seen the survey but had chosen not to participate was the fear of 'phishing'. Phishing is a phenomenon were people attempt to use legitimate appearing emails from reputable organizations in an attempt to get individuals to reveal personal information. Future Internet survey work will have to consider how to address both survey fatigue and fears of phishing or other fraudulent practices.

In an attempt to negate individuals' fear of phishing, attempts to personally reach out to the target demographic may be helpful. Reaching out to nurse managers and APHON chapter presidents to introduce the survey and ask they encourage nurses they work with to take the survey prior to the link being distributed. Such practices may have help staff nurses view the study as important to their practice, the survey link as being legitimate, and participation worthy of their time. Going to APHON national conference, distributing information about

the survey, asking conference attendees to take it on site as well as asking them to help distribute the survey URL via snowballing on returning home to the desired population are additional strategies.

The findings from this study lay the groundwork for future research on nurses' CDM and nutritional assessment of pediatric oncology patients. Future research should focus on ways to improve the knowledge of nutrition and accuracy of nurses' nutritional assessment. Exploring why staff nurses' cue selection varied so greatly from the experts' cue selection may lead to educational interventions designed to increase their accuracy of nutritional ratings. Considering that children with over-nutrition have higher morbidity and mortality during treatment, and patients being treated for acute lymphoblastic leukemia, the largest portion of pediatric oncology patients, trend toward over-nutrition; the participants' propensity to under-rate nutritional status of patients should be further explored. Efforts to create standardized evidence-based guidelines for assessing nutritional status in pediatric oncology patients should be a priority for clinical facilities and professional organizations. Accurate assessment is necessary to ensure the patients at risk for nutritional related sequelae are accurately identified and appropriate interventions are initiated.

Implications for Policy

A policy initiative that is recommended, based on this research, is that nurses and other healthcare providers be required to have more in-depth education on nutrition. While registered dieticians are available for referral, all healthcare providers managing the treatment of patients must be able to identify the patients

that should be referred early, preferably to prevent malnutrition but definitely before it becomes severe. Anecdotal experience from clinical practice notes that registered dieticians report that they often do not get referrals until the child's nutritional status is severely compromised. Some children are admitted inpatient for nutritional intervention prior to being brought to the attention of a registered dietician. Mandating that all healthcare providers including RNs and APRNs receive more education and training on nutritional assessment will increase the ability for early referral to a registered dietician. As part of this policy, a standardized nutritional assessment method or tool should be created and be incorporated into the education of providers.

As the professional organization for pediatric hematology/oncology nurses, APHON should consider developing a position paper on nutrition and nutritional assessment for pediatric oncology patients. The purpose of APHON includes "to support and advance nurses and their practice in order to optimize outcomes" (APHON, n.db.) Nurses are currently not practicing to their maximum potential regarding nutritional CDM due to lack of education, guidelines, or standardized tools. APHON is well positioned to be the catalyst for improvement in pediatric oncology nursing practice and thus patient outcomes.

Institutions could use this position paper as a foundation for developing and implementing nursing policies regarding nutritional assessment and referrals. Enacting specific policies provides the best opportunity for ensuring early identification and intervention for pediatric oncology patients at risk for malnutrition. Routine review of policies and procedures will ensure the most up-

to-date, evidence-based practices within the institution leading to the highest quality of care for patients.

Nutritional recommendations are already part of policy in the United States; the Food Guide Pyramid was released by the United States Department of Agriculture (USDA) in 1992 (USDA, n.d.). The Food Guide Pyramid was replaced by MyPyramid in 2005, and further updated to MyPlate in 2011. MyPlate aims to educate the public about healthy nutritional choices by age and caloric needs, and incorporates exercise into the recommendations. However, all the information available at the federal level is aimed at healthy individuals. After searching the MyPlate website (MyPlate.gov) there was no discoverable information that individuals with disease or injury may have different nutritional needs, no links to resources individuals with disease or injury can access and not even a reference to speak with a healthcare provider if you have a disease or injury. Individuals with disease or injury must seek out other sources, such as research publications, to obtain this information, although they may not have the necessary levels of health literacy to accurately discern the relevancy of such materials to their own condition.

Summary

This study is one of the first studies to explore CDM and nutritional assessment of pediatric oncology nurses. It also provides insight into the cues nurses consider when making clinical decisions on nutrition. Previous work on CDM has been done with different populations of interest such as critically ill patients (Currey & Worrall-Carter, 2001) or with a different clinical phenomenon

of interest, such as pain (Ferrell et al., 1991). An extensive literature search did not find any previous research on pediatric oncology nurses' CDM, despite the complexity of their patient population in terms of age and diagnoses. The data derived from this study provide information to staff nurses, nurse educators, and nurse managers that may improve clinical practice. In addition, the results provide direction for nursing education while providing questions for future nursing research.

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APPENDIX A

Boston College IRB Approval

BOSTON COLLEGE
Institutional Review Board
Office for Research Protections
Waul House, 3rd Floor
Phone: (617) 552-4778, fax: (617) 552-0498

IRB Protocol Number: 17.060.01

DATE: October 13, 2016

TO: Amanda Lulloff

CC: Judith Vessey

FROM: Institutional Review Board – Office for Research Protections

RE: NUTRITION RELATED CLINICAL DECISION MAKING OF PEDIATRIC ONCOLOGY
             NURSES Phase II & III

Notice of IRB Review and Approval
Expedited Review as per Title 45 CFR Part 46.110, FR 60366, FR, # 7
_____

The project identified above has been reviewed by the Boston College Institutional
Review Board (IRB) for the Protection of Human Subjects in Research using an
expedited review procedure. This is a minimal risk study. This approval is based on the
assumption that the materials, including changes/clarifications that you submitted to the
IRB contain a complete and accurate description of all the ways in which human subjects
are involved in your research.

This approval is given with the following standard conditions:

   1. You are approved to conduct this research only during the period of approval
      cited

   below;

2. You will conduct the research according to the plans and protocol submitted (approved copy enclosed);

3. You will immediately inform the Office for Research Protections (ORP) of any injuries or adverse research events involving subjects;

4. You will immediately request approval from the IRB of any proposed changes in your research, and you will not initiate any changes until they have been reviewed and approved by the IRB;

5. The IRB has waived [description of the alteration] of informed consent under 45CFR 46.116 (c) or 45CFR 46.116 (d). The research involves no more than minimal risk; the alteration will not adversely affect the rights and welfare of subjects and the research could not practicably be carried out without an alteration.

6. You will only use the informed consent documents that have the IRB approval dates stamped on them (approved copies enclosed).

7. You will give each research subject a copy of the informed consent document;

8. You may enroll up to 520 participants. You may not enroll more than this number of participants without seeking IRB approval. To do so will be a violation of the conditions of IRB approval and, if federal funding is involved in your project, a matter of non-compliance that we must report to the federal government. This could significantly and negatively impact your research.

9. If your research is anticipated to continue beyond the IRB approval dates, you must submit a Continuing Review Request to the IRB approximately 30 days prior to the IRB approval expiration date. Without continuing approval the Protocol will automatically expire on October 12, 2017**.**

Additional Conditions: Any r*esearch personnel that have not completed an acceptable education/training program should be removed from the project until they have completed the training. When they have completed the training, you must submit a Protocol Revision and Amendment Form to add their names to the protocol, along with a copy of their education/ training certificate.*

Approval Period: **October 13, 2016-October 12, 2017.**

If you are conducting research using an online survey (e.g. Survey Monkey, Qualtrics), the IRB requires that the approval dates appear on the online consent page of your survey. Please copy and paste the statement below onto your survey:

The Boston College IRB has approved this protocol from October 13, 2016-October 12, 2017.

Boston College and the Office for Research Protections appreciate your efforts to conduct research in compliance with Boston College Policy and the federal regulations that have

been established to ensure the protection of human subjects in research. Thank you for your cooperation and patience with the IRB process.

Sincerely,

Stephen Erickson
Director
Office for Research Protections

APPENDIX B

Consent Form

Based on your occupation as a registered nurse who takes care of pediatric oncology patients, you are being asked to participate in a research study "Nutrition Related Clinical Decision Making of Pediatric Oncology Nurses". This research is being conducted as part of a doctoral dissertation through Boston College William F. Connell School of Nursing.

The overall purpose of the study is to assess the quality of decision making regarding nutritional assessment by pediatric oncology nurses.

Participation will be a one-time, online survey. The survey should take you approximately 30 minutes to complete. The survey will ask you information about yourself, the organization you work for, and present vignettes describing patients. You will be asked to rate the nutritional status of each patient presented and your confidence in the rating.

There are no anticipated risks in participation, but as with any research, there may be risks that are unknown.

There are no direct benefits to you, but you may feel gratified knowing that you helped further the scholarly work related to nursing decision making. There are no costs to you associated with your participation.

The principal investigator will exert all reasonable efforts to keep your responses and your identity confidential. The records of this study will be kept private. In any report that may be published, no information that may identify you will be included. Research information will be kept on a password protected computer. However, regulators, sponsors or Institutional Review Board members that oversee research may see access the records to make sure that the researchers have followed regulatory requirements.

Your participation is voluntary. If you choose not to participate it will not affect your relations with Boston College, your employing institution or any professional organization. You are free to withdraw or skip questions for any reason. There are no penalties for withdrawing or skipping questions. As a thank you for participating, after completion of the survey you can choose to enter a random drawing to win one of five, $50 Amazon gift cards.

If you have questions or concerns concerning this research you may contact the principal investigator, Amanda J. Lulloff by email lulloff@bc.edu or by phone at 414-510-1978 or the Boston College Faculty Supervisor Dr. Judith A Vessey at vessey@bc.edu or 617-552-8817. If you have questions about your rights as a

research participant, you may contact the Office for Research Protections, Boston College, at 617-552-4778 or irb@bc.edu.

The Boston College IRB has approved this protocol from October 13, 2016- October 12, 2017 .

If you agree to the statements above and agree to participate in this study, please press the "Consent Given" button below.

If you wish to have a copy of the consent for your records, it can be downloaded here.

APPENDIX C

Demographic Form

1. Are you currently licensed and employed as a staff nurse providing direct patient care (staff nurse) to pediatric oncology patients 8 or more hours per week?
  Yes
  No (thank you for your time, currently ineligible to participate in this survey).

2. Where do you reside? (drill down region, country, state/province)

3. What year were you born? (drop down)

4. What is the highest nursing degree you have completed?
  Diploma in nursing
  Associate degree in nursing
  Bachelor's degree in nursing
  Master's degree in nursing
  PhD in nursing
  DNP
  Other (Please specify)
  Prefer not to answer

5. If responds yes to anything above a Bachelor's in nursing:
Are you an Advanced Practice Registered Nurse (APRN)?
  Yes, Certified Nurse Midwife (CNM)
  Yes, Clinical Nurse Specialist (CNS)
  Yes, Certified Registered Nurse Anesthetists (CRNA)
  Yes, Nurse Practitioner (NP)
  Yes, Other (please specify)
  No
  Prefer not to answer

6. Do you have any professional certifications?
  Yes
  No
  Prefer not to answer

7. Which professional certifications do you have? (Select all that apply)
  APHON Chemotherapy/Biotherapy Provider
  APHON Chemotherapy/Biotherapy Instructor
  CPON
  CPHON
  CPN
  BMTCN

Other (Please specify)

8.   a. How many years have you been working as an RN?
        b. How many years have you been working as a pediatric oncology RN?

9. On average, how many hours per week do you work?
     <8
     8-11.9
     12-15.9
     16-19.9
     20-23.9
     24-27.9
     28-31.9
     32-35.9
     36-39.9
     40+

10.   a. On average, how many patients are you assigned every shift?

       b. On average, how many pediatric oncology patients are you assigned every shift?

11. What is your practice setting?
     Inpatient (Hospital Based)
     Outpatient (Clinic Based)
     Both Inpatient and Outpatient
     Other (please specify)

12.   a. Based on their response above, they'll be presented with the appropriate question(s)
     One average, how many inpatient beds are occupied by pediatric oncology patients in your facility each day?
         1-10
         11-20
         21-30
         31-40
         41-50
         More than 50
         I don't know

     b. On average, how many pediatric oncology clinic visits occur at your facility each day?
         1-10
         11-20
         21-30

31-40
41-50
51-60
61-70
71-80
More than 80
I don't know

13. Does your facility have Magnet designation? (link to Magnet)
     Yes
     No
     Unsure

14. Is your facility part of the Children's Oncology Group (COG)? (if yes ask if they are a member of the COG nursing discipline)
     Yes
     No
     Unsure

15. Does your facility have any specific policies and procedures for nutritional assessment of pediatric oncology patients?
     Yes
     No
     Unsure

16. Does your facility have an experienced pediatric oncology registered dietician?
     Yes
     No
     Unsure

17.   a. At my facility, the nurse staffing is safe in terms of number of patients.
       b. At my facility, the nurse staffing is safe in terms of patient acuity.
       c. At my facility, the health care team collaborates well to provide quality patient care.
1. Strongly Disagree
2.
3. Neither agree nor Disagree
4.
5. Strongly Agree

APPENDIX D

New General Self-Efficacy Scale (NGSE)

1. I will be able to achieve most of the goal I have set for myself.

2. When facing difficult tasks, I am certain that I will accomplish them.

3. In general, I think that I can obtain outcomes that are important to me.

4. I believe I can succeed at most any endeavor to which I sent my mind.

5. I will be able to successfully overcome many challenges.

6. I am confident that I can perform effectively on many different tasks.

7. Compared to other people, I can do most tasks very well.

8. Even when things are tough, I can perform quite well.

(Chen, Gully, & Eden, 2001)

APPENDIX E

Nutritional Variables of Interest

Family of Cue	Dimension	Categories for cue
Biological	Activity level	Sedentary
		Moderately active
Psychological	Affect	Cheerful
		Age appropriate
		Depressed
Biological	Age*	Young Child (2-6 years)
		Child (6-12 years)
		Adolescent (12-18 years)
Biochemical	Albumin**	Severely low
		low
		WNL
Medical	Appearance	Well appearing
		Sick appearing
Anthropometric	BMI+	Underweight
	Include height/weight to achieve BMI	Healthy Weight
		Overweight
Output	Bowel movement	Constipated
		Within normal limits
		Diarrhea
Medical	Diagnosis	Stage IV neuroblastoma (high risk of under-nutrition)
		Abdominal rhabdomyosarcoma (high

risk of under-nutrition)

Acute myeloid leukemia (high risk of under-nutrition)

Acute lymphoblastic leukemia (high risk of over-nutrition)

Cranial ependymoma (high risk of over-nutrition)

Malignant glioma (high risk of over-nutrition)

Social/Medical	Diet	Regular
		Age appropriate
		Gluten and lactose free
Intake	Dietary intake++	75% of appropriate caloric intake
		Appropriate caloric intake for age
		125% of appropriate caloric intake
Symptom	Nausea	No nausea
		Mild nausea
		Severe nausea
Symptom	Pain	No pain
		Mild pain
		Severe pain
Social and biological	Sex	Female
		Male
Social	Socioeconomic Status	low income
		Middle Class

		high income
Medical	Treatment Phase	Newly Diagnosed
		In treatment
		Relapsed
Laboratory	Triglycerides#	WNL
		high
		Severely high
Anthropometric	Weight loss/gain##	5% loss
		Maintained
		5% gain

*Age categories as defined by World Health Organization (Knoppert et al., 2007)

** Levels determined by St. Jude's malnutrition algorithm (Bowman et al., 1998)

+ BMI individually selected for each vignette based on child's age/gender using *BMI-for-age Boys Growth Chart* and *BMI-for-age Girls Growth Chart* (CDC, 2015c)

++ appropriate intake will be individually selected for each vignette based on Estimated calorie needs per day by age, sex, and physical activity level (CDC, 2015b)

#Based on the American Academy of Pediatrics screening guidelines (Daniels, Greer, and Committee on Nutrition, 2008)

Change in weight of 5% considered to be nutritional risk (Bauer et al., 2011)