OUTCOMES OF DIETITIAN INVOLVEMENT WITH LEUKEMIA PATIENTS RECEIVING TOTAL PARENTERAL NUTRITION

by

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A Research Paper

Submitted in Partial Fulfillment of the
Requirements for the
Master of Science Degree
With a Major in Food and Nutritional Sciences

Approved: 6 Semester Credits

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The Graduate College
University of Wisconsin-Stout
May 2002

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ABSTRACT

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Outcomes of Dietitian Involvement With Leukemia Patients Receiving Total Parenteral Nutrition

(Title)

Food and Nutritional Sciences	Dr. Carol Seaborn	May/2002	104
(Graduate major)	(Research Advisor)	(Month/Year)	(No. of Pages)

Turbian, Kate L. Manual for Writers of Term Papers, Theses, and Dissertations

(Name of Style Manual Used in the Study)

There is an increasing need for justification of medical nutrition therapy given by the dietitian. With health care costs escalating rapidly, practitioners need to demonstrate that they can improve patient outcomes. Outcomes research provides a practical approach to health care evaluation. The purpose of this study is to determine if the amount of involvement by a registered dietitian with leukemia patients on total parenteral nutrition (TPN) improves outcomes. The outcomes included in this study were 1) length of inpatient stay, 2) length of TPN administration, 3) percentage of energy needs met by the TPN, 4) weight change, and 5) visceral protein status measured by serum albumin on admission and discharge. Dietitian involvement was defined as the percentage of recommended follow up documentations achieved (meeting the protocol of

documentation every four days). A retrospective study of 115 medical records from adult patients with leukemia was conducted. The types of leukemia included were, acute myelogenous leukemia, acute lymphocytic leukemia, chronic myelogenous leukemia, and chronic lymphocytic leukemia. Data was analyzed using SPSS statistical analysis software. Timely dietitian involvement was indirectly correlated with length of days on TPN ($r = -0.211$, $p = 0.026$), and positively correlated with percentage of energy needs met ($r = 0.028$, $p = 0.012$). No significant associations were observed for length of inpatient stay, weight change, or visceral protein status. These results suggest that the dietitian can improve patient outcomes by decreasing the number of days on TPN as well as meeting essential energy requirements. This study demonstrates dietitian intervention produced better patient outcomes as well as potential cost savings to the institution.

Acknowledgements

There are so many people who have helped to make this thesis research a success. I was so fortunate to have an excellent thesis committee. First, I would like to thank my thesis advisor. Dr. Seaborn, thanks to your direction, encouragement, and patience this thesis is now complete. Dr. Milanesi, thank you for your continuous support with the statistics portion of this research. You have proved your class warranty to be true. Dr. Coker, thank you for your organizational support with this thesis. Dr. Splett, it was a pleasure to have an expert in the field be a part of this committee. Thank you for your direction with outcomes research. Donna, thank you for your constant encouragement and input with nutrition support issues. It took a long time to complete this research and I owe so much of this to my committee members. Thank you all so much for being a part of this. I do also want to acknowledge the University of Wisconsin-Stout for their financial support with this research.

My family has also been a source of support and encouragement. Joy, thank you for allowing me to live with you while I collected data and wrote much of this thesis. You always encouraged me to finish this up. Mom, I have shared so much of this experience with you. Thank you for always listening. Last but not least, I want to thank my fiancé Ryan, who could now probably write a thesis in nutrition. Ryan you have been so supportive, thank you.

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List of Abbreviations

ADA	American Dietetic Association
ACG	Ambulatory Care Group
AGA	American Gastroenterology Association
ALL	Acute Lymphocytic Leukemia
AMA	American Medical Association
AML	Acute Myelogenous Leukemia
ANLL	Acute Nonlymphocytic Leukemia
APACHE	Acute Physiology, Age, and Chronic Health Evaluation
ASPEN	American Society for Parenteral and Enteral Nutrition
BMT	Bone Marrow Transplantation
CDS	Chronic Disease Score
CI	Comorbidity Index
CLL	Chronic Lymphocytic Leukemia
CML	Chronic Myelogenous Leukemia
CNS	Central Nervous System
CPN	Central Parenteral Nutrition
CSI	Computerized Severity Index
CVA	Central Venous Alimentation
DRG	Diagnosis Related Group
DS	Disease Staging
GVHD	Graft Versus Host Disease
HLA	Human Leukocyte Antigens
ICD-9-CM Codes	International Classification of Diseases, 9th edition, Clinical Manifestations
IV	Intravenous
JCAHO	Joint Commission on Accreditation of Healthcare Organizations
PG-SGA	Patient-Generated Subjective Global Assessment
PICC	Peripherally Inserted Central Catheter
PN	Parenteral Nutrition
PPN	Peripheral Parenteral Nutrition
PVA	Peripheral Venous Alimentation
RD	Registered Dietitian
SGA	Subjective Global Assessment
TLC	Total Lymphocyte Count
TPN	Total Parenteral Nutrition
WBC	White Blood Cell

Introduction

Leukemia is a type of cancer of the bone marrow and blood affecting both adults and children. In the U.S. in 2001, it was estimated that there would be 30,200 new cases of leukemia (The Leukemia and Lymphoma Society 2001a).

In cancer patients, the course of the disease and treatment places them at nutritional risk. Proper nutrition is essential for cancer patients. Enough calories should be consumed so that the body does not have to use reserves such as protein stores (Bloch 1998). A form of nutrition support called total parenteral nutrition (TPN) may be indicated in certain circumstances to maintain an adequate nutritional state. TPN is an intravenous feeding in which a solution of dextrose, amino acids, fat, and vitamins and minerals are infused into the patient.

Providing safe and effective parenteral nutrition was the means for starting a multidisciplinary approach to nutrition support. The nutrition support team consists of a physician, registered dietitian, nurse, and pharmacist, with each team member assessing the patient according to his or her discipline (Wesley 1995). The dietitian's role includes conducting a nutrition assessment. A nutrition assessment generally consists of anthropometric, biochemical, clinical, and dietary information. After evaluation of this information and data from the other health disciplines, the dietitian develops a care plan, and follows through with intervention and evaluation (Posthauer et al. 1994).

Rationale for the Study

Two hospitals that are part of a health system in a large metropolitan area in the Midwest were used in this study. To maintain confidentiality these hospitals will be referred to as site A and site B. Site A is a large teaching hospital and site B is a smaller community hospital. In 1997, these two separate organizations merged into this new health system. Each of these medical institutions came into the merger with their own unique practices by the dietitians. The health system may be considering standardizing practice across the hospitals.

Outcomes research provides a practical approach to health care evaluation. The three outcomes categories that are typically assessed in outcomes research are clinical, patients, and cost outcomes (Splett 1996). Outcome data on nutrition intervention has been done in the areas of cardiovascular disease; hypertension; diabetes mellitus; obesity; surgical recovery; and nutrition for women, infants, and children (Gallagher-Allred, Voss, and Gussler 1995). Outcomes research for cancer patients on TPN is not only needed to standardize dietetic practice for the institutions included in this study, but also to determine if patient outcomes are improved by dietitian involvement.

Problem Statement

Screening and assessment of the cancer patient is the key to effective nutrition intervention and management (Bloch 1998). Patients are classified as low, moderate, or high risk, and follow up on patients is to be completed in 7, 5, or 4 days, respectively. This study investigated if timely dietitian follow up correlated with the outcomes of

weight gain, improved protein status, decreased length of TPN administration, and decreased length of hospital stay of leukemia patients. Timely dietitian follow up was defined as meeting the protocol of documentation every four days. This study also compared dietetic practice across the two hospitals. Dissemination of the outcome findings would provide a basis to standardize clinical practice and maximize the quality of care in each institution.

Research Questions

H_{o1}: Timely follow up documentation from the dietitian will not significantly influence the outcome of length of hospital stay for patients in this sample.

H_1: Timely follow up documentation from the dietitian will significantly decrease the length of hospital stay for patients in this sample.

H_{o2}: Timely follow up documentation from the dietitian will not significantly influence the outcome of length of TPN for patients in this sample.

H_2: Timely follow up documentation from the dietitian will significantly decrease the duration of TPN for patients in this sample.

H_{o3}: Timely follow up documentation from the dietitian will not significantly influence the outcome of protein status for patients in this sample.

H_3: Timely follow up documentation from the dietitian will significantly improve protein status for patients in this sample.

H_{o4}: Timely follow up documentation from the dietitian will not significantly influence the outcome of weight for patients in this sample.

H_4: Timely follow up chart notes from the dietitian will significantly increase weight gain for patients in this sample.

H_{o5}: Dietitian involvement with TPN protocols would not be significantly different between the two institutions.

H_5: Dietitian involvement with TPN protocols would be significantly different between the two institutions.

Assumption of the Study

It was assumed in this study that the registered dietitian or dietetic technician had calculated accurate calorie and protein needs for each patient. It was also assumed that the medical record was an accurate documentation of the care provided and contained all of the chart notes that were completed.

Delimitation of the Study

The results of this study were only applied to 115 adult males and females who had acute lymphocytic leukemia, acute myelogenous leukemia, chronic lymphocytic leukemia, or chronic myelogenous leukemia and were admitted and discharged from one of the two hospitals during the time span of January 1, 1997 through December 31, 2000.

Limitations of the Study

Due to having only two sites and one specific patient population, there was not a large variance of dietitians who would have been charting in the medical records.

Therefore, this sample may not represent the practices of all of the dietitians from the two facilities. The lab values included in this study were recorded to the nearest day of admit and discharge, thus some of the lab values may be a few days off from the admit or discharge date. The type and duration of chemotherapy or other medications were not recorded which could have a further impact on the patient's health status during the course of the hospital stay.

Review of the Literature

Introduction

With the increasing costs of health care, medical nutrition therapy must be justified to both payers and providers. These changes are affecting the profession of dietetics more than ever as practitioners are experiencing the need to demonstrate that they can improve patient outcomes. In today's health care system, the response to this need is outcomes research (Gallagher-Allred, Voss, and Gussler 1995).

There are three major factors that have motivated the outcomes research movement. First, with so many attempts to reduce and contain health care costs, there is a concern that the quality of care will decline (Epstein 1990). Quality of care is no longer measured by standards or by how or who is performing the task. Insurers, administrators, and consumers are now the ones who are determining quality (Shiller and Moore 1999). Health care reimbursement is influenced by managed care organizations serving over 50% of the United States population (August 1996a). Outcomes can support the determination of the effect of cost containment on the quality of care (Epstein 1990). Second, with the competition in health care, purchasers want to know what they are getting for their money. Outcomes can stipulate the quantity and quality of the goods being purchased. Third, outcomes research can identify unexplained geographic differences in health care practices and how resources are used (Epstein 1990).

Health care costs have escalated above 15% of the Gross National Product. Some of the trends multiplying health care costs include increased accessibility of high-cost technologies, the aging population, individuals not having access to proper medical care,

and increased utilization of resources due to disease and trauma from violence. Health care organizations are seeking cost-effective practices that will maintain the quality of care (Splett 1996).

Outcomes research has been identified as a necessary future role for dietitians (Dahlke et al. 2000). "Outcomes research is particularly relevant to nutrition support. Outcomes research may provide the methods by which the clinical effectiveness of nutrition support can be demonstrated and its monetary cost determined" (August 1995, 3, 4).

What is Outcomes Research?

Definition

Outcomes research is frequently defined as "the rigorous determination of what works in medical care and what does not" (August 1995, 2; Tanenbaum 1993, 1268). Outcomes research has been referred to as "the outcomes movement", "the third revolution in medical care", "a technology of patient experience", and "a belief in the practical superiority of statistical knowledge to other types of knowledge" (August 1995, 1). The American Society for Parenteral and Enteral Nutrition (ASPEN) defines an outcome as, "The measured result of the performance of a system or process" (ASPEN Board of Directors 1995, 2). Splett identifies the driving question of outcomes research as "What works best, for whom, and at what cost?" (Splett 1996, 6). To summarize, "Information on outcomes empowers" (August 1995, 1).

Objectives

"The purpose of outcomes research is to collect data to help patients, providers, payers, and administrators make informed choices regarding medical treatment options and health care policy" (August 1995, 2). The goals of outcomes research include evaluating the effectiveness of current clinical practices; investigating the use of preventive, therapeutic, and rehabilitative procedures; thorough and timely evaluations; and dissemination of the findings for improvement of clinical practice (Splett 1996). The overreaching goal of outcomes research is to maximize the quality of care and minimize the total costs (Gallagher-Allred, Voss, and Gussler 1995).

Components of Outcomes Research

Methodology

The foundation of outcomes research is that poor outcomes detect poor quality of care. A leading researcher in methodologies of quality in health care, Avedis Donabedian, defines quality in health care as, "the extent to which care provided is expected to achieve the most favorable balance of risks and benefits" (Srp, et al. 1991, 133). Analyzing the factors that affect outcomes can improve health care procedures as well as outcomes. Quality of care includes controllable and uncontrollable factors. Figure 1 identifies those factors, which can affect the quality of care and patient outcomes.

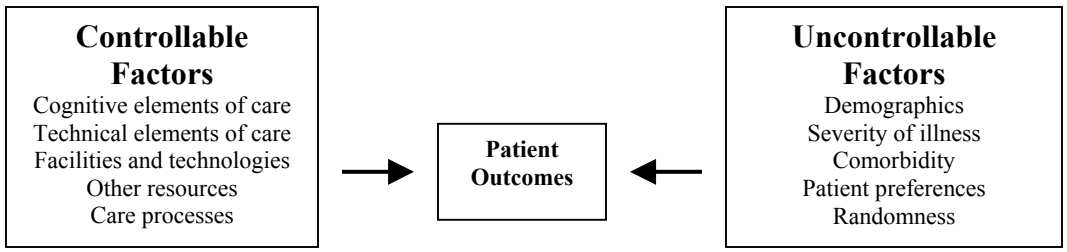

Figure 1. Controllable and Uncontrollable Factors That Affect Outcomes
Source: August David Allen. 1997. Outcomes Research and Management of Nutrition Support. In *Improving Clinical Practice With Nutrition in a Managed Care Environment*, ed. Esther Silverman and Judith D. Gussler, 7-13. Columbus, OH: Ross Products Division, Abbott Laboratories.

Controllable factors include technology, employees, decision making, knowledge base, facilities, clinical pathways, and care processes. Uncontrollable factors include the severity of the illness, comorbidities, demographic factors, and randomness. Outcomes research should be designed to adjust for the uncontrollable factors (August 1997).

Outcomes research differs from randomized clinical trials and other types of common research in several ways. Outcomes research takes place in typical practice settings rather than research centers. Data may be collected either retrospectively or prospectively in outcomes research. The sample size needs to be large, and the subjects included in outcomes research may be a group of patients with a certain diagnoses or stage of illness versus a more narrow range of patients who meet the study's criteria. Outcomes research focuses on an intervention that is within the span of usual care whereas other controlled studies have a strict protocol that must be followed. Outcomes research can measure a variety of factors including clinical endpoints, functional status, quality of life, and health care resource utilization. Cost is typically a measure included in outcomes research, while in other research designs cost is not often considered (Splett 1996). In outcomes research, the goal is effectiveness and efficiency rather than efficacy. Effectiveness identifies the outcomes that were achieved in ordinary practice settings,

while efficacy is associated with outcomes achieved in ideal settings or controlled experiments (Splett 1996 and Davies et al. 1994).

Types of Outcomes

The three outcomes that are typically assessed in outcomes research are clinical outcomes, patient outcomes, and cost outcomes. Clinicians are responsible for identifying what clinical outcomes are important in specific diseases. Clinical outcomes define the results of the intervention (Splett 1996). August (1996b) breaks down clinical outcomes into two categories of primary and secondary outcomes. Primary outcome examples include those that are study specific, physiologic, and anatomic. Examples of secondary outcomes include length of stay, readmissions, medication use, and rates of infection. Successful clinical outcomes can be determined from a combination of expert judgment, previous studies, and established norms (Splett 1996).

Patient outcomes focus on consequences that would interest the patient. Patient outcomes may include survival, side effects of treatment or disease, relief of symptoms, quality of life, and satisfaction with the care and cost received (Splett 1996). Patient outcomes may be categorized into functional outcomes and patient satisfaction outcomes (August 1996b). The project director for Indicator Development Outcomes Research at the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) stated, "Patient outcomes are influenced by all activities of a health care organization" (Srp et al. 1991, 132).

Cost outcomes describe the financial value of the resources utilized or saved as a result of the intervention. Examples of cost outcomes include costs to treat side effects, costs of medications, and costs saved from shortened length of hospital stay. Cost

outcomes may be reported in dollar amounts, a ratio of costs to clinical outcomes, or a ratio of costs to quality of life (Splett 1996).

Benefit Analysis

The three types of benefit analyses commonly used in outcomes research are risk benefit, cost benefit, and cost effectiveness analyses. Risk-benefit analysis compares the morbidity, mortality, and reduced quality of life from a treatment to reduced morbidity, mortality, and increased quality of life resulting from the treatment. Risk-benefit analysis is not monetary. Cost-benefit analysis is a relation of the monetary costs to the monetary benefits of the intervention. The problem with cost-benefit analysis is that precise costs are often impossible to determine. Also, cost-benefit analysis may not be of interest to clinicians who work with human problems, which are difficult to place a price tag upon. Cost-effectiveness analysis is the cost of achieving a predetermined outcome. In cost-effectiveness analysis, clinicians and patients determine the desired outcomes to be measured. The cost of achieving these outcomes is analyzed and the best intervention is the one that attains the desired outcomes at the lowest cost (August 1998).

Consumers of Outcomes Data

There are several potential consumers of outcomes data. Patients may be some of the main beneficiaries as quality of life can be improved through outcomes research (August 1998). By knowing outcomes, patients may be able to participate in decisions about treatment alternatives (Splett 1996). The use of unnecessary and ineffective treatments may be reduced (August 1996a). The application of outcomes research will aid clinicians in determining best possible practice methods (Splett 1996).

Clinicians should be interested in outcomes data as healthcare is being economized and funding for specialty positions is decreasing (August 1998). Outcomes research allows clinicians to demonstrate their productivity as well as their ability to improve outcomes and reduce costs (August 1996a).

Healthcare organizations can use outcomes data to improve the way they do business (August 1998). Outcomes data may be used by hospitals to establish guidelines and protocols for improved patient care, demonstrate regulatory compliance, identify areas for improvement, and to market their services (Gallagher-Allred, Voss, and Gussler 1995).

Outcomes data is also valuable to healthcare payers and purchasers, which includes insurance companies, Medicare, Medicaid, and managed care organizations (Splett 1996). Payers and purchasers are interested in data on the effectiveness of care as the information may help them reduce healthcare costs, regulate care and make reimbursement decisions, make purchasing decisions and establish national guidelines (Gallagher-Allred, Voss, and Gussler 1995).

The healthcare sector including providers, insurers, and government can utilize outcomes data and employ joint planning across the overarching health care system. The most cost effective settings for specific care or diseases can be determined using outcomes data (Splett 1996).

Steps have been made by the health care sector in the direction of outcomes research. In the 1980's, the American Dietetic Association (ADA) and the JCAHO pioneered Agenda for Change to move from process-oriented standards of care to outcome-oriented indicators of quality care (Merkens 1994). The federal government has

funded and facilitated outcomes research. In 1989, Congress established the federal Agency for Health Care Policy and Research, which is overtly committed to conducting outcomes research and disseminating the results (Tanenbaum 1993).

What is Risk Adjustment?

Definition

In outcomes research, the goal is to determine the association between treatment and outcomes. The difficulty with this is that there are several other factors, which influence patient outcomes. Adjusting for these other factors is called risk adjustment or sometimes referred to as "case-mix adjustment". Risk factors can directly influence a patient's outcome. The reliability of outcomes research may depend on adjusting for potential interfering risk factors. There are several classes of risk factors that could be identified. In risk adjustment, the main components are severity and comorbidity with demographic and psychosocial factors. Severity of illness defines the extent or the effects a condition has on that person. It usually reflects the patient's primary diagnosis or disease. Comorbidity describes the potential effects of other existing clinical problems. Demographic and psychosocial factors may have an effect on the causes, treatment, or the outcomes (Kane 1997).

Severity

The two terms used in adjusting for severity are severity of disease and severity of illness. Severity of disease is often the severity and the importance of the principle diagnosis. The severity of illness is all of the patient's diagnoses combined to obtain a score describing the patient's overall level of illness. The severity of illness includes the

importance and severity of the principle diagnosis as well as the importance and severity of each secondary diagnoses. Ideally the severity of illness should be collected prior to and after symptom onset, but before the intervention. Severity of illness is important to incorporate into a research study as it adjusts for selection bias, improves the capacity to predict outcomes, and forms a basis for subgroup analysis. If patients are not randomly distributed into groups, selection bias may occur. Adjusting for the severity of illness will deal with possible confounding differences in initial severity, and reduce the possibility that the outcome is a result of the level of severity of the population studied. Measures of severity can be used to explain some of the variance in outcomes. Subgroups of patients with more or less disease severity may respond differently to the intervention. Subgroups may be selected for different analyses in the early stages of the study (Smith 1997).

There are several measures that can adjust for severity of illness. Some of the measures that have shown consistent reliability and validity include Acute Physiology, Age and Chronic Health Evaluation (APACHE), Computerized Severity Index (CSI), diagnoses-related groups (DRGs), Disease Staging (DS), and Medigroups. All of these measures have been constructed for use on hospitalized patients (Smith 1997).

Comorbidity

"Comorbidities, or the coexisting diagnoses, are diseases unrelated in etiology or causality to the principle diagnosis" (Nitz 1997, 154). Comorbidity is the severity and importance of each secondary diagnosis. Comorbidities do not include treatment complications or complications of the disease. Comorbid conditions should be measured prior to any treatments. Comorbidities are measured for similar reasons as the severity of

illness. Comorbidities can help to remove observed variation in outcomes in different groups and help to isolate the effects of the treatment. Comorbidity is a useful measure to establish the patient's usual state of health before treatment (Nitz 1997).

Several measures are available for adjusting for comorbidities. Measures specific for ambulatory care settings include the Chronic Disease Score (CDS) and Ambulatory Care Groups (ACGs). These measures were actually created to assess severity of illness, but have been adapted for comorbidities by excluding the disease of primary interest when calculating the scores (Nitz 1997).

The measures developed for use in a hospital setting include Comorbidity Index (CI), Duke Severity of Illness Checklist, Kaplan and Feinstein, and the Charlson Comorbidity Index (Nitz 1997). The Charlson Comorbidity index classifies comorbidities in an ordinal scale according to their prognosis. It was first developed based on a cohort study of over 600 patients admitted to an acute care hospital. The index was then validated in another cohort study of breast cancer patients (Charlson et al. 1987). In 1992, Deyo and colleagues adapted the Charlson Comorbidity Index for use with the International Classification of Diseases, 9th edition, Clinical Manifestations (ICD-9-CM) codes in a study of outcomes of lumbar spine surgery. The conclusion they reached was that "the Charlson index can be valuable when used with the ICD-9-CM administrative databases" (Deyo, Cherkin, and Ciol 1992, 619). The Charlson Comorbidity Index and the adapted comorbidity index with the ICD-9-CM codes are listed in appendices A and B, respectively.

Demographic and Psychosocial Factors

"Demographic, psychological, and social variables may be risk factors for an illness or other outcomes, confounders of results, or modifiers of treatment effect" (Derose 1997, 175). These variables may even be viewed as outcomes themselves. Any variables that could impact the outcomes or define the population being studied are the variables of interest. Traditional variables commonly measured include age, sex, ethnic background, race, religion, socioeconomic status, occupation, and martial status. Psychological and social variables are often more complicated to measure because they are abstract concepts and need to be fit into a measurement scale. There are many measurement scales in the literature. Scales may measure different dimensions of these variables, but must be applicable to the population being studied, the setting, and the expected range of responses. Categories of some of the scales include depression scales; anxiety scales; psychological well-being scales; social health scales; and health beliefs, attitudes, and behavior scales (Derose 1997).

Parenteral Nutrition

Definition

"Parenteral nutrition (PN) is the intravenous provision of macronutrients and micronutrients to the individual who has a nonfunctional gastrointestinal tract, has an enteral tract that cannot be accessed, or is unable to digest nutrients" (McCrae 1997, 181). "TPN [total parenteral nutrition] permits a highly concentrated, hypertonic solution to be administered to the patient" (McCrae 1997, 181). Parenteral nutrition provides protein in the form of amino acids, carbohydrate in the form of dextrose, and fat,

vitamins, and minerals (Matarese and Steiger 1999). Parenteral nutrition or intravenous feeding has several different names. TPN and hyperalimentation are the two most common names. Other specific terms include central parenteral nutrition (CPN), central venous alimentation (CVA), peripheral parenteral nutrition (PPN), and peripheral venous alimentation (PVA) (Heimburger and Weinsier 1997). The route of administration depends on the length of therapy, the goal of nutrition therapy, availability of intravenous (IV) access, severity of illness, and fluid status (Matarese and Steiger 1999).

Administration

The expected duration of therapy, the patient's nutritional status, and venous presentation are the main determinants for the route of administration for parenteral nutrition. Parenteral nutrition through a peripheral vein is generally for patients who require therapy for less than 14 days, do not have severe malnutrition, and have good peripheral access. With peripheral TPN it is difficult to provide the full nutritional requirements because of the limits with the osmolarity of the solution to prevent thrombophlebitis (inflammation of a vein) (DeChicco and Matarese 1998).

Central TPN is recommended for patients who require long-term therapy, have a fluid restriction, or have high metabolic requirements. Since the solution is infused into a large vein, there are no osmolarity limits. The subclavian vein is the preferred site for central TPN. The internal or external jugular vein or femoral vein can also be used (DeChicco and Matarese 1998). It is recommended that TPN not be discontinued until at least 50% of the patient's nutrient needs and 100% of the patient's fluid needs have been met through oral or enteral feeding for three consecutive days (Winkler and Lysen 1993).

The duration and the type of therapy will determine the access device. A percutaneous venous catheter is temporary and is usually only used for hospitalized patients. A permanent catheter is placed surgically and is used for long-term therapy. Broviac, Hickman, and Groshong are examples of permanent catheters. A peripherally inserted central catheter (PICC) is an alternative for central access for TPN. PICC lines were often used for long-term antibiotic therapy, but TPN has been infused with good results (DeChicco and Matarese 1998).

Macronutrients

Parenteral nutrition formulas contain protein, carbohydrate, and fat. These nutrients are delivered in ratios, which are tailored to meet the needs of each individual patient (Skipper 1998).

Protein

In parenteral nutrition, the main function of protein is to maintain nitrogen balance and prevent skeletal muscle breakdown or gluconeogenesis. The protein requirement for healthy adults is 0.8 g/kg per day. For critical illness, the recommendations vary slightly. A range of 1.2 to 2.0 g/kg per day of protein is recommended for most patients (Skipper 1998). Amino acids contain 4 calories per gram (McCrae 1997). Commercial amino acids exist in concentrations of 3.5, 5.5, 7, 7.5, 8.5 10, 11, and 15%. Peripheral administration will most often utilize the dilute concentrations (3.5% and 5.5%). Central TPN administration most often uses the concentrated amino acid solutions (8.5, 10, 11, and 15%). Essential amino acid proportions in the parenteral solutions are based upon the Food and Agricultural Organization and the World Health Organization recommendations (Skipper 1998).

Carbohydrate

Carbohydrate is the primary energy source in the parenteral solution. The requirement for carbohydrate has not been clearly defined. A minimum amount of 100 g per day is most frequently used. This minimum amount is based on research, which demonstrated that two liters of fluid with 50 g of carbohydrate per liter suppresses gluconeogenesis and consequently protein catabolism. The recommendation for critically ill patients, is that carbohydrate intake be reduced to 4 mg/kg per minute. Carbohydrate solutions contain 3.4 calories per gram of dextrose. Commercial carbohydrate is composed of anhydrous dextrose monohydrate in sterile water. Carbohydrate solutions are available in concentrations of 5% to 70% (Skipper 1998).

Lipids

Lipids are included in the parenteral solution as a source of essential fatty acids and calories. Requirements for lipids can be met with 4% of calories as linoleic acid or about 10% of calories from a commercial lipid emulsion from safflower oil (Skipper 1998). To prevent a deficiency, approximately 4% of calories must be provided as essential fatty acids (McCrae 1997). Research has validated the recommendation to limit lipids to 1 g/kg per day or 25% to 30% of total calories. These limits have stemmed from research that long-chain fatty acids can impair neutrophil function, endotoxin clearance, and complement synthesis. Commercial lipids are aqueous emulsions of safflower or soybean oil, consisting primarily of long chain triglycerides. The three concentrations available commercially are 10%, 20%, and 30%. As well as the fatty acids, lipids also contain glycerol emulsifiers, which increase the calories to 1.1 calories per mL for a 10% emulsion and 2.0 calories per mL for a 20% emulsion (Skipper 1998).

Additives

Electrolytes

Electrolyte requirements vary for each patient depending on body weight, any malnutrition or catabolism, amount of electrolyte depletion, organ function, electrolyte losses, and the disease process. Medications may also have an effect on electrolyte requirements. There are several different recommendations for parenteral electrolytes. Skipper (1998) summarized and compared three investigator's electrolyte recommendations (Table 1). The recommendations need to be utilized along with clinical judgment of the practitioner.

Table 1. Parenteral Electrolyte Recommendations

		Investigators	
	Sheldon	Grant	Schlictig
Potassium	120-160 mmol/d	70-150 mEq	70-100 mEq
Sodium	125-150 mmol/d	60-150 mEq	70-100 mEq
Phosphorus	12-25 mmol/1000 kcal	7-10 mmol/1000 kcal	20-30 mmol
Magnesium	7.5-10 mmol/d	0.35-0.45 mEq/kg/d	15-20 mEq
Calcium		0.2-0.3 mEq/kg/d	10-20 mmol
Chloride		Equal to Na to prevent Acid-base disturbances	

Source: Skipper A, 1998. Principles of Parenteral Nutrition. In *Contemporary Nutrition Support Practice A Clinical Guide*, ed. Laura Matarese and Michele Gottschlich, 227-242. Philadelphia, PA: W.B. Saunders Company.

Vitamins

Vitamins and minerals proved to be a requirement in TPN solutions early in history. Vitamin free parenteral solutions resulted in deficiency states that were not often seen in patients who consumed a normal diet. The American Medical Association (AMA) has issued the current vitamin recommendations for TPN, which have remained unchanged since 1975. Table 2 delineates these recommendations. Commercial preparations are available that follow the AMA recommendations. Vitamin K is not

included in commercial products as many patients are on anticoagulants. Vitamin K may be added to the TPN with a dose of 10 mg per week or 1 mg daily (Skipper 1998).

Table 2. AMA Recommendations for Parenteral Vitamin Intake

Vitamin	Amount per day
Vitamin A	3,300 IU
Vitamin D	200 IU
Vitamin E	10 IU
Ascorbic Acid	100 mg
Folacin	400 µg
Niacin	40 mg
Riboflavin	3.6 mg
Thiamine	3 mg
B_6 (pyridoxine)	4 mg
B_{12} (cyanocobalamin)	5 µg
Pantothenic acid	15 mg
Biotin	60 µg

Source: Nutrition Advisory Group of the Department of Foods and Nutrition, American Medical Association. 1979. Multivitamin Preparations for Parenteral Use: A Statement by the Nutrition Advisory Group. *Journal of Parenteral and Enteral Nutrition* 3: 258-262.

Minerals

In 1977, the AMA also developed the recommendations for trace minerals in the parenteral solution. Table 3 presents these recommendations. There are several commercial preparations available and in different concentrations. Zinc, copper, chromium, and manganese are available with or without the addition of selenium and iodide (Skipper 1998).

Table 3. AMA Recommendations for Parenteral Mineral Intake

Mineral	Amount per day
Zinc	2.5-4.0 mg (2.0 mg/day in acute catabolism, 12.2 mg/L of small bowel fluid losses, 17.1 mg/kg of stool or ileostomy output)
Copper	0.5-1.5 mg
Chromium	10.0-15.0 µg
Manganese	0.15-0.8 mg
Selenium	20.0-40.0 µg

Source: American Medical Association Department of Foods and Nutrition. 1979. Guidelines for essential trace element preparations for parenteral use. A statement by an expert panel. *Journal of the American Medical Association*, 24:2051.

Insulin

Hyperglycemia is commonly seen in patients receiving TPN. Insulin may be added to the solution to regulate blood glucose levels. It has been documented that the insulin absorbs to glass bottles, polyvinyl chloride bags, and tubing used for the TPN administration. The only insulin loss will usually occur within the first hour. The addition of insulin can result in good control of blood glucose levels (Skipper 1998).

Indications

"Parenteral nutrition was originally developed to nourish those whose gastrointestinal tract was not capable of digesting and absorbing nutrients. The ultimate indication for parenteral nutrition continues to be a nonfunctioning gastrointestinal tract and documented inability to tolerate enteral feeding" (Skipper 1998, 227). The patient should also be at nutritional risk. Nutritional risk is defined as a weight loss of at least 10% of preillness weight and a patient who has not had anything by mouth for 5 to 7 days. TPN is only indicated if the administration would be long-term (more than 2 weeks) (Skipper 1998; ASPEN 1993). The American Society for Parenteral and Enteral

Nutrition (ASPEN) has published Practice Guidelines for Parenteral Nutrition (Appendix C). The first practice guideline states "Patients who are candidates for parenteral nutrition support cannot, should not, or will not eat adequately to maintain their nutrient stores. These patients are already or have the potential of becoming malnourished" (ASPEN 1993, 10SA).

There are several guidelines that have been developed by organizations for the selection of patients to receive TPN. In 1989, the American Gastroenterology Association (AGA) published guidelines for parenteral nutrition. Categories of indications for TPN from AGA include short bowel syndrome, inflammatory bowel syndrome, chronic intestinal disorders, gastrointestinal fistulas, postoperative complications, preoperative preparation, pancreatitis, cancer, neurologic and pulmonary disease, and neonates and infants (Sitzmann, Pitt, and The Patient Care Committee of The American Gastroenterological Association 1989). In 1990, the U.S. Department of Health and Human Services funded a technology assessment and practice guidelines forum. Categories of these guidelines for selection of patients to receive TPN include those with malignant disease (cancer), perioperative total parenteral nutrition, inflammatory bowel disease, short-bowel syndrome, hepatic disease, pancreatitis, critical care, renal failure, Acquired Immunodeficiency Syndrome, respiratory failure, and eating disorders. In 1986, ASPEN published the first of these guidelines, and they were revised and expanded in 1993 (Skipper 1998). The latest revision was published in 2002 (ASPEN 2002).

Malnutrition

ASPEN defines malnutrition as, "Depletion of an essential nutrient or tissue compartment"(ASPEN 1993, 5SA). Clinically malnutrition is diagnosed if the serum albumin level is less than 3.5 g/dL, total lymphocyte count is less than 1,800 mm^3, or if there is an unplanned decrease in body weight by 15% (Gallagher-Allred et al. 1996). A weight loss greater than 10% is often associated with functional abnormalities and a poor clinical outcome. With malnutrition other complications are more likely to occur including weakness, compromised immunity, and decreased wound healing. In hospitalized patients, there may be as many as 50% that are moderately malnourished and 5% to 10% of patients may be severely malnourished (ASPEN 1993). Hospital charges for malnourished patients may range from 35% to 75% higher than well-nourished patients (Gallagher-Allred et al. 1996). In 1993, ASPEN developed Practice Guidelines for Malnutrition, which can be found in Appendix D.

The ASPEN Guidelines state that enteral tube feeding should be considered if a patient could not maintain adequate oral intake. If enteral support is not enough, both enteral and parenteral support may be initiated. Parenteral nutrition alone may be initiated if enteral nutrition is not meeting nutrient requirements or if enteral feeding is contraindicated (ASPEN 1993).

Cancer

"Cancer patients frequently become malnourished during the course of their disease because of the malignancy's direct effects or as a result of treatment side effects" (ASPEN 1993, 12SA). In cancer patients with malnutrition, nutrition support may improve nutrition indices and overall patient performance status.

The AGA guidelines for cancer state, "parenteral nutrition may be indicated in the cancer patient if anticipated treatment regimens are likely to aggravate or induce nutritional compromise" (Sitzmann, Pitt, and The Patient Care Committee of The American Gastroenterological Association 1989).

ADA developed clinical indicators for nutrition support in oncology as part of their Agenda for Change to be used by organizations with membership to the JCAHO. The indicators developed for oncology are as follows:

> No patient is on a clear liquid diet or nothing by mouth without nutrition support for more than five days; All patients at moderate or high risk are identified by screening and assessed within 72 hours of admission; Patients at moderate or high risk are able to implement nutrition care plan at discharge (Queen, Caldwell, and Balogun 1993, 342).

The ASPEN Practice Guidelines do state however that nutrition support should not be routinely utilized for well-nourished or mildly malnourished cancer patients. TPN may not benefit cancer patients who are unresponsive to chemotherapy or radiation therapy (ASPEN 1993; Sitzmann, Pitt, and The Patient Care Committee of The American Gastroenterological Association 1989). Appendix E delineates the ASPEN Practice Guidelines for cancer.

Leukemia

Physiology

Leukemia is a cancer of the blood, specifically the white blood cells or lymphocytes. Leukemia starts in the bone marrow and then can spread to the blood,

lymph nodes, spleen, liver, central nervous system, and other organs. In leukemia there are too many abnormal white blood cells being produced, which inundate the bone marrow (Leukemia Society of America 1999a, b, c and The Leukemia and Lymphoma Society 2000).

Organs of the immune system may be referred to as lymphoid organs as they are involved with the growth, development, and deployment of lymphocytes. Lymphoid organs include the bone marrow, thymus, lymph nodes, spleen, tonsils and adenoids, appendix, and lymph tissue found in the small intestine called Peyer's patches. There are about one trillion white blood cells (Schindler 1993). White blood cells include the neutrophils, monocytes, eosinophils, basophils, and lymphocytes. Neutrophils and monocytes are phagocytes and can ingest and kill bacteria or fungi. White blood cells help cure an infection by actually leaving the blood and invading the tissue to kill the bacteria or fungi that is causing an infection. Eosinophils and basophils participate in allergic responses. The three types of lymphocytes are T cells, B cells, and natural killer cells (Leukemia Society of America 1999a, b, c; The Leukemia and Lymphoma Society 2000). The B cells secret antibodies into the body's fluids. Each B cell produces one specific antibody. B cells need the T cells in order to make antibodies against most substances. T cells interact directly with their targets. Natural killer cells are filled with potent chemicals and can protect against a wide variety of infections (Schindler 1993).

The bone marrow is the central cavity of the bone in which blood cell development takes place. In adults bone marrow that is actively making blood cells is found only in the vertebrae, hip and shoulder bones, ribs, breastbone, and skull. Hematopoiesis is the process of making blood cells. Stem cells make the blood cells in

the marrow. Differentiation is the process of stem cells changing into the specific blood cells (Leukemia Society of America 1999a, b, c; The Leukemia and Lymphoma Society 2000). Figure 2 diagrams the differentiation process.

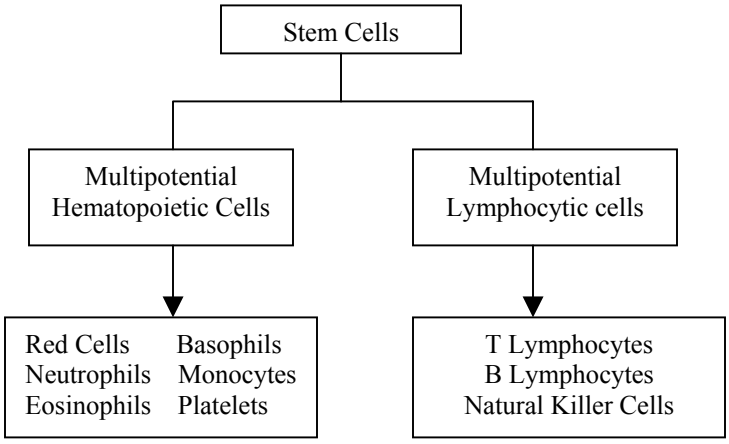

Figure 2. Blood Cell and Lymphocyte Development
Source: Leukemia Society of America, 1999. *Chronic Myelogenous Leukemia*, 3. New York, NY: Leukemia Society of America, Inc.

Types of Leukemia

The two main types of leukemia are lymphocytic and myelogenous. Both of these types have both an acute and chronic form. Lymphocytic and myelogenous indicate the cell type involved. Lymphocytic leukemia develops from the lymphocytes in the bone marrow. Myelogenous leukemia develops from granulocytes or monocytes, two types of white blood cells. The four major types of leukemia are acute myelogenous leukemia (AML), acute lymphocytic leukemia (ALL), chronic myelogenous leukemia (CML), and chronic lymphocytic leukemia (CLL). Acute leukemia is a disease that affects cells that are unformed or not yet fully developed. The cells are growing so rapidly that they are not able to mature properly. Immature cells cannot carry out their normal functions. The immature cells, lymphoblasts or myeloblasts, reproduce in an uncontrolled way and crowd out the cells that make normal blood cells. Acute leukemia is rapidly progressing, whereas chronic leukemia progresses more slowly. Greater numbers of cells are developed; however they are not completely normal. In chronic leukemia, some of these mature cells can perform their normal functions (The Leukemia and Lymphoma Society 2000).

Acute Myelogenous Leukemia

AML, also called acute nonlymphocytic leukemia (ANLL), comprises about 40% of all leukemias in the Western world (Rohatiner and Lister 1996). AML occurs in adults and children. In adults, AML accounts for 80% of the acute leukemias. AML is more common in males (Lichtman 1995a). AML results from acquired, not inherited, genetic damage to the DNA of developing cells in the bone marrow. This results in

uncontrolled and increased growth of leukemic blasts that cannot function normally. Also there is a barrier to the production of normal cells, which leads to a deficiency of red blood cells (anemia), platelets (thrombocytopenia), and normal white blood cells, especially neutrophils (Leukemia Society of America 1999a). Granulocytic sarcoma or chloroma are solid tumors. It is very rare if tumor cells appear as a solid tumor (National Cancer Institute 2000a).

Environmental factors including, high-dose radiation exposure, chronic benzene exposure, and alkalizing agents may cause AML. Among electrical workers, a small but significant increase in AML was found. There are predisposing diseases to AML including AIDS, Down syndrome, Fanconi anemia, or Bloom syndrome (Lichtman 1995a).

AML is difficult to initially detect. The early signs of AML are similar to the flu or other common illnesses. These symptoms may include fever, weakness, tiredness, or achiness in the bones or joints. Blood tests are taken to count the number of each of the different types of cells. If the results are not normal, a bone marrow biopsy is done. This identifies the type of leukemia present (National Cancer Institute 2000a).

Staging

There is really no formal staging for AML. Treatment choices depend upon whether the patient has already been treated. These periods are referred to as untreated, in remission, or recurrent/refractory. Untreated AML is newly diagnosed leukemia with no prior treatment. Features of untreated AML include 30% or more blasts in the bone marrow, abnormal white cell count and differential, abnormal hematocrit and hemoglobin, abnormal platelet count, and signs and symptoms of AML. Remission is

identified by normal peripheral blood cell count, less than 5% of blasts in the bone marrow, and no signs of symptoms of AML. Recurrent AML indicates the leukemia has come back after remission. Refractory AML refers to the leukemia not going into remission after treatment (National Cancer Institute 2000b).

Treatment

Successful treatment requires control of the bone marrow. Specific treatment of the central nervous system (CNS) disease if present is also required. However, only 5% of patients with AML develop CNS disease (National Cancer Institute 2000b). There are two phases of treatment, induction (to attain remission) and post remission (to maintain remission). Chemotherapy is the primary treatment for AML. Radiation is utilized in certain cases. Untreated AML will most often be treated with systemic chemotherapy. Intrathecal chemotherapy (injected directly into the spinal cord) will be used if leukemia cells are found in the brain. Systemic chemotherapy is commonly used for AML in remission. Radiation is given in recurrent AML to reduce symptoms (National Cancer Institute 2000a, b).

In patients younger than 60 years of age during first remission, allogeneic or autologous bone marrow transplantation (BMT) may be considered. Most studies express that relapses are decreased in the first remission after allogeneic BMT compared with chemotherapy alone. However, similar survival rates are demonstrated due to graft-versus-host disease and interstitial pneumonia with bone marrow transplants. Between 35% and 50% of AML patients in remission with autologous BMT survive disease free (National Cancer Institute 2000b).

In adult AML remission rates are adversely related to age. The expected remission rate is greater than 65% for AML patients younger than 60 year of age. Remission status after induction therapy can be reached by about 60% to 70% of adults. More than 15% can survive 3 or more years and may be cured (National Cancer Institute 2000b).

Acute Lymphocytic Leukemia

ALL is most often thought of as a disease of childhood. ALL accounts for only about 15% of adult acute leukemias (Hoelzer 1996). ALL occurs most often in children age 10 and under, but then increases in frequency in older individuals. ALL is very similar to AML in that there is an acquired genetic injury to the DNA of cells in the bone marrow. Also the effects are the same as there is an increased growth and accumulation of lymphoblasts and the production of normal marrow cells are blocked (The Leukemia and Lymphoma Society 2000).

There are very few factors that have been associated with a risk of developing ALL. High exposure to irradiation is one of the factors. ALL has been found to occur at different rates in different locations. More developed countries and higher socioeconomic groups are found to have a higher incidence of ALL. There have not been any solid conclusions relating life-style factors and environmental factors with AML (The Leukemia and Lymphoma Society 2000).

ALL as with AML is difficult to identify, as the symptoms are very common. Patients may feel more tired easily, short of breath when physically active, pale complexion, petechiae, fever, discomfort in the bone and joints, and the lymph nodes may be enlarged from the accumulation of lymphoblasts. Headaches or vomiting may

occur if leukemic cells are in the lining of the brain or spinal cord (The Leukemia and Lymphoma Society 2000). Blood tests and a bone marrow biopsy are done to diagnose ALL. A spinal tap may also be done (National Cancer Institute 2000c).

Staging

There is no true staging for ALL. As with AML, treatment depends on whether the patient has been treated before. The same three periods of untreated, remission, and recurrent/refractory exist for ALL. These periods have the same meaning for both ALL and AML (National Cancer Society 2000c).

Treatment

The choice of treatment with ALL depends on the type of disease, the patient's age, and overall condition. Research has found prognosis to be better in patients younger than 35 years of age. This is partly because there is an increased incidence of the Philadelphia (Ph) -chromosome in older adults with ALL. Patients with the Ph-chromosome are associated with a poorer prognosis and are rarely cured with chemotherapy (National Cancer Institute 2000d). The Ph-chromosome was first identified as a short chromosome 22, but is actually a balanced translocation between chromosomes 9 and 22 (Cortes, Talpaz, and Kantarjian 1996).

Chemotherapy is the primary treatment of ALL. Treatment of ALL has two stages similar to AML, which are induction therapy (to attain remission) and continuation therapy (to maintain remission). Chemotherapy may be administered for several years to maintain remission. Systemic and intrathecal chemotherapy will be the main treatment for untreated ALL. Chemotherapy, autologous or allogeneic BMT, or radiation may all

be utilized with ALL in remission. Radiation and BMT may be used in recurrent ALL (National Cancer Institute 2000c).

For adults with ALL, 60% to 80% can attain remission status after induction therapy. Aggressive post-remission chemotherapy demonstrates a long-term disease-free survival rate of approximately 40%. Allogeneic BMT results in the lowest incidence of leukemia relapse (National Cancer Institute 2000d).

Chronic Myelogenous Leukemia

CML accounts for about 20% of all cases of leukemia. CML affects mostly adults and is more common among men than women (Lichtman 1995b). CML accounts for approximately 7% to 15% of all leukemias in adults (Cortes, Talpaz, and Kantarjian 1996). The largest numbers of cases of CML are found in individuals aged 60 to 70 (Barnett and Eaves 1996). CML results from an acquired injury to the DNA. This change is not present at birth and it is not understood what produces this change. CML allows for the development of white blood cells that can function normally. This is an important difference from the acute leukemias and can explain why there is less severity in the early course of CML (Leukemia Society of American 1999b). However, CML has a high potential to evolve rapidly into an accelerated fatal phase that is similar to acute leukemia (Lichtman 1995b).

There is not enough evidence to link genetic factors to CML. High doses of irradiation are associated with a higher incidence of CML, as seen with the survivors of Nagasaki and Hiroshima. Therapeutic radiation for other cancers has also been

correlated with an increased risk for CML (Cortes, Talpaz, and Kantarjian 1996; Lichtman 1995b; Barnett and Eaves 1996). Almost all CML patients (90 to 95%) have the Ph-chromosome (Cortes, Talpaz, and Kantarjian 1996).

Common symptoms for the onset of CML include easily fatigued, shortness of breath when physically active, pallor, and discomfort from an enlarged spleen. Blood and marrow cells both generally need to be examined to diagnose CML. The white blood cell count will be high. Of the white blood cells, a small proportion will be very immature and a larger proportion will be myelocytes and neutrophils (matured cells). A cytogenetic analysis is also conducted to measure the number and normality of chromosomes. Polymerase chain reaction increases the amounts of DNA and RNA to make them more detectable and assess the type of DNA and RNA. Almost all CML patients are diagnosed in the first or chronic phase of the disease (Leukemia Society of America 1999b).

Staging

CML progresses through different phases. The chronic phase shows no symptoms of leukemia and few blast cells in the marrow and blood. Less than 5% blasts and promyelocytes are in the peripheral blood and bone marrow (National Cancer Institute 2000f). This phase may last for several months to several years (National Cancer Institute 2000e), with a median duration of 3.5 to 5 years (Cortes, Talpaz, and Kantarjian 1996). In the accelerated phase, there are more blast cells in the blood and marrow and fewer normal cells (National Cancer Institute 2000e). This phase is identified as greater than 5% blasts in either the peripheral blood or marrow, but less than 30% in the peripheral blood and bone marrow (National Cancer Institute 2000f). At least

20% of CML patients will not go through an accelerated phase and progress directly to a blastic phase (Cortes, Talpaz, and Kantarjian 1996). During the blastic phase or "blast crisis", more than 30% of the cells are blast cells. The blast cells may form tumors in the lymph nodes or the bones (National Cancer Institute 2000e). The transition between these three phases may occur gradually over a year or more. The annual rate of progression from chronic to blastic is 5% to 10% in the first two years and 20% in the years following (National Cancer Institute 2000f). There is also a refractory phase, during which leukemia cells do not decrease even when treatment is given (National Cancer Institute 2000e).

Treatment

"CML is not curable with conventional chemotherapy or immunotherapy. Allogeneic bone marrow transplantation from related or unrelated donors is the only known curative therapy" (National Cancer Institute 2000f, 1). However treatment may still include chemotherapy, radiation therapy, or BMT (National Cancer Institute 2000e). Patients age 60 and over have a worse prognosis. With allogeneic BMT, long-term survival rates of 50% to 80% and disease free survival rates of 30% to 70% may occur in the chronic phase. BMT results are improved for patients in the chronic versus the accelerated or blastic phases, which have long-term survival rates of 15% to 40% and less than 15%, respectively. Patients in the blast phase do not have a good response to any therapy (Cortes, Talpaz, and Kantarjian 1996).

Chronic Lymphocytic Leukemia

Twenty-five to 30% of all cases of leukemia in the United States are CLL. CLL is uncommon in patients younger than 30 years of age, but increases exponentially with

age for both men and women. Men have higher incidence rates than women (Keating 1996). CLL is the most common adult leukemia (Kipps 1995). According to studies in Olmstead County, Minnesota, the incidence of CLL has been increasing over the last 50 years (Keating 1996).

In CLL, as with the other three types of leukemia, there is an abnormal uncontrolled growth of lymphocytic cells in the marrow resulting in an increase in lymphocytes in the blood. In CLL as well as CML normal cells can be produced and function normally, which may account for less severity in the early course of the disease (Leukemia Society of America 1999c).

As with the other types of leukemia, the cause of CLL is unknown. There is an association between exposure to benzene as rubber workers and petroleum workers present with CLL. There is however, no association with exposure to ionizing radiation with CLL (Keating 1996). Genetics are involved as first-degree relatives have a threefold greater likelihood of getting the disease than other people (Leukemia Society of America 1999c).

The symptoms of CLL develop gradually. Tiredness, shortness of breath when physically active, weight loss, and sometimes recurrent infections of the skin, lungs, kidneys or other sites are symptoms of CLL. Diagnosis includes examining blood and marrow cells. The white cell count will be increased, but platelets and red cell counts may be decreased. Immunoglobulins in the blood may also be deficient. A cytogenetic analysis is done to determine abnormality of chromosomes (Leukemia Society of America 1999c).

Staging

Staging is used to predict prognosis, determine treatment, and treatment results. There is not a standard staging system for CLL. The Rai staging system and Binet classification system are delineated below according to the National Cancer Institute's Physicians Desk Query (2000g).

Rai Staging System
Stage 0 – Absolute lymphocytosis (>15,000 per cubic millimeter) without adenopathy, hepatosplenomegaly, anemia, or thrombocytopenia.
Stage I – Absolute lymphocytosis with lymphadenopathy without hepatosplenomegaly, anemia, or thrombocytopenia.
Stage II – Absolute lymphocytosis with either hepatomegaly or splenomegaly, with out without lymphadenopathy
Stage III – Absolute lymphocytosis and anemia (hemoglobin <11 g/dL) with or without lymphadenopathy, hepatomegaly, or splenomegaly.
Stage IV – Absolute lymphocytosis and thrombocytopenia (<100,000 per cubic millimeter) with or without lymphadenopathy, hepatomegaly, or anemia

Binet classification
Clinical stage A – No anemia, thrombocytopenia and fewer than three areas of lymphoid involvement (Rai stages 0, I, and II)*
Clinical stage B – No anemia or thrombocytopenia with three or more areas of lymphoid involvement (Rai stages I and II)*
Clinical stage C – Anemia and/or thrombocytopenia regardless of the number of areas of lymphoid enlargement (Rai stages III and IV)
*Lymphoid areas include cervical, axillary, inguinal, and spleen

The most common staging system used in the United States is the Rai staging system and Binet staging is the most common system in Europe. There is also a staging system called total tumor mass score; however, this system has not received wide acceptance (Keating 1996). The International Workshop on Chronic Lymphocytic Leukemia recommended an integrated Binet/Rai system as follows: A(0), A(I), A(II); B(I), B(II); and C(III), C(IV) (Keating 1996; National Cancer Institute 2000g). This

staging system however is not widely used. Patient survival may range from less than one year after diagnosis to 20 years of excellent health after diagnosis (Keating 1996).

Treatment

With CLL, a more conservative approach is taken with treatment because CLL is usually not curable, progresses slowly, and most frequently occurs in the elderly (National Cancer Institute 2000g). Patients who have minimal changes in their blood and few related infections are generally not treated. Signs of progression of CLL include rapid increase of lymphocyte counts in the blood, enlarged lymph nodes, enlarged spleen, worsening anemia, and decreasing platelet count. Chemotherapy is the most commonly used treatment when the disease has progressed. Radiation may be used to shrink lymph node masses. BMT may be utilized, but is more successful in younger patients (Leukemia Society of America 1999c). Leukapheresis may be used to take out extra lymphocytes (National Cancer Institute 2000f).

Side Effects of Treatment

Chemotherapy

Therapeutic measures are necessary in most cases of cancer to control, eradicate, or minimize the neoplastic process. Symptoms of chemotherapy side effects may occur within hours of administration or several days later (Bloch 1998). Chemotherapy affects tissues that require a high rate of cell division, which include the lining of the mouth, the lining of the intestines, the skin, and the hair follicles. This is why mouth ulcers, diarrhea, and hair loss are so common after chemotherapy (The Leukemia and Lymphoma society 2000). After chemotherapy begins, anorexia may develop. Chemotherapy drugs may cause xerostomia (dry mouth), dysgeusia (a change in the taste

of food), and odynophagia (pain upon swallowing). Nausea and vomiting is a side effect of chemotherapy, which can result in decreased calorie intake, weight loss, cachexia, dehydration, electrolyte and fluid imbalances, and metabolic derangements such as hypokalemia and metabolic alkalosis. Diarrhea can cause fluid and electrolyte losses, dehydration and metabolic alkalosis. Constipation and obstipation (severe constipation) can develop after chemotherapy begins and can last for several weeks. Stomatitis and mucositis (inflammation of the mucous membrane of the entire alimentary tract) are very common side effects of chemotherapy. Serious complications may include cardiac toxicity, nephrotoxicity, and hepatoxicity (Bloch 1998).

The purpose of chemotherapy is to eliminate leukemia cells; however, in the process developing blood cells are eliminated as well. This results in a deficiency of red blood cells, phagocytes, and platelets (Leukemia Society of America 1999a; The Leukemia and Lymphoma Society 2000). The lowest value that blood cell levels fall to is called the nadir. Platelets and white blood cells will reach their nadir in 7 to 14 days, but red blood cells may not reach a nadir for several weeks (American Cancer Society 2001). A transfusion of red blood cells or platelets may be required. Antibiotic therapy also may be required with the reduction in phagocytes as this can cause an infection. After several weeks, blood cell production often returns to normal. Blood cells counts will slowly approach normal levels. When this occurs and leukemia cells cannot be identified in the blood or bone marrow, the patient is in remission (Leukemia Society of America 1999a; The Leukemia and Lymphoma Society 2000).

Radiation

Side effects of radiation may vary according to dose, site of administration, and individual response. When the gastrointestinal tract is part of the radiation field, problems with nutrition should be expected. Side effects of radiation may include the following: nausea, vomiting, diarrhea, anorexia, stenosis, radiation enteritis, malabsorption, anosmia (blunted taste and smell), difficulty or pain with swallowing or chewing, loss of taste, dry mouth, mucositis, dental decay, osteoradionecrosis, oral infections, trismus, dysphagia, dysgeusia, fatigue, strictures, and fistulas (Bloch 1998).

Bone Marrow Transplant

A risk after a bone marrow transplant is graft versus host disease (GVHD). GVHD occurs in approximately 30% of allogeneic graft recipients who have human leukocyte antigens (HLA)- identical donors. Autologous graft recipients occasionally develop GVHD, but the disease is usually cured with a short course of immunosuppression. Immunosuppressant drugs are used at the time of the BMT and for a minimum of six months after the transplant to prevent GVHD. The incidence and severity of GVHD increases for older patients, patients with unrelated or mismatched family donors, and patients who do not tolerate sufficient prophylactic drug therapy. In 15% of recipients, there are long-term complications that include poor engraftment with associated immunodeficiency and restrictive and obstructive lung disease. Cataracts, aseptic bone necrosis, retarded growth, gonadal and ovarian failure, and tooth decay are other possible complications (Lenssen 1998).

There is also a chronic form of GVHD, which develops 70 to 400 days (or more) after allogeneic BMT in 30% of patients with HLA-identical sibling donors and in as

many as 70% of patient with unrelated donors. Several types of medications may be used in treating or preventing GVHD, including chemotherapy agents, immunotherapy and biological response modifiers, antimicrobials, and immunosuppressants, which add more side effects to the overall procedure (Lenssen 1998).

Total Parenteral Nutrition and Cancer

Total parenteral nutrition has been the standard used with cancer patients due to concerns of infection, bleeding, and intolerance with enteral feeding. In 1999, Ford and Pietsch conducted a study with children on home enteral feeding after chemotherapy or bone marrow transplantation. The researchers found that the tube feedings were well tolerated, there were minimal complications, and costs were reduced when compared with TPN. The conclusion reached was that tube feedings should be considered before TPN in children after intensive chemotherapy or BMT (Ford and Pietsch 1999).

Several studies have been conducted with TPN and chemotherapy. Chan and Blackburn (1999) reviewed eight prospective randomized clinical trials, and concluded that there was no overall advantage in survival of those receiving nutrition support, but the combination of drugs used for the chemotherapy were ineffective. The overall conclusion reached was that TPN during chemotherapy should only be used for patients with hypoalbuminemia or weight loss of more than 10% who are responsive to chemotherapy (Chan and Blackburn 1999).

Nosocomial Infections

Infections that develop in a hospital or are produced by microorganisms acquired during the hospital stay are called nosocomial infections. Most nosocomial infections are detectable while the patients are still in the hospital; however, the onset of a disease could

occur after a patient has left the hospital. Infections that the patient has upon admission are not considered nosocomial, but rather community acquired unless the patient received the infection from a previous hospitalization (Brachman 1998).

There are both preventable and nonpreventable nosocomial infections. Preventable infections occur in a situation that could have been altered in order to prevent the infection from occurring. An example of this is hand washing between contacts of urinary collection equipment from patients. It is estimated that 30% of all nosocomial infections are preventable. A nonpreventable infection is one that will occur regardless of the precautions taken to protect the patient (Brachman 1998).

It is estimated that 19,000 deaths occur nationwide annually that are directly attributable to nosocomial infections. In approximately 58,000 deaths, nosocomial infections contributed but were not the only cause. These estimates place nosocomial infections just below the tenth leading cause of death among the U.S. population (Martone et al. 1998).

The major types of nosocomial infections and the percentages they represent of the total are urinary tract infection (42%), surgical wound infection (24%), pneumonia (10%), bacteremia (5%), and other (19%) (Gaynes 1998). The average length of extended hospital days per infection is 1.0, 7.3, 5.9, 7.4, and 4.8, respectively (Martone et al. 1998).

Parenteral Nutrition

There are an estimated 30 million patients who receive transfusion therapy each year. Transfusion therapy can be fluid and electrolyte replacement, blood transfusion, hemodialysis, IV drug administration, intraarterial cancer chemotherapy, and total

parenteral nutrition. Nationwide there are 50,000 to 100,000 patients who will obtain blood stream infections each year. Blood stream infections can come from the intravascular device or contaminated infusate. Parenteral fluids can become contaminated during administration in the hospital. Culture surveys conducted on already in-use IV fluids, demonstrated a 1% to 2% contamination rate (Maki and Mermel 1998). Catheter-related sepsis may be caused from inappropriate technique of the line placement, poor catheter care, or a contaminated solution (Fuhrman 1998).

Neutropenia

"Neutropenia is the most important factor predisposing to infections in leukemic patients, although not the only one" (Bassan 1996, 258). "Neutropenia refers to an absolute blood neutrophil count (total lymphocyte count x percent of neutrophils) that is less than two standard deviations below the normal mean" (Dale 1995, 815). The risk of infection is inversely correlated with this count. As the duration of neutropenia increases, so will the frequency of infections (Bassan 1996). The concentration of neutrophils in the blood is reduced with age. Adults, age 70 years and older, are more likely to develop neutropenia with severe inflammation or infections. Patients who have neutropenia generally present with fever, sore throat, and inflammation of the skin or mucous membranes (Dale 1995).

Metabolic Changes and Cancer

There are several possible metabolic changes that are brought about by cancer. The energy expenditure in cancer patients is not always elevated. It is estimated that one third of cancer patients are hypometabolic, one third are normometabolic, and one third

are hypermetabolic. "Increased resting energy expenditure may occur in patients with small cell carcinoma, leukemia, and lymphoma" (Bloch 1993, 214). In protein metabolism, cancer causes increased turnover of whole-body protein, increased rate of protein synthesis of protein in the liver, decreased rate of synthesis in the skeletal muscle, and an increase in overall skeletal muscle breakdown. Cancer patients who have a progressive disease will metabolize more fat than those who do not have a progressive disease. It is frequent for cancer patients to have a decrease in total body fat, which may be attributable partly to insulin resistance or deficiency. Glucose metabolism may be altered and glucose intolerance can occur. There is decreased insulin sensitivity and responsiveness to insulin (Bloch 1993).

Nutritional Assessment of the Cancer Patient

Definition and Purpose

Nutritional assessment has been defined as, "an evaluation of the nutritional status of individuals or populations through measurement of food and nutrient intake and evaluation of nutrition-related health indicators" (Lee and Nieman 1996, 3). The U.S. Department of Health and Human Services explained nutritional assessment as, "the measurement of indicators of dietary status and nutrition-related health status to identify the possible occurrence, nature and extent of impaired nutritional status" (Lee and Nieman 1996, 3). The American Dietetic Association describes nutritional assessment as, "a comprehensive approach, completed by a registered dietitian, to defining nutritional status that uses medical, nutrition, and medication histories; physical examination; anthropometric measurements; and laboratory data" (Posthauer et al 1994,

838). The purpose of nutritional assessment according to the World Health Organization is to improve human health (Lee and Nieman 1996).

Components of Nutritional Assessment

Nutritional assessment of the cancer patient is similar to the assessment of any other hospitalized patient (D'Angelo 2000). In a nutritional assessment there are four different methods used to collect data. These include anthropometric, biochemical, clinical, and dietary. "ABCD" is the mnemonic that is often used to help remember these methods (Lee and Nieman 1996).

Anthropometric

The two types of anthropometric measurements are growth and body composition measurements. The most commonly used measurements of growth are height and body weight. Current and usual weight of the patient must be known to assess changes in body weight. Changes in weight may be due to changes in protein status, water, minerals, and/or body fat content. For adults, height/weight ratios or body mass indices are commonly used (Gibson 1990). Quetelet's Index ($weight/height^2$) is the most frequently used (Gibson 1990; Lee and Nieman 1996).

Body composition measurements include assessing body fat and fat free mass. These measurements can be done by skinfold thickness and circumference measurements. Skinfolds can provide an assessment of subcutaneous fat stores and therefore overall total body fat. Circumference of muscle area provides an estimate of protein reserves in the body, and overall protein status (Gibson 1990).

For the hospitalized adult cancer patient, weight is a very important measure. Weight loss greater than 10% is seen in 45% or more cancer patients. Cancers with the lowest frequency of weight loss (31% to 40%) include acute nonlymphocytic leukemia, breast, sarcoma, and non-Hodgkin's lymphoma. Colon, prostate, and lung cancers have an intermediate frequency of weight loss (48% to 61%). Pancreas and stomach cancers have the highest frequency of weight loss (83% to 87%). Placing patients at nutritional risk is involuntary weight loss of 5% to 10% in a period of one to six months (Bloch 1998).

Cancer patients also commonly experience changes in body composition, which includes loss of subcutaneous fat stores and loss of lean body mass. Bloch reports loss of muscle tissue can lead to fatigue, weakness, increased risk of thrombosis, decubiti, muscle atrophy, compromised respiratory function, and gastrointestinal symptoms (Bloch 1998). Anthropometric measurements for the cancer patient may include body weight, weight-height ratio, triceps skinfold thickness, and midarm muscle circumference (Herrmann, Fuhrman, and Borum 1998). Anthropometry measures for muscle mass may be useless due to visible signs of wasting and fat store depletion (Bloch 1998; Herrmann, Fuhrman, and Borum1998). Anthropometry would be more useful if the patient is followed long term in an outpatient setting (Bloch 1998).

Biochemical

Biochemical tests can provide the most quantitative and objective data when compared with the other methods of nutritional assessment. Biochemical tests usually detect nutrient deficiencies before anthropometric or clinical signs appear (Lee and

Nieman 1996). There are two general groups of biochemical tests, which are static tests and functional tests. Static tests are measures of nutrients or its metabolite taken in the blood, urine, or body tissue (Lee and Nieman 1996; Gibson 1990). The most readily available static tests include serum measurements of albumin, calcium, or vitamin A. These tests do have some limitations. They may not reflect overall nutritional status, because they only measure a tissue or fluid that was sampled (Lee and Nieman 1996). Many different factors may confound the results of static tests including recent dietary intake, exercise, age, sex, infections, weight loss, inflammatory stress, medications, nutrient interactions, and hemolysis (Gibson 1990).

Functional tests measure the extent of functional consequences of a specific nutrient deficiency (Lee and Nieman 1996; Gibson 1990). Examples of functional tests include impairment of immune status from protein-energy malnutrition, assessment of vitamin A status through dark adaptation, and assessing vitamin B_6 status through urinary excretion of xanthureic acid in response to consumption of tryptophan. A limitation of functional tests is that they are not specific. They may indicate general nutrient deficiencies, but do not identify specific nutrient deficiencies (Lee and Nieman 1996). Also non-nutritional factors may influence functional tests (Gibson 1990).

For assessment of cancer patients, nutritional biochemical tests measuring visceral protein status and blood levels of electrolytes and minerals should be measured and monitored (Bloch 1998). Visceral protein tests include thyroxine-binding prealbumin (transthyretin), transferrin, retinol binding protein, and albumin (Bloch 1998; Harrison and Brennan 1995). Transferrin has a half-life of 8 to 10 days, responding more rapidly to nutrition repletion or depletion. Prealbumin has a half-life of 2 to 3 days, responding

quickly to nutritional status. Retinol-binding protein has the shortest half-life of 10 to 12 hours (Harrison and Brennan 1995).

Serum albumin has the limitations of assuming a steady state, which is not true during acute illnesses, a long half-life of about 20 days, and levels are affected by hydration status (Harrison and Brennan 1995). Malnutrition, malabsorption, overhydration, nephrotic syndrome, protein-losing enteropathy, pregnancy, burns, and chronic illness may cause hypoalbuminemia. Hyperalbuminemia is seen in patients with dehydration or patients taking anabolic steroids (Farkas and Hyde 1996). A decrease in serum albumin is correlated with increased morbidity and mortality (Herrmann, Fuhrman, and Borum 1998). The normal range for adults is 3.5-5.0 grams per deciliter (Farkas and Hyde 1996).

"White blood cell count and differential is one of the most widely performed clinical laboratory tests" (Jordan 1996, 309). White blood cell (WBC) count is an actual count of the number of leukocytes in a given amount of blood. The reference adult range is 4.8-10.8 x 10^9 cells per liter. Included in the WBC differential are neutrophils, bands, lymphocytes, monocytes, basophils, and eosinophils. Each component in the WBC differential is measured as a percentage, and the percentages must add up to 100% (Jordan 1996). Appendix F provides a table of the normal white blood cell count and differential. White blood cells have an average six-hour lifespan (American Cancer Society 2001). Patients who have chronic leukemia will always have an increase in WBC. Patients with acute leukemia may have a low, normal, or high WBC. Occasionally, the WBC may be several times higher than an average count (The Leukemia and Lymphoma Society 2001b). For patients with a low WBC, hematopoietic

growth factors may be administered in a drug form. These drugs help the bone marrow to recover more quickly and reduce the risk of serious infections (American Cancer Society 2001).

The adult range for total lymphocyte count (TLC) is 20-40% (Jordan 1996). A decrease in TLC can reflect nutritional depletion, and repletion can be reflected by an increase in TLC (Harrison and Brennan 1995). The equation used for TLC and nutritional status is % lymphocytes multiplied by WBC divided by 100 equals TLC. For an indication of nutritional status, a TLC of 1500 to 1800 mm^3 reflects mild depletion, 900 to 1500 mm^3 reflects moderate depletion, and less than 900 mm^3 reflects severe depletion. TLC is not an absolute indicator of nutritional status. Patients who have leukemia or an infection will have increased levels of TLC. TLC will decrease with cancer, metabolic stress, steroid therapy, and after surgery (Hopkins 1993).

Platelets in the blood promote clot formation. The average platelet lifespan is 8 to 12 days. Thrombocythemia is an excess of platelets, which can be seen in patients who have chronic myelogenous leukemia. Thrombocytopenia is a low platelet count. Metastatic cancers, leukemia, and aplastic anemia may reduce the production of platelets (Groce and Carter 1996). For low platelet counts, platelet transfusions may be given. Transfused platelets only last a few days and after several platelet transfusions, an immune reaction may develop that destroys donor platelets. A platelet growth factor may also be given as a drug for people with thrombocytopenia (American Cancer Society 2001). Approximately one-third of platelets can be found in the spleen. Enlargement of the spleen will cause platelets to drop. In leukemia patients, the spleen may be removed to improve cells counts. If the spleen is removed, thrombocythemia will occur, but will

subside within one month (Association of Cancer Online Resources 2001). The normal adult range for platelets is 140,000-440,000 per microliter (Groce and Carter 1996).

Clinical

Clinical assessment consists of the medical history and physical examination. The medical history can be obtained from the patient or from the medical record. Medical history usually includes a description of the patient, any relevant environmental, social and family factors (Gibson 1990). The physical examination has been defined as, "those changes, believed to be related to inadequate nutrition, that can be seen or felt in superficial epithelial tissue, especially the skin, eyes, hair, and buccal mucosa, or organs near the surface of the body" (Gibson 1990, 579).

For the cancer patient, a detailed history of weight loss is very important. The percentage of weight loss correlates with complications and mortality. A history of bacterial and viral illness suggests immune dysfunction. Specific changes to note during the physical examination include general muscle wasting, peripheral edema, poor wound healing, and neurologic changes (Herrmann, Fuhrman, and Borum 1998).

There are several screening and assessment tools that may be used to determine nutrition status. The Subjective Global Assessment (SGA), Patient-Generated Subjective Global Assessment (PG-SGA), and the Oncology Screening Tool are forms being utilized in different clinical settings. These forms identify the patient's nutritional risk category. In the SGA, there are five components of history and three components of physical examination. The history includes current weight and weight history, current and usual dietary intake, gastrointestinal symptoms, performance status, and metabolic

requirements. The physical examination includes muscle, fat, and fluid status. After assessing these aspects, the patient is categorized as well nourished, moderately or possibly malnourished, or severely malnourished (Bloch 1998).

Dietary

Nutrient intake data are very valuable for nutritional assessment, especially when used with anthropometric, biochemical, and clinical data (Lee and Nieman 1996). There are two main methods for measuring food consumption of individuals. Quantitative daily consumption methods include recalls or records designed to measure the quantity of food consumed over a one-day period. The second group of methods consists of dietary history and the food frequency questionnaire. Dietary intake data are often compared to The Recommended Dietary Allowances, food groups, dietary guidelines, or the United States Department of Agriculture's Food Guide Pyramid (Gibson 1990).

There are several categories that may need to be assessed in the cancer patient. Some of these include, dietary habits, patterns, current practices, food aversions, changes in preferences, identifiable taste changes or sensations, and actual intake compared to food prepared or on the plate. Diet histories are more labor intensive, and should be used only with high-risk patients. Food frequency questionnaires are not as useful for individuals, but more for a group of people as they usually encompass a global intake of food. The most useful form for the hospitalized cancer patient would be a current or recent food intake history. This could be accomplished in any form including a calorie count. A general recent diet history gives the dietitian a more accurate picture of the patient's overall food and nutrient status (Bloch 1999).

The Role of the Nutrition Support Team

It has been almost three decades since the first nutrition support teams were started. There was a rapid growth of nutrition support teams during the 1970's and early 1980's; however, recently the growth of new teams has tapered off. It is almost universal that the nutrition support team consists of at least one physician, nurse, dietitian, and pharmacist (Wesley 1995). The purpose of the nutrition support team is simply to provide nutritional care. Wesley (1995, 219) identified three ways that this purpose is accomplished, "(1) identification of patients who are nutritionally impaired, (2) performance of a nutrition assessment that can adequately guide nutrition therapy, and (3) provision of safe and effective nutrition support". The role of nutrition support teams across the country includes inpatient consultation, educational programs, quality assurance, research, and home nutrition support programs (Wesley 1995).

There are several generally recognized cost-effective benefits of a nutrition support team, which include the following (Wesley 1995, 220):

- Recognition and treatment of malnutrition
- Reduction of mechanical and metabolic complications of parenteral and enteral nutrition
- Reduction in morbidity and mortality
- Reduction in the cost of providing specialized nutrition support by facilitating the appropriate use of enteral and parenteral therapies
- Provision for more cost-effective selection of products
- Reduction in costly wastage of formula
- Selection of appropriate nutrition support equipment and devices
- Reduction in length of stay and costs to the hospital
- Reduction in liability exposure
- Selection and monitoring of appropriate laboratory test

The dietitian is a valued member of the nutrition support team. Research has demonstrated that patients achieve nutrition goals more quickly when dietitian

recommendations were followed. The dietitian is the key team member for monitoring nutritional progress of the patient as well as ongoing assessment for readiness to progress to another type of nutritional support or to discontinue therapy (Skipper and Perlmutter 1992).

The Role of the Registered Dietitian in Nutrition Support

American Dietetic Association

The role of the dietitian in enteral nutrition is a well-acknowledged skill, but the role of the dietitian in parenteral nutrition is less recognized by medical staff and other health care professionals (Gilmour and Glencorse 1998). The Position Statement of The American Dietetic Association regarding the role of dietitians in nutrition support states,

> It is the position of The American Dietetic Association that a registered dietitian (RD) with competency in nutrition support is qualified to assume responsibility for the assessment, planning, implementing, and monitoring of enteral, parenteral, and specialized oral therapies in patient care (The American Dietetic Association 1997, 302).

Nutrition support has evolved over the years and registered dietitians have developed their skills to keep up with this rate of change. The American Dietetic Association has delineated the role of the registered dietitian in nutrition support, which is listed in Table 4.

Table 4. Current Role of the Registered Dietitian in Nutrition Support

- Identifies patients at nutritional risk
- Performs periodic assessment of patients receiving nutrition support
- Acts as the advocate for all aspects of nutrition care
- Participates in the design, implementation, and monitoring of enteral and parenteral nutrition regimens
- Provides for nutritionally complete transitional feeding
- Documents nutrition care plans
- Provides education to patients, families, and health care professionals
- Translates the nutrition care plan into understandable language
- Participates in the design, implementation, and monitoring of home enteral and parenteral nutrition regimens
- Participates in local, regional, national, and international programs
- Promotes the importance of nutrition and dietetics services to providers and government to enhance reimbursement for these services
- Documents for proper coding both nutrition services and diagnoses to increase reimbursement
- Participates in research studies
- Participates in studies designed to examine clinical outcomes for nutrition services in specific populations

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Source: The American Dietetic Association, 1997. Position of The American Dietetic Association: The role of registered dietitians in enteral and parenteral nutrition support. Journal of the American Dietetic Association 97:302-304.

A survey conducted in 1995, by Gilmour and Glencorse (1998), demonstrated that there is a need for dietitians to be more involved in parenteral nutrition and also that dietitians are increasing their involvement. According to their survey, 99% of dietitians felt they had a role to play in parenteral nutrition. A total of 83% of the dietitians surveyed felt they would like to be more involved with parenteral nutrition. Doctors are still the most common prescribers of TPN, despite the fact that routine training is not received in nutritional assessment, nutrient calculations, and prescribing. According to the survey, 50% of dietitians knew of cases where medical staff prescribed inappropriate parenteral nutrition (Gilmour and Glencorse 1998).

In 1996, a study by Mueller et al., reported the most frequent response to the dietitian's role in the decision to provide parenteral nutrition was to "recommend"

parenteral nutrition to a physician or other health care professional. Of the total respondents of this study, 37% wrote parenteral nutrition orders some or all of the time. The study also found that specialists were more likely to write orders than clinicians or managers, however educational level and length of registration did not affect the likelihood of those writing orders (Mueller, Colaizzo-Anas, and Shronts 1996).

Registered dietitians do have the skills to participate in parenteral nutrition regimens. "Registered dietitians with competency in nutrition support have acquired unique skills, through both clinical experience and formal training, to plan, implement, and monitor any combination of enteral and parenteral therapies" (The American Dietetic Association 1997, 302). The American Dietetic Association has pronounced the RD to be "the primary resource for the choice of appropriate oral supplements, enteral formulas, and prescriptions of parenteral solutions" (The American Dietetic Association 1997, 303).

American Society for Parenteral and Enteral Nutrition

In 1986, the American Society for Parenteral and Enteral Nutrition published standards of practice for nutrition support dietitians. The standards were revised in 1990, and revised again in 1999 (Appendix G). There are nine general standards described as well as several specifics for each standard. The standards included are as follows: competency; screening and assessment; medical nutrition therapy care plan; implementation; monitoring; reassessment, updating, and termination of medical nutrition therapy care plan; administrative management; education, training, and communication; and research. These standards were developed as general guidelines for registered dietitians in nutrition support (ASPEN 1993). "Use of these standards is expected to

promote quality patient care and improve the effectiveness of health care activities" (Winkler 1993, 1113).

Winkler conducted a study about the importance and value of the ASPEN standards of practice to dietitians in 1993. Of the total respondents, 68% reported using the ASPEN standards of practice. All the standards of practice had high importance ratings and were used widely, giving validity to the standards (Winkler 1993).

The Need for Outcomes Research

For dietitians, documenting outcomes is essential to compete in the ongoing health care economic battle. "Specifically, clinical dietitians need to do outcomes research and report their results" (Eck et al. 1998, 452). Eck and colleagues (1998) conducted a survey of registered dietitians in clinical practice, and found that dietitians have an interest in research, however the interest does not produce more involvement or publication. Eck et al. (1998, 457) summarized the need for outcomes research,

> Dietetics research and dietetics practice currently operate as separate entities, but research must become a key component in clinical dietetics practice. The goal of meshing the 2 areas is not only possible but expedient to the successful growth of our profession in the rapidly changing health care environment.

Methodology

Introduction

Since the 1997 merger of the two organizations, there has been a variance of dietetic practice at the different hospital sites. This inconsistency of practice has been especially noted in the area of nutrition support. At both the hospitals patients on TPN were classified as high nutrition risk patients, and the protocol is for the registered dietitian to document in the medical record a follow up chart note every four days. It is generally understood that at site A, the dietitians allowed pharmacy to follow patients on TPN, whereas at site B the dietitians followed patients on TPN more closely. The health system is considering standardizing the practice of nutrition support and the role of the dietitian at these sites. An objective of this research was to determine if the amount of dietitian follow up in the area of nutrition support affects patient outcomes in these two institutions. Other objectives were to determine if the amount of dietitian involvement would influence the length of stay, length of TPN administration, and protein status or weight gain of leukemia patients (hypotheses 1-4).

Data Collection

Inclusion Criteria

Medical records of 115 adult patients (18 years and older) with the diagnosis of leukemia and who had received TPN were retrospectively reviewed. Medical records included in the study were individuals with the diagnosis of leukemia and TPN discharged from January 1, 1997 through December 31, 2000 at site A and site B. Outpatient records and data were not utilized.

Because parenteral nutrition is not always coded by the ICD-9-CM codes in the computer system, a data analyst from a performance improvement team with the health system created the list of patients by combining the billing code for TPN and the ICD-9-CM codes for leukemia. Data on these patients were collected by a review of the medical record using the form in Appendix H. The health system's Human Subjects Review Board as well as the University of Wisconsin-Stout Institutional Review Board approved this study. (See Appendix I for approval forms.)

Data Collection Instrument

The data collection form is divided into four major sections relating to admission information, dietitian involvement, TPN prescription, and lab values. Adjustments for comorbidities were made using a translation of the Charlson Comorbidity Index (Charlson et al. 1987) in Appendix A into the ICD-9-CM codes (Deyo, Cherkin, and Ciol 1992) found in Appendix B. Severity of disease was determined using the clinical staging of the leukemia. Dietitian involvement was defined by charting completed by the dietitian in the medical record. A follow up note by the dietitian was only counted as a follow up if the note contained more information than just calorie count data. A change in the TPN prescription by the dietitian was only recorded if the dietitian recommended a change within three days of TPN initiation. If a lab value or weight was not taken on the admission or discharge day, then the closest value taken to the day was recorded. For the weight status, if calculated dry weight was available it was utilized. The percent ideal body weight was calculated using the Hamwi equation (Lysen 1997). The Hamwi equation for males is 106 pounds for the first 5 feet plus 6 pounds for every one-inch

above five feet. For females the equation is 100 pounds for the first 5 feet plus 5 pounds for every one-inch above 5 feet.

Statistical Methods

Descriptive analyses included tabulating means, medians and percentages. Associations between variables were explored using Pearson and Spearman correlational analyses. Differences between the two hospital sites were tested by chi-square analyses or t-tests. Statistical and correlational analyses were performed with SPSS, version 10.0 (1999, Chicago, IL). The level of significance for all tests was $\underline{p} \leq 0.05$.

Results

Study Sample

During the four-year time span (1997-2000), 130 patients with leukemia were admitted and given TPN. The study sample included 115 of these patients. The remaining 15 patients were excluded from the study due to unavailability of the medical records. A series of chi-square and t-tests were preformed to test for group difference between research subjects and persons excluded from the study. Although complete medical data were not available, existing computerized archival data was used to obtain the following variables: age; gender; year of admission; type of leukemia; length of stay; and the four lab values of albumin, total lymphocyte count (TLC), platelets, and white blood cells. Initial analysis with the 15 patients not included in the study revealed significant differences only for length of stay and TLC on discharge. However, one subject in this group was an extreme outlier due a long length of stay. Removing that subject from the analyses left significance only for TLC on discharge with an observed mean of 7.89% for those not included in the group compared to an observed mean of 17.01% (p=0.021) for those who were included.

Description of the Subjects

A total of 115 patients, 86 from site A and 29 from site B, were included in the study. Table 5 delineates the age of the subjects at the individual sites and in the combined sample. The results of the t-test demonstrated significant mean differences for age between site A and site B ($p<0.001$), with site B having an older population.

Table 5. Subject Age

Age in years	Hospital site		
	Site A	Site B	Combined
N	86	29	115
Minimum	19	22	19
Maximum	79	92	92
Mean ± SD	42.95 (15.37)	60.10 (15.67)	47.28 (17.10)

t-value = 5.17, df = 113, $p<0.001$

Table 6 identifies the frequency and percent of males and females at each site and that of the total sample. The chi-square test revealed significant differences between the two sites for gender ($p<0.001$), with site A having more males and site B having more females.

Table 6. Subject Gender

Gender	Hospital site					
	Site A		Site B		Combined	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Male	53	61.6	8	27.6	61	53.0
Female	33	33.8	21	72.4	54	47.0
Total	86	100.0	29	100.0	115	100.0

$\chi = 10.09$, df = 1, $p<0.001$

Table 7. Subject Type of Leukemia

Type of leukemia	Hospital site					
	Site A		Site B		Combined	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
AML	46	53.5	21	72.4	67	58.3
ALL	9	10.5	1	3.4	10	8.7
CML	24	27.9	3	10.3	27	23.5
CLL	7	8.1	4	13.8	11	9.6

$\chi = 6.14$, df = 3, $\underline{p} = 0.105$

Table 7 classifies each type of leukemia by individual sites and the entire sample. The chi-square test did not demonstrate significant differences between the two sites for the type of leukemia for which the patient was diagnosed. The total number of patients diagnosed with AML, ALL, CML, and CLL were 46, 9, 24, and 7, respectively at site A; and 21, 1, 3, and 4, respectively at site B.

Table 8. Subject Stages of Leukemia

Stage of leukemia	Hospital site					
	Site A		Site B		Combined	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
AML						
Remission	15	32.6	0	0	15	22.4
Recurrent/Refractory	30	65.2	21	100.0	51	76.1
Total	45	97.8	21	100.0	66	98.5
Missing	1	2.2	0	0	1	1.5
Total	46	100.0	21	100.0	67	100.0
ALL						
Remission	4	44.4	0	0	4	40
Recurrent/Refractory	5	55.6	1	100.0	6	60
Missing	0	0	0	0	0	0
Total	9	100.0	1	100.0	10	100.0
CML						
Chronic	15	62.5	1	33.3	16	59.3
Accelerated	1	4.2	0	0	1	3.7
Blastic	5	20.8	1	33.3	6	22.2
Refractory	1	4.2	0	0	1	3.7
Total	22	91.7	2	66.7	24	88.9
Missing	2	8.3	1	33.3	3	11.1
Total	24	100.0	3	100.0	27	100.0
CLL						
Stage 3	1	14.3	0	0	1	9.1
Missing	6	85.7	4	100.0	10	90.9
Total	7	100.0	4	100.0	11	100.0

$\chi = 16.67$, df = 6, $\underline{p} = 0.011$

Table 8 identifies the frequency and percent for each of the stages of the four types of leukemia. Results from the chi-square test revealed that there was a significant difference in leukemia stages between the two sites ($\underline{p}=0.011$), with site A representing more of the possible stages for AML, ALL, and CLL. Site B had no patients who were in remission whereas site A had 19 patients in remission.

Table 9. Subject Charlson Comorbidity Index

Charlson Comorbidity Index	Hospital site					
	Site A		Site B		Combined	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
0	70	81.4	17	58.6	87	75.7
1	9	10.5	5	17.2	14	12.2
2	4	4.6	4	13.8	8	6.9
3	3	3.5	0	0.0	3	2.6
4	0	0.0	3	10.4	3	2.6
Total	86	100	29	100	115	100

$\chi = 14.82$, df = 4, $\underline{p} = 0.005$

Table 9 identifies the frequency and percents of the Charlson Comorbidity Index scores at each site and both the sites combined. Results from the chi-square test confirmed that the Charlson Comorbidity Index was significantly different between the two sites ($\underline{p}$=.005), with site B having patients with higher comorbidity scores.

Table 10. Subjects Expiring During Hospitalization

Expired	Hospital site					
	Site A		Site B		Combined	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
No	64	74.4	17	58.6	81	70.4
Yes	22	25.6	12	41.1	34	29.6

$\chi = 6.14$, df = 3, $\underline{p}$ =0.107

Frequencies and percents of subjects expiring are shown in table 10. A significant difference was not found between the numbers of patients expiring at the two sites using a chi-square test.

Research Hypotheses

The purpose of this study was to investigate if timely dietitian follow up was associated with the outcomes of decreased length of stay, decreased duration of TPN administration, improved protein status, and weight gain for leukemia patients. The following tables identify differences across the variables related to the hypotheses. Table 11 identifies the means and standard deviations of the percent of expected follow-ups performed. The t-test indicated that a significantly greater number of dietitian follow ups occurred at site B.

Table 11. Percent of Dietitian Follow ups Performed

Percent of RD follow ups	Hospital site		
	Site A	Site B	Combined
N	85	29	114
Minimum	0	0	0
Maximum	233.33	342.86	342.86
Mean ± SD	27.10 (39.09)	73.33 (62.48)	38.86 (50.12)

t-value = 4.67, df = 112, $p < 0.001$

A significant difference was not found between the two sites for length of inpatient hospital stay. Table 12 identifies range and mean stay in days.

Table 12. Length of Stay

Length of stay in days	Hospital site		
	Site A	Site B	Combined
N	86	29	115
Minimum	6	3	3
Maximum	83	90	90
Mean ± SD	34.27 (14.16)	32.03 (21.78)	33.70 (16.34)

t-value = -0.635, df = 36.31, $p = 0.609$

A significant difference was found between the two sites for the number of days on TPN, with site A having a longer duration of TPN ($\underline{p}$ =0.007), 17.9 days compared to site B with 12.2 days. Site A had one patient who was an outlier with 74 days on TPN and that patient was removed from the analyses. The median and mode at Site B were 8 and 6, respectively. At site A, the median was 18 and the mode was 14. The results from the t-test are listed in table 13.

Table 13. Number of Days on TPN

Number of days on TPN	Hospital site		
	Site A	Site B	Combined
N	83	29	112
Minimum	1	1	1
Maximum	46	37	46
Mean ± SD	17.92 (9.64)	12.17 (10.07)	16.43 (10.03)

t-value = -2.73, df = 110, $\underline{p}$ = 0.007

Table 14 identifies the mean and range for the serum albumin values collected. Albumin has a half-life of approximately 20 days, indicating that a hospital stay of less than 20 days may not reflect changes in albumin. To control for the shorter length of stay, only those with a length of stay greater than 20 days were evaluated. The albumin change value was calculated by subtracting the discharge value from the admit value. No significant difference was found between the two sites for the change in albumin.

Table 14. Serum Albumin Values

Albumin on admit	Hospital site		
	Site A	Site B	Combined
N	74	20	94
Minimum	1.6	1.5	1.5
Maximum	4.4	4.3	4.4
Mean ± SD	3.18 (0.56)	3.09 (0.624)	3.16 (0.57)
Albumin on discharge			
N	73	19	92
Minimum	1.6	1.4	1.4
Maximum	3.6	3.2	3.6
Mean ± SD	2.77 (0.39)	2.4 (0.46)	2.69 (0.44)
Albumin change			
N	73	19	92
Minimum	-0.80	-0.40	-0.80
Maximum	1.90	2.00	2.00
Mean ± SD	0.42 (0.55)	0.69 (0.69)	0.48 (0.59)

t-value = 1.83, df = 90, $\underline{p}$ = 0.700

Table 15 identifies the mean and range for the TLC values collected. Because chemotherapy kills lymphocytes, only patients who did not receive chemotherapy were evaluated. No significant difference was found for a change in TLC between the two sites.

Table 15. Total Lymphocyte Count Values

TLC on admit	Hospital site		
	Site A	Site B	Combined
N	16	8	24
Minimum	2.0	6.0	2.0
Maximum	96.0	98.0	98
Mean ± SD	22.35 (24.87)	46.38 (38.48)	30.36 (31.43)
TLC on discharge			
N	15	7	22
Minimum	2.0	5.0	2.0
Maximum	60.0	97.0	97.0
Mean ± SD	15.67 (17.68)	33.00 (31.46)	21.19 (23.66)
TLC change			
N	15	7	22
Minimum	-38.00	-16.00	-38.00
Maximum	40.00	30.00	40.00
Mean ± SD	1.77 (17.34)	7.00 (16.15)	3.43 (16.77)

t-value = 0.673, df = 20, $\underline{p}$ = 0.509

The range and mean weight lost in kilograms is identified in Table 16. A t-test did not demonstrate a significant difference for weight change between the two sites.

Table 16. Weight Change in Kilograms for Subjects

Weight lost in kg	Hospital site		
	Site A	Site B	Combined
N	82	27	109
Minimum	-17	-8	-17
Maximum	32	17	32
Mean ± SD	-1.46 (5.67)	-0.36 (4.59)	-1.18 (5.43)

t-value = .913, df = 107, $\underline{p}$ = 0.361

Table 17. Correlations of Dietitian Involvement and Outcomes

		Length of Stay n=114	Total number of days on TPN n=111	Difference between Alb on admit and discharge[a] n=91	Difference between TLC on admit and discharge[b] n=22	Weight loss in Kg n=109
Percent of RD Follow ups performed[c]	Pearson Correlation	-0.146	-0.211*	-0.150	-0.074	0.080
	Sig. (2-tailed)	0.122	0.026	0.156	0.744	0.408

a.Only patients with a length of stay ≥ 20 days were included in this analysis.
b.Only patients who did not receive any treatment were included in this analysis.
c. LOS divided by 4=expected number of RD follow ups. Actual number of follow up notes divided by expected number of follow up notes x 100=percent of RD follow ups performed.

Table 17 identifies the correlations between these variables for the research hypotheses. The total number of days on TPN was the only variable that correlated with dietitian follow up. Patients who had expired were left in these analyses for statistical power. However, a partial correlation was used which controlled for survival to hospital discharge and no statistically significant changes were found from the above results.

The primary null hypothesis of this research (H_{o1}) was that timely follow up documentation from the dietitian will not significantly influence the outcome of length of hospital stay. A non-significant negative correlation was found with dietitian follow-up and the total number of days in the hospital. Therefore, the null hypothesis must be accepted. The primary alternate hypothesis (H_1) was that timely follow up documentation would significantly decrease length of stay. Thus, the alternate hypothesis was rejected.

The second null hypothesis (H_{o2}) was that timely follow up by the dietitian would not significantly influence the outcome of length of TPN. A significant negative correlation was found with dietitian follow up and the total number of days on TPN.

Thus, the null hypothesis must be rejected. The alternate hypothesis (H_2), stating timely dietitian follow up will significantly decrease the length of TPN, must then be accepted.

The third null hypothesis (H_{o3}) asserts that timely dietitian follow up will not significantly influence the outcome of protein status. The differences between admit and discharge for the lab vales of albumin and total lymphocyte count were used to determine protein status. For both of the changes in albumin and TLC, non-significant negative correlations were found, indicating to accept the null hypothesis. The alternate hypothesis (H_{o3}), states that dietitian follow up will significantly improve protein status. Thus, the alternate hypothesis must be rejected.

The fourth null hypothesis (H_{o4}) declares that timely follow up by the dietitian will not significantly influence the outcome of weight. Using the difference in body weight from admission to discharge, a non-significant positive correlation was found indicating that the null hypothesis must be accepted. The alternate hypothesis (H_{o4}), that timely dietitian follow up will significantly increase weight, must then be rejected.

To examine the difference of dietitian follow up between the two sites, the fifth null hypothesis of this research (H_{o5}) was that dietitian involvement with TPN protocols would not be significantly different between the two institutions. Dietitian involvement was defined by the percent of expected follow-ups performed by the dietitian. The results of the t-test indicate that dietitian involvement was significantly different between the two sites ($\underline{p}<0.001$). Thus, the null hypothesis was rejected.

The alternate hypothesis (H_5) was that dietitian involvement with TPN protocols would be significantly different between the two sites. Thus, the alternate hypothesis was not rejected.

Results From Other Data Collected

Admission Information

Data was also collected from the medical records on the reason for admission (principle diagnosis), the treatment received while in the hospital, and the number of readmissions during the four-year time span for each patient. Table 18 identifies the reasons for admission for each of the sites and then the sites combined. Chi-square test results identified a non-significant difference between the two sites. Caution should be used when interpreting this table as the analyses is weak due to the low patient number in many of the cells.

Table 18. Principle Diagnosis of Subjects

Diagnosis	Hospital site					
	Site A		Site B		Combined	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
AML	35	40.7	12	41.4	47	40.9
ALL	7	8.1	0	0	7	6.1
CML	21	24.4	3	10.3	24	20.9
CLL	3	3.5	0	0	3	2.6
Chemo	7	8.1	7	24.1	14	12.2
Heart failure	1	1.2	1	3.4	2	1.7
Septicemia	1	1.2	0	0	1	0.9
Hemorrhage	1	1.2	0	0	1	0.9
Facitis	1	1.2	0	0	1	0.9
Pancreatitis	1	1.2	0	0	1	0.9
Complicated BMT	2	2.3	0	0	2	1.7
Hypovolemia	2	2.3	0	0	2	1.7
Aspergillosis	1	1.2	0	0	1	0.9
Spondylitis	1	1.2	1	3.4	1	0.9
Lymphoma	1	1.2	0	0	1	0.9
CVA	1	1.2	0	0	1	0.9
Infections	0	0	1	3.4	1	0.9
Vascular device infection	0	0	1	3.4	1	0.9
Pneumonia	0	0	1	3.4	1	0.9
Colon cancer	0	0	1	3.4	1	0.9
Lymphproliferate disease	0	0	1	3.4	1	0.9
Total	86	100.0	28	100.0	115	100.0

$\chi = 32.48$, df = 21, $\underline{p} = 0.052$

Table 19. Cancer Treatment of Subjects

Cancer treatment	Hospital site					
	Site A		Site B		Combined	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
None	17	19.8	8	27.6	25	21.7
Chemo	24	27.9	21	72.4	45	39.1
BMT/chemo	43	50.0	0	0	43	37.4
BMT/chemo/radiation	2	2.3	0	0	2	1.7
Total	86	100.0	29	100.0	115	100.0

$\chi = 26.76$, df = 3, $p < 0.001$

The type of treatment each patient received for leukemia was also examined. Table 19 lists the various treatments given to patients at site A and site B. A significant difference was found with a chi-square test between the two sites ($p<0.001$). Site B had no patients who received a BMT while in the hospital, while 52.3% at site A had this procedure.

Table 20. Total Number of Readmissions from 1997-2000 of Subjects

Total number of admits in the 4 yr time span	Hospital site		
	Site A	Site B	Combined
N	84	29	113
Minimum	1	1	1
Maximum	8	11	11
Mean ± SD	2.02 (1.65)	3.31 (2.82)	2.35 (2.08)

t-value = 2.33, df = 34.86, $p = 0.026$

The total number of readmissions from 1997 through 2000 is identified with ranges, means and standard deviations for each site in Table 20. The results from the t-test indicate a significant difference between the two sites ($p=0.026$), with site B having the greater number of readmissions.

Dietitian Information

Data collected relating to the dietitian includes the risk level of the patient determined by dietitian or dietetic technician assessment, how the dietitian calculated calorie needs, percent ideal body weight, who recommended the TPN, percentage of needs the TPN met, if the dietitian recommended a changed in the TPN prescription, and if the physician made that change. Table 21 identifies the nutritional risk level patients were assigned by the dietitian or dietetic technician. The missing data reflects risk levels that were not given because the initial assessment was not found in the medical record. Chi-square test results indicate that the difference in nutritional risk level between the two sites was significant ($p = 0.001$), with site A having no patients at low risk and more patients at high risk than site B. Site B had patients at low risk and fewer patients at high risk than site A.

Table 21. Nutritional Risk Level of Subjects

Nutritional risk level	Hospital site					
	Site A		Site B		Combined	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Low risk	0	0	4	13.8	4	3.5
Moderate risk	22	25.6	6	20.7	28	24.3
High risk	55	64.0	14	48.3	69	60.0
Total	77	89.5	24	82.8	101	87.8
Missing	9	10.5	5	17.2	14	12.2
Total	86	100.0	29	100.0	115	100.0

$\chi = 13.38$, $df = 2$, $p < 0.001$

Dietitians and dietetic technicians calculate calorie needs either using Resting Energy Expenditure (REE) or calories per kilogram of body weight. Table 22 identifies frequencies and percents of the calculations completed to assess calorie needs. The row labeled “not completed” refers to the medical records in which no calculation of calorie

needs was found. The row labeled "missing" identifies those charts in which there was no calculation of calorie needs and either height or weight was not available to calculate the needs. A significant difference using a chi-square test was not found between the two sites, however REE is used more frequently at site A than at site B.

Table 22. Dietitian and Dietetic Technician Calculation of Calorie Needs

Calculation of calorie needs	Hospital site					
	Site A		Site B		Combined	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
REE	49	57.0	14	48.3	63	54.8
Kcal/kg	21	24.4	10	34.5	31	27.0
Not completed	13	15.1	3	10.3	16	13.9
Total	83	96.5	27	93.1	110	95.7
Missing	3	3.5	2	6.9	5	4.3
Total	86	100.0	29	100.0	115	100.0

$\chi = 1.469$, df = 2, $\underline{p} = 0.480$

Table 23 delineates the percent ideal body weight on admission for the subjects. Results from the t-test reveal that the difference in percent ideal body weight between the two sites was not significant.

Table 23. Percent Ideal Body Weight of Subjects

Percent ideal body weight	Hospital site		
	Site A	Site B	Combined
N	84	29	113
Minimum	72	73	72
Maximum	185	236	236
Mean ± SD	119.12 (26.93)	130.66 (28.24)	122.08 (30.47)

t-value = 1.50, df = 38.04, $\underline{p} = 0.142$

The dietitian, physician, or pharmacist generally made the TPN recommendations. For purposes of this research, the physician and pharmacist were grouped together as the data to distinguish the two was not collected. Table 24 identifies which health professional made the recommendation to begin TPN. A chi-square test did not reveal significant differences between the sites.

Table 24. TPN Recommendations by Health Professional

Health professional	Hospital site					
	Site A		Site B		Combined	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Dietitian	9	10.5	4	13.8	13	11.5
Physician or pharmacist	75	87.2	25	86.2	100	87.0
Total	84	97.7	29	100.0	113	98.3
Missing	2	2.3	0	0	2	1.7
Total	86	100.0	29	100.0	115	100.0

$\chi = 0.201$, df = 1, $\underline{p} = 0.654$

The dietitian at times made recommendations for changes in the TPN prescription. These changes were only recorded if the recommendation was made within three days of initial TPN administration. Table 25 lists the frequency and percent of these recommendations. Chi-square test results indicated a significance difference between the two sites ($p<0.001$), with the dietitian at site B more frequently changing TPN prescriptions.

Table 25. TPN Changes Recommended by the Dietitian

Did the RD change the prescription?	Hospital site					
	Site A		Site B		Combined	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
No	83	96.5	9	31.0	92	80.0
Yes	2	2.3	20	69.0	22	19.1
Total	85	98.8	29	100.0	114	99.1
Missing	1	1.2	0	0	1	0.9
Total	86	100.0	29	100.0	115	100.0

$\chi = 61.61$, df = 1, $\underline{p} < 0.001$

Table 26 identifies whether or not dietitian recommendations were actually carried out by the physician. Significance for the variable of physicians making the changes recommended by the dietitian was not demonstrated with a chi-square test. At site A, no changes were implemented that were recommended by the dietitian, while at site B 45% (9 of 20) were implemented.

Table 26. Dietitian Recommendations Implemented by the Physician

Did the physician make changes?	Hospital site					
	Site A		Site B		Combined	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
No	2	2.3	11	37.9	13	11.3
Yes	0	0	9	31.0	9	7.8
No changes recommended	84	97.7	9	31.0	93	80.9
Total	86	100.0	29	100.0	115	100.0

$\chi = 1.52$, df = 1, $\underline{p} = 0.217$

The type of feeding that the subjects were transitioned to after TPN included oral feeding, enteral feeding, and home TPN. Table 27 lists the transitional feedings in frequencies and percentages for each site. No significant difference was found between the two sites with transitional feedings using a chi-square test.

Table 27. Transitional Feeding After TPN for Subjects

Type of feeding	Hospital site					
	Site A		Site B		Combined	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Oral	63	73.3	20	69.0	83	72.2
Enteral	3	3.5	1	3.4	4	3.5
Home TPN	5	5.8	1	3.4	6	5.2
Died on TPN	12	14.0	7	24.1	19	16.5
Total	83	96.5	29	100.0	112	97.4
Missing	3	3.5	0	0	3	2.6
Total	86	100.0	29	100.0	115	100.0

$\chi = 1.60$, df = 3, $\underline{p} = 0.661$

Infections

Patients may acquire nosocomial infections during their stay or be admitted with an infection. Data collected on these infections included whether the patient had a line infection as well as any other type of infections. Table 28 describes the type of infections patients had by percentages. There was a significant difference ($p<0.003$) between the two sites, with subjects at site B having more infections. Percentages with no infections for the site A and site B was 50.0 and 17.2%, respectively.

Table 28. Infections of Subjects

Infections	Hospital site					
	Site A		Site B		Combined	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
None	43	50.0	5	17.2	48	41.7
Pneumonia	7	8.1	5	17.2	12	10.4
Aspergillosis	2	2.3	0	0	2	1.7
E.coli septicemia	0	0	1	3.4	1	0.9
Bacteremia	6	7.0	1	3.4	7	6.1
Pseudomonas	1	1.2	0	0	1	0.9
UTI	0	0	1	3.4	1	0.9
Candidiasis	1	1.2	0	0	1	0.9
Staphyloc	1	1.2	1	3.4	2	1.7
Septicemia	7	8.1	2	6.9	9	7.8
Combinations of 2 or more of the above infections	18	20.9	13	44.8	31	27.0
Total	86	100.0	29	100.0	115	100.0

$\chi = 51.25$, $df = 27$, $p = 0.003$

Leukemia and Lab Values

Table 29 identifies the normal range of the lab values for both of the sites.

Table 29. Normal Lab Value Ranges

Lab	Normal Range
Albumin (Alb)	3.3-4.6 g/L
Platelets (Plt)	150-450 10^9/L
White Blood Cells (WBC)	4-11 10^9/L
Total Lymphocyte Count (TLC)	20-48%

Table 30 identifies the mean and range of each of the lab values categorized by the type of leukemia. Results from these tables need to be read and interpreted with caution because medications and transfusions were not taken into account. Medications and transfusions could greatly influence these lab vales.

Table 30. Lab Values of the Types of Leukemia

Type of leukemia		Serum albumin on admit g/L	Lowest serum albumin value g/L	Serum albumin on discharge g/L	Platelets on admit 10^9/L	Lowest platelets value 10^9/L	Platelets on discharge 10^9/L	WBC on admit 10^9/L	Lowest WBC value 10^9/L	WBC on discharge 10^9/L	TLC on admit %	Lowest TLC value %	TLC on discharge %
AML	Mean	3.12 (0.55)	2.29 (0.039)	2.61 (0.52)	97.34 (85.69)	11.73 (11.02)	78.81 (92.70)	17.77 (43.35)	2.34 (14.10)	11.13 (20.08)	26.03 (23.82)	4.96 (5.50)	18.26 (24.29)
	Minimum	2.0	1.4	1.4	7.0	1.0	1.0	0.10	0.00	0.05	1.0	0.5	1.0
	Maximum	4.3	2.9	3.6	473.0	91.0	434.0	298.00	115.00	136.00	97.0	33.0	100.0
ALL	Mean	2.92 (0.62)	2.44 (0.34)	2.81 (0.38)	167.20 (102.20)	23.90 (21.38)	36.11 (24.67)	6.39 (9.51)	0.73 (1.61)	4.90 (4.27)	20.43 (13.38)	7.89 (8.00)	15.51 (15.17)
	Minimum	2.0	2.0	2.0	12.0	10.0	2.1	1.10	0.05	0.05	2.0	1.0	4.0
	Maximum	3.8	3.2	3.3	336.0	75.0	93.0	32.80	5.20	12.80	49.0	20.0	55.0
CML	Mean	3.27 (0.45)	2.49 (0.32)	2.76 (0.36)	323.07 (260.88)	19.33 (42.35)	79.26 (85.29)	28.12 (26.59)	0.40 (1.74)	7.16 (10.19)	13.54 (12.73)	2.89 (3.40)	9.72 (9.75)
	Minimum	2.4	2.0	2.0	10.0	5.0	11.0	3.10	0.00	0.05	1.0	0.5	0.5
	Maximum	4.0	3.2	3.4	861.0	230.0	349.0	92.60	9.10	45.30	48.0	16.0	36.0
CLL	Mean	2.69 (0.78)	1.89 (0.37)	2.27 (0.41)	169.46 (132.57)	71.10 (87.33)	116.30 (103.29)	39.23 (50.21)	23.93 (50.03)	53.78 (107.62)	50.27 (38.51)	22.11 (32.64)	31.67 (31.67)
	Minimum	1.5	1.5	1.7	17.0	9.0	12.0	1.40	0.05	3.90	6.0	1.0	2.0
	Maximum	4.4	2.6	3.1	451.0	229.0	279.0	159.00	159.00	350.00	98.0	96.0	97.0
Total	Mean	3.10 (0.58)	2.32 (0.40)	2.64 (0.48)	163.31 (175.35)	19.81 (37.42)	78.46 (88.75)	21.26 (39.31)	3.63 (18.90)	13.38 (36.70)	24.92 (24.60)	6.12 (11.34)	17.01 (22.10)
	Minimum	1.5	1.4	1.4	7.0	1.0	1.0	0.10	0.00	0.05	1.0	0.5	0.5
	Maximum	4.4	3.2	3.6	861.0	230.0	434.0	298.00	159.00	350.00	98.0	96.0	100.0

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Other Interesting Findings

TPN Trends from 1997 through 2000

Lists of patients with leukemia admitted each year from January 1997 through December 2000, were obtained from data analysts from the Health Information Management System at both sites. From this information, trends over the four-year period could be developed regarding TPN usage with leukemia patients (Table 31). Figure 3 depicts this trend. The percentages were developed by dividing the total number of patients with leukemia on TPN each year (including readmissions) by the total number of admissions with a diagnosis of leukemia. Of the overall sample, including readmissions, TPN was administered to leukemia patients 11.8% of the time.

Table 31. Leukemia Admissions With and Without TPN

Leukemia patients admitted by year	Hospital site	
	Site A	Site B
1997	220	78
1998	241	128
1999	269	139
2000	246	94
Leukemia patients given TPN by year		
1997	4	3
1998	0	14
1999	40	11
2000	71	8

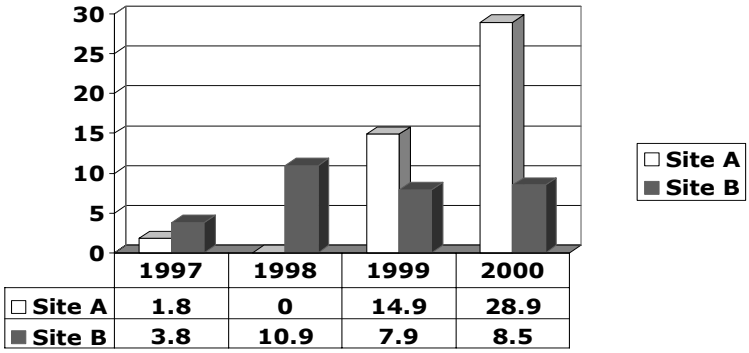

Figure 3. Percentages of total leukemia patients given TPN.

Additional Follow Up Analyses

Further analyses, beyond the hypotheses, were used to examine other plausible outcomes. Additional analyses included further study on dietitian involvement as well as the percentage of calorie and protein needs that were met by the TPN. The percentage of dietitian involvement did not correlate with the length of stay; however, dietitian involvement did directly correlate with the duration of TPN ($r = 0.028$, $p = 0.012$).

The percentages of theses calorie and protein needs met by the TPN solution is delineated in Table 32 and Table 33, respectively.

Table 32. Percent of Calorie Needs Met by TPN

Percent of calorie needs met	Hospital site		
	Site A	Site B	Combined
N	81	29	110
Minimum	22	64	22
Maximum	147	135	147
Mean ± SD	80.44 (22.03)	100.55 (18.41)	85.74 (22.86)

t-value = 4.39, df = 108, $p < 0.001$

Table 33. Percent of Protein Needs Met by TPN

Percent of protein needs met	Hospital site		
	Site A	Site B	Combined
N	81	29	110
Minimum	50	59	50
Maximum	175	170	175
Mean ± SD	114.49 (27.35)	106.56 (30.24)	112.40 (28.22)

t-value = -1.30, df=108, p =0.195

Results from the t-test demonstrated a significant difference between the two sites for the percentage of calorie needs met ($p<0.001$). Site B was identified as meeting more of the patients needs for calories. Both of the means for calorie and protein needs met were close to 100% at site B, while site A was under on calorie needs and over on the protein needs met by the TPN. This data should be interpreted with caution however, as the patient's oral intake was not studied. It is possible that patients at site A could be eating meals or snacks and therefore were not prescribed full TPN to meet their needs.

The percent of calories and protein met from the TPN did not correlate with the length of stay. The percent of protein from the TPN did not correlate with the length of TPN, however the percent of calories met did inversely correlate with the duration of TPN ($r = -0.201$, $p = 0.036$).

To summarize, site B used TPN less with leukemia patients but appeared to be meeting the nutritional needs of more of those patients; whereas site A was using TPN with more patients, but appeared to be meeting nutritional needs of fewer that were receiving TPN.

Discussion and Conclusions

Discussion

Characteristics of the Study Sample

Age of the Sample Population

The age range of subjects in this study was 19 years to 92 years with a median age of 47.0 years (mean age = 47.28). For females, the median age was 50.0 years (mean age = 49.76), and for males 45.0 years was the median age (mean age = 45.08).

When comparing the two hospital sites, according to t-test results, site B had a significantly older population. Charlson et al. (1987) reported that of all the clinical and demographic variables only age and comorbidity were significant predictors of comorbid death. For longitudinal studies it was recommended to use age as one point on the comorbidity index, such as each decade over age 40 would add one point to the comorbidity risk index. Age was not used in this study as a point on the comorbidity index, but as discussed above advanced age could be another risk factor.

Gender of the Sample Population

In this study, 53% of the sample was male and females represented 47% of the sample. The two hospital sites were significantly different with site B having more females and site A having more males.

Type of Leukemia and Stages

The overall sample, with both sites combined, reveals the majority of patients diagnosed with AML, followed by CML, CLL, and ALL with percentages of 58.3%, 23.5%, 9.6%, and 8.7%, respectively. A significant difference between the two sites was not found with the type of leukemia diagnosis. Overall age-adjusted incidence rates from

the Surveillance, Epidemiology, and End Results (SEER) Data and the National Cancer Institute per 100,000 people are as follows: AML 2.5; CLL 1.8; CML 1.3; and ALL 1.3 (The Leukemia and Lymphoma Society 2001c). National data identifies AML as the most prominent type of leukemia and this was reflected in the study sample.

The stages of leukemia did differ significantly between the two sites. This is primarily due to the fact that site B had a smaller sample size and had less of the variance of stages. Site B had no patients who were in remission with AML, ALL, and no patients with CML in the accelerated or refractory stages.

Comorbidity and Death

The Charlson Comorbidity Index scores were significantly different between the two sites according to results from the chi-square test. Site B had a higher mean comorbidity score than site A, 0.86 and 0.30, respectively. While the Charlson Comorbidity Index scores differed significantly across sites, the index was not significantly associated with any of the outcome measures in this study. This is probably due to the highly skewed distribution of scores inherent to the instrument. Of the total sample with both sites included, 76% had a comorbidity score of 0. Charlson et al. (1987) validated the comorbidity index on breast cancer patients. They reported 86% of their population to have a comorbidity index score of 0. Singh et al. (1997) also validated the Charlson Comorbidity Index on head and neck cancer patients, and found the index to be a valid prognostic indicator. However, Romano, Roos and Jollis (1993) made a relevant point that each specific population needs to be assessed, as there may be other methods to measure comorbidities that would be more relevant to that population. Further validation of the Charlson Comorbidity Index should be conducted, especially in

larger samples to allow for statistical transformations of skewed data or other non-linear analyses. Alternatively, a more sensitive index should be developed.

In the total sample studied, 29.6% expired during hospitalization. Site B did have a greater percentage of their total leukemia patients expire, but the differential death rates between site A and site B were not statistically significant. More patients dying at site B could be related to a significantly higher comorbidity score and older patient population. Results from this study using a Spearman correlation demonstrate that the Charlson Comorbidity Index did positively correlate with age and dying.

Correlations of Dietitian Involvement and Outcome Measures

Length of Stay

Dietitian involvement had an inverse non-significant correlation with length of stay. Chima et al. (1997) reported that patients at risk for malnutrition had a significantly longer length of stay. Length of stay did have a significant positive correlation with the amount of weight lost during hospitalization. However, percent ideal body weight on admission and percent of calorie and protein needs met by the TPN did not significantly correlate with length of stay. McEllistrum et al. (1993) demonstrated a significant negative correlation between the albumin level on admission and the total length of stay. Conversely, in this study sample, a significant positive correlation was found between admit albumin and length of stay, suggesting a higher albumin upon admission is not a predictor of a shorter length of stay.

Length of TPN Administration

A significant inverse correlation was found between dietitian involvement and total length in days on TPN, indicating that more involvement by dietitians is associated with a shorter length of TPN. This may be due to a significant positive correlation between dietitian involvement and the percent of calorie needs met by the TPN. Increased dietitian involvement helps patients to meet their calorie needs and meeting calorie needs may reduce the length of TPN. A non-significant inverse correlation was found between dietitian involvement and percent of protein needs met by TPN.

Albumin and Total Lymphocyte Count

The differences between admit and discharge values for albumin and TLC when correlated with dietitian involvement demonstrated a negative non-significant correlation. This indicates that dietitian involvement did not positively impact these protein lab values during the patient's length of stay. Weddle et al. (1995) reported that patients on enteral nutrition had an odds ratio at least four times greater for maintaining serum albumin (+/- 1 g/L) when dietitian's recommendations were followed then when they were not followed. In this study for the total sample the physician implemented only 41% of recommendations made by the dietitian.

Both the albumin and TLC values on admission have a positive significant correlation with the identical lab value on discharge. This demonstrates that nutrition status reflected by these lab values on admission may be the most consistent indicators of nutritional status on discharge. For cancer patients receiving chemotherapy TLC may not be a good indicator of nutritional status. As a result of the chemotherapy lymphocytes are killed, so TLC will be much lower than the recommended or normal range.

Weight Loss

Weight lost during the patient's length of stay was not significantly correlated with dietitian involvement. Weight loss did not significantly correlate with the percent of protein or calorie needs met by the TPN. In the total sample, a mean weight loss of 1.18 kg per person was found. However, research has recognized that TPN for cancer patients receiving chemotherapy (Lees 1997) or BMT (Shike 1996) is beneficial to body weight. In a study done at the University of Minnesota Hospital by Weisdorf et al. (1984), it was identified that BMT patients who received inadequate calories experienced a significant weight loss without TPN compared to those patients receiving TPN. Shike (1996) reported that the weight gained does not demonstrate an improvement in lean body mass and the gains from the TPN diminish after the TPN was stopped.

The dietitian involvement between the two sites was significantly different with more involvement at site B. At site B, the number of days on TPN was significantly lower which would translate to decreased cost to the patient or payer. Thus, dietitian involvement may be a cost effective intervention.

Conclusions

As reported by Splett (1996) one of the goals of outcomes research should be to evaluate the effectiveness of current clinical practice. In brief this research evaluated the association of dietitian involvement in oncology and nutrition support with important outcomes. This study examined whether dietitian involvement with leukemia patients on TPN improved the outcomes of length of stay, length of TPN administration, lab vales of albumin and total lymphocyte count, and weight loss during the hospital stay. The results of the Pearson Correlation demonstrated significance only for the total number of days on TPN being reduced with more dietitian involvement. Thus, the conclusion of this study is that dietitian involvement can lead to a shorter duration for a patient on TPN, which in turn reduces costs from the TPN, facilitates earlier oral intake, and reduces time for the development of a line infection.

This research examined two different hospitals under one organization. Enforcing standard TPN policies is challenging as site A and site B both handle patients on TPN differently. In addition, the sites appear to admit patients at different stages of leukemia. One of the main practice differences between the two sites was the nutrition support team at site B. The nutrition support team started at site B in 1986. The team consists of a registered dietitian; pharmacist; consultant coordinator, consultant registered nurse, and consultant respiratory therapist; and liaison physician. The team rounds one time per week for approximately 60 to 90 minutes, however the team does discuss patients on a daily basis. The written policy at site B was for dietitians to monitor the macronutrients and pharmacy to monitor the micronutrients. At site A in oncology, there was not a nutrition support team. Procedures at site A were for dietitians to follow TPN

macronutrients. However pharmacy was following as well, therefore the dietitians leave much of the follow up to the pharmacists. This of course involves another health care discipline and their policies and procedures, which may again be different at each site. Enforcing a standard of practice across the sites would involve a change in the time allotment from both disciplines of dietetics and pharmacy.

The central conclusion of this study, dietitians following up on patients is associated with a shortened duration on TPN, is an outcome with significant implications. This is one indicator of the effectiveness of dietitians in oncology in the treatment of leukemia.

The first recommendation for the nutrition services department at site A is to evaluate their TPN protocol. Are there any obstacles that prevent dietitians from complying with the current protocol? The protocol has been if pharmacy is following the patient on nutrition support then dietitians do not have to follow as closely. Communication is needed between pharmacy and the dietitians working in nutrition support. Time and budget may be issues between the two disciplines. Another issue that remains however is the nutrition support team. Is there a desire or a need for a nutrition support team in oncology at site A? Is it really possible to standardize practice across the sites? If that is the desire of the health system a change in the protocol, time allotment for nutrition support dietitians, and communication with pharmacy would be needed.

Future Recommendations

The results of this study showed that dietitian involvement and follow up were associated with a decrease in the amount of time a patient was on total parenteral nutrition. Other hypotheses investigated by this study including association with weight gain, reduced length of stay, and increased albumin and total lymphocyte count were rejected. Albumin and TLC were the only available lab values in this study, but they may not be the best predictors of nutritional status, particularly among leukemia patients. There are so many other factors that affect these lab values such as medications, cancer treatment, and hydration status. These lab values also have a longer half-life than other nutritional lab values that could be used. A future recommendation for nutritional lab values is to use lab values with a shorter half-life such as transferrin or prealbumin, which would be more representative of nutritional status at that point in time. These lab values would also be affected by the cancer treatment, but would be more reflective of current nutrition status.

The Charlson Comorbidity Index was validated with breast cancer patients; thus, this index may not be the best parameter to assess comorbidities of leukemia patients. From the total sample of this study, 76% had a comorbidity index of 0. A recommendation for future studies is to develop a comorbidity index specific to leukemia patients.

A growing trend in outcomes research is to assess patient outcomes. Clinical indicators in oncology for JCAHO membership include patients at moderate or high risk implementing their nutrition care plan upon discharge (Queen, Caldwell, and Balogun 1993). A recommendation for future research is to conduct a prospective study in which

patients are assessed as to how well the patient can put into practice their specific nutritional care plan at discharge. This type of study could lead to demonstrating further outcomes of dietitian involvement.

Appendix A

Charlson Comorbidity Index

Weighted index of comorbidity

Assigned weights for diseases	Conditions
1	Myocardial infarct
	Congestive heart failure
	Peripheral vascular disease
	Cerebrovascular disease
	Dementia
	Chronic pulmonary disease
	Connective tissue disease
	Ulcer disease
	Mild liver disease
	Diabetes
2	Hemiplegia
	Moderate or severe renal disease
	Diabetes with end organ damage
	Any tumor
	Leukemia
	Lymphoma
3	Moderate or severe liver disease
6	Metastatic solid tumor
	AIDS

Source: Charlson, Mary E, Peter Pompei, Kathy L Ales, and C Ronald Mackenzie. 1987. A new method of classifying prognostic comorbidity in longitudinal studies: Development and validation. *Journal of Chronic Disease* 40: 373-383.

Appendix B

Translation of the Charlson Comorbidity Index Into ICD-9-CM Codes

Translation of Charlson comorbidity index components into ICD-9-CM codes

Diagnostic category	Number (%) of patients in study dataset	ICD-9-CM codes	Description
Myocardial infarction	892 (3.3)	410-410.9	Acute myocardial infarction
		412*	Old myocardial infarction
Congestive heart failure	595 (2.2)	428-428.9	Heart failure
Peripheral vascular disease	698 (2.6)	443.9*	Peripheral vascular disease including intermittent claudication
		441.441.9*	Aortic aneurysm
		785.4*	Gangrene
		V43.4*	Blood vessel replaced by prosthesis
		Procedure 38.48	Resection and replacement of lower limb arteries
Cerebrovascular disease	940 (3.5)	430-438†	Cerebrovascular disease
Dementia	59 (0.2)	290-290.9*	Senile and presenile dementias
Chronic pulmonary disease	2466 (9.1)	490-496*	Chronic obstructive pulmonary disease
		500-505*	Pneumoconioses
		506.4*	Chronic respiratory conditions due to fumes and vapors
Rheumatologic disease	440 (1.6)	710.0*	Systemic lupus erythematosus
		710.1*	Polymyositis
		714.0-714.2*	Adult rheumatoid arthritis
		714.81*	Rheumatoid lung
		725*	Polymyalgia rheumatica
Peptic ulcer disease	544 (2.0)	531-534.9	Gastric, duodenal and gastrojejunal ulcers
		531.4-531.7	Chronic forms of peptic ulcer disease* (subset of above listing)
		532.4-532.7	
		533.4-533.7	
		534.4-534.7	
Mild liver disease	54 (0.2)	571.2*	Alcoholic cirrhosis
		571.5*	Cirrhosis without mention of alcohol
		571.6*	Biliary cirrhosis
		571.4-571.49*	Chronic hepatitis
Diabetes	2828 (10.4)	250-250.3*	Diabetes with or without acute metabolic disturbances
		250.7*	Diabetes with peripheral circulatory disorders
Diabetes with chronic complications	74 (0.3)	250.4-250.6*	Diabetes with renal, ophthalmic, or neurologic
Hemiplegia or paraplegia	178 (0.7)	344.1*	Paraplegia
		342-342.9*	Hemiplegia

Renal disease	123 (0.5)	582-582.9*	Chronic glomerulonephritis
		583-583.7*	Nephritis and nephropathy
		585*	Chronic renal failure
		586*	Renal failure, unspecified
		588-588.9*	Disorders resulting from impaired renal function
Any malignancy, including leukemia and lymphoma	550 (2.0)	140-172.9	Malignant neoplasms‡
		174-195.8	Malignant neoplasms‡
		200-208.9	Leukemia and lymphoma
Moderate or sever liver disease	11 (0.04)	572.2-572.8*	Hepatic coma, portal hypertension, other sequelae of chronic liver disease
		456.0-456.21*	Esophageal varices
Metastatic solid tumor	137 (0.5)	196-199.1	Secondary malignant neoplasm or lymph nodes and other organs
AIDS	0	042-044.9£	HIV infection with related specified conditions

*Asterisked codes were included if listed during index or prior admissions. Other codes were included only if recorded prior to the index admission.

† Only code 438 (late effects of cerebrovascular disease) was included during an index admission.

‡ These codes exclude skin cancer other than melanoma.

£ These ICD codes were effectively excluded from this analysis because they only became effective 1 October 1986.

Source: Deyo, Richard A, Daniel C Cherkin, and Marcia A Ciol. 1992. Adapting a clinical comorbidity index for use with ICD-9-CM administrative databases. *Journal of Clinical Epidemiology* 45:613-619.

Appendix C

ASPEN Practice Guidelines for Parenteral Nutrition

Practice Guidelines
Parenteral Nutrition

1. Patients who are candidates for parenteral nutrition support cannot, should not, or will not eat adequately to maintain their nutrient stores. These patients are already, or have the potential of becoming, malnourished. (B)
2. PPN may be used in selected patients to provide partial or total nutrition support for up to 2 weeks in patients who cannot ingest or absorb oral or enteral tube-delivered nutrients, or when central vein parenteral nutrition is not feasible. (B)
3. TPN support is necessary when parenteral feeding is indicated for longer than 2 weeks, peripheral venous access is limited, nutrient needs are large or fluid restriction is required, and the benefits of TPN support outweigh the risks. (C)
4. Indications for HPN are the same as for hospital TPN, except that the patient's illness no longer requires an acute-care setting. (C)
5. The patient/caregiver should understand the risks, costs, expected outcome, and benefits of HPN therapy before it is initiated. (C)
6. HPN should be instituted and supervised by a multidisciplinary team with knowledge and expertise in HPN. (C)
7. The patient/caregiver and home environment should be suitable for safe delivery and monitoring of HPN. (C)
8. The patient's need for and potential benefits from HPN therapy should be reevaluated periodically. (C)
9. Patients receiving parenteral nutrition support should be monitored by health care professionals trained to detect the infectious, mechanical, metabolic, and nutritional complications of intravenous feeding at an early stage. Monitoring should be completed at intervals appropriate for each specific condition and setting. Abnormalities detected during monitoring should be treated promptly. (C)

Source: ASPEN. 1993. Guidelines for the use of parenteral and enteral nutrition in adult and pediatric patients. *Journal of Parenteral and Enteral Nutrition* 17: 1SA-51SA.

Appendix D

ASPEN Practice Guidelines for Malnutrition

Practice Guidelines
Malnutrition

General guidelines for the diagnosis and treatment of malnutrition include the following:

1. An effort should be made in hospitalized patients to detect actual or potential malnutrition at an early stage. (C)
2. Patients should be considered malnourished or at risk of developing malnutrition if they have inadequate nutrient intake for ≥7 days or if they have a weight loss ≥10% of their preillness body weight. (C)
3. The onset or development of malnutrition should be prevented or slowed by giving appropriate patients optimum nutrition counseling and diets. (C)
4. Patients who cannot maintain adequate oral intake and who are candidates for nutrition support should be considered for enteral tube feeding first. (C)
5. Enteral tube feeding and parenteral nutrition should be combined when enteral support alone is not possible. (C)
6. Parenteral nutrition should be used alone when enteral feeding techniques have failed to provide some or all of the patient's nutrient requirements or in selected conditions in which enteral nutrition support is contraindicated. (C)
7. Malnutrition should be corrected at a judicious rate and overfeeding should be avoided. (C)

Source: ASPEN. 1993. Guidelines for the use of parenteral and enteral nutrition in adult and pediatric patients. *Journal of Parenteral and Enteral Nutrition* 17: 1SA-51SA.

Appendix E

ASPEN Practice Guidelines for Cancer

Practice Guidelines
Cancer

1. Enteral tube feeding and parenteral nutrition support may benefit some severely malnourished cancer patients or those in whom gastrointestinal or other toxicities are anticipated to preclude adequate oral nutritional intake for more than 1 week. Patients who are candidates for nutrition intervention under these circumstances should receive nutrition support, if possible, in conjunction with the initiation of oncologic therapy. (C)
2. Specialized nutrition support is not routinely indicated for well-nourished or mildly malnourished patients undergoing surgery, chemotherapy, or radiation treatment and in whom adequate oral intake is anticipated. (A)
3. TPN is unlikely to benefit patients with advanced cancer whose malignancy is documented as unresponsive to chemotherapy or radiation therapy. (B)

Source: ASPEN. 1993. Guidelines for the use of parenteral and enteral nutrition in adult and pediatric patients. *Journal of Parenteral and Enteral Nutrition* 17: 1SA-51SA.

Appendix F

Normal White Blood Cell Count and Differential

Normal WBC Count and Differential

Cell Type	Normal Range
Total WBC count	4800-10,800/mm^3
Polymorphonuclear neutrophils (segs, PMNS, polys)	45-73%
Bands (stabs)	3-5%
Lymphocytes	20-40%
Monocytes	2-8%
Eosinophils	0-4%
Basophils	0-1 %

Source: Jordan, Nancy S. 1996. Hematology: Red and white blood cells tests. In *Basic Skills in Interpreting Laboratory Data*, 2nd ed, ed Scott L Traub, 297-319. Bethesda, MD: American Society of Health-System Pharmacists.

Appendix G

ASPEN Standards of Practice for Nutrition Support Dietitians

The American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.) Standards of Practice for nutrition support dietitians

M. PATRICIA FUHRMAN, MS, RD, FADA; MARION WINKLER, MS, RD; CHRISTINE BIESEMEIER, MS, RD

Registered dietitians (RD) who specialize in nutrition support face unique challenges in today's dynamic healthcare environment. Downsizing, shrinking education dollars, and reimbursement issues often result in staff reductions. Many nutrition support dietitians have large patient assignments and receive limited training to enable them to accomplish their duties and responsibilities. Developing and maintaining expertise in nutrition support can be challenging.

Given these circumstances, what course should the nutrition support RD take? The RD has two professional responsibilities:

Use of evidence-based practice and evidence-based tools for patient care, e.g. the Medical Nutrition Therapy (MNT) Protocols and other available protocols that are patient care focused.

- ADA "Tool Kit" for Developing and Validating Evidence-Based Guides for Practice (1).
- Dietitians in Nutrition Support (DNS) has been involved in the development of MNT Protocols (2) for nutrition support in acute care and alternate sites. The enteral and parenteral feeding MNT protocols are currently under revision. The Acute Care/Adults MNT protocol will be used by DNS to design and perform a nutrition support outcomes project so that we can provide evidence-based practice guidance to dietetic professionals.
- Development of a model for effective nutrition care will provide a template from which outcomes can be defined and measured (3)

Self-evaluation using the Commission on Dietetic Registration model (Professional Development [PD]—2001), ADA's Standards of Professional Practice (SOPP)(4), *and SOPP that are applicable to the nutrition support practice setting, e.g. the American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.) Standards of Practice (SOP)* (5).

- A.S.P.E.N. has published Interdisciplinary Core competency statements that provide a model for self or peer review (6). Based on A.S.P.E.N.'s SOPs, these competencies can be incorporated into job descriptions and performance appraisals. A.S.P.E.N. also offers self-assessment programs in general nutrition, nutritional assessment, enteral nutrition, and parenteral nutrition.

The A.S.P.E.N. Standards of Practice for Nutrition Support Dietitians were based on a recent role delineation study conducted by the National Board of Nutrition Support Certification (NBNSC) (7). The study population included Certified Nutrition Support Dietitian (CNSDs), members of A.S.P.E.N., and members of DNS. In the development process, the A.S.P.E.N. SOPs were widely circulated and reviewed by the NBNSC, DNS, Clinical Nutrition Management DPG, the Commission on Dietetic Registration and ADA's Quality Management Team. As such, DNS decided to adopt these standards, rather than develop new SOPP for nutrition support dietitians. DNS submitted the published A.S.P.E.N. SOP for Nutrition Support Dietitians to the ADA QM committee for approval and adoption by ADA.

- Adoption versus creating new SOPP avoids duplication and member confusion about which standards to use.
- Many DNS members and leaders collaborated in the development of the A.S.P.E.N. SOP.
- The A.S.P.E.N. SOP incorporate all 6 ADA SOPP, as determined by the QM Committee during a recent review/approval process.

A.S.P.E.N.'s revised Standards of Practice for Nutrition Support Dietitians (5) encompass the following topics:

- Scope of Practice
  - defining the nutrition support dietitian
  - competency*
- Standards of Care
  - screening* and assessment
  - MNT care plan
  - implementation
  - monitoring
  - reassessment, updating, and termination of MNT care plan*

M. Patricia Fuhrman is chair of the Dietitians in Nutrition Support (DNS) dietetic practice group; Marion Winkler is director of clinical practice, A.S.P.E.N.; Christine Biesemeier is the ADA Quality Management Chair.

- Management of nutrition support services*
- Promotion of nutrition support*
  education, training, communication*
  research.*

Each of the 2000 Nutrition Support Dietitian Standards is followed by an explanation of the intent of the standard. The 2000 standards are more global and comprehensive with emphasis on the evolving professional role of the registered dietitian involved in nutrition support. The importance of lifelong learning through continuing education and mentoring are incorporated into the standards. The standards emphasize the importance of interdisciplinary communication, education and cooperation. Nutrition support dietitians practice in a variety of healthcare settings and are challenged daily to provide optimal nutrition care amidst a whirlwind of new technology and scientific findings. Incorporation of research into clinical duties as well as critical evaluation of research in order to provide evidence-based nutrition support is encouraged. The standards look to the future and promote expansion of skills by addressing bedside placement of feeding tubes, parenteral nutrition order writing, and performance of nutrition-focused physical assessment. Ethical issues are addressed as well as the participation of the registered dietitian in developing practice guidelines, selecting infusion devices and equipment, and directing the nutrition support service. The standards are designed to provide guidance for the nutrition support registered dietitian and do not supersede the clinician's professional judgement or the policies and procedures of the healthcare institution in which the dietitian practices.

A "nutrition support team" can be a formal assembly of designated personnel or an association of interested clinicians who share information and informally discuss patient care. Today's communication capabilities do not require that the "team" be in the same physical location. As a member of a nutrition support team or as a sole practitioner, it is imperative that there be standards by which clinical practice is guided in order for patients to receive effective and efficient nutrition care. This is an empowering document for the nutrition support dietitian. You can integrate the SOP into your professional development portfolio. The SOP can facilitate the professional development process to maintain/increase competency and maintain dietetic registration, as well as in facility performance evaluation process. We encourage each of you to read the standards carefully, share them with your supervisor and hospital administrator and begin today to incorporate the standards into your practice.

References

1. Splett PL. *Developing and Validating Evidence-Based Guides for Practice: A Tool Kit for Dietetics Professionals.* Chicago, IL: American Dietetic Association, 2000.
2. *Medical Nutrition Therapy Across the Continuum of Care* 2nd ed. and *Medical Nutrition Therapy Across the Continuum of Care: Supplement 1.* American Dietetic Association and Morrison Health Care, Chicago, IL: American Dietetic Association, 1998;1997.
3. Splett P, Meyers EF. A proposed model for effective nutrition care. *J Am Diet Assoc.* 2001;101:357-363.
4. American Dietetic Association. Standards of Professional Practice for Dietetics Professionals. *J Am Diet Assoc.* 1998;98:83-87.
5. American Society for Parenteral and Enteral Nutrition, Board of Directors: Standards of Practice for Nutrition Support Dietitians. *Nutr Clin Prac.* 2000;15:53-59.
6. Board of Directors, American Society for Parenteral and Enteral Nutrition. Interdisciplinary nutrition support core competencies. *Nutr Clin Prac.* 1999;14:331-333.
7. Nutrition Support Dietitian Role Delineation Survey. Prepared by Professional Testing Corporation, New York, NY, for the National Board of Nutrition Support Certification, September, 1997.

* denotes standards not previously included in 1990 publication

Standards of Practice for Nutrition Support Dietitians

American Society for Parenteral and Enteral Nutrition, Board of Directors

Introduction

The American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.) is a professional Society of physicians, nurses, dietitians, pharmacists, and nutritionists committed to promoting quality patient care, education, and research in the field of nutrition and metabolic support in all health care settings. The diversity of our membership emphasizes both the importance of good nutrition in clinical practice and the necessity for a team approach. These "Standards for Nutrition Support Dietitians" represent an update of a similar 1990 set of standards from A.S.P.E.N. The activities described in this document also reflect information obtained from a 1997 survey of practice activities performed by board-certified nutrition support dietitians.(1)

A.S.P.E.N. has developed these standards as the general guidelines for registered dietitians in the provision of specialized nutrition support. Their application in any individual case should be determined by the best judgment of the professional. The standards represent a consensus of A.S.P.E.N.'s members as to the range of activities (as appropriate to the individual's position, education, and practice environment) a Nutrition Support Dietitian may perform at the minimal level of practice necessary to assure safe and effective enteral and parenteral nutrition care. Use of the word "shall" within this document indicates standards strictly to be followed to conform to the standard; use of "should" indicates that among several possibilities one is particularly suitable, without mentioning or excluding others or that a certain course of action is preferred but not necessarily required. "May" is used to indicate a course of action that is permissible within the limits of recommended practice.

These standards do not constitute medical or other professional advice and should not be taken as such. To the extent that the information published herein may be used to assist in the care of patients, this is the result of the sole professional judgment of the attending health professional whose judgment is the primary component of quality medical care. The information presented in these standards is not a substitute for the exercise of such judgment by the health professional.

These standards have been developed, reviewed, and approved by the A.S.P.E.N. Dietetics Practice Section and the A.S.P.E.N. Board of Directors.

These Standards of Practice for Nutrition Support Dietitians (NSDs) should be used in conjunction with the following publications:

The American Dietetic Association. Standards of Professional Practice for Dietetics Professionals. *J Am Diet Assoc.* 1998;98:83-7.

Definitions of Terms Used in A.S.P.E.N. Guidelines and Standards. NCP 1995;10:1-3.

Standards for Nutrition Support: Hospitalized Patients. NCP 1995;10:208-18.

Standards for Nutrition Support: Hospitalized Pediatric Patients. NCP 1996;11:217-28.

Standards of Nutrition Support for Adult Residents of Long Term Care Facilities. NCP 1997;12:284-93.

Standards for Home Nutrition Support. NCP 1999;14:151-62.

Standards for Nutrition Support Physicians. NCP 1996;11:235-40.

Standards of Practice: Nutrition Support Nurse. NCP 1996;11:127-34.

Standards of Practice for Nutrition Support Pharmacists. NCP 1999;14:275-81.

Safe Practices for Parenteral Feeding Formulations. JPEN 1998;22(Suppl).

CHAPTER I: SCOPE OF PRACTICE

As the importance of specialized nutrition support continues to be recognized, and the technology of enteral and parenteral nutrient delivery advances, the role of the NSD continues to expand. The NSD's role has clearly emerged as a specialty practice within professional dietetics. The goal of the NSD, working in conjunction with other health care professionals, which include a pharmacist, a nurse, and a physician, is to support, restore, and maintain optimal nutritional health for those individuals with potential or known alterations in nutritional status.

The NSD is a registered dietitian with clinical expertise or credentialing in nutrition support obtained through education, training, or experience in this field. The NSD assures optimal nutrition support through (a) individualized nutrition screening and assessment; (b) development of a medical nutrition therapy (MNT) care plan and its implementation2; (c) monitoring and reassessment of an individual's response to the nutrition care delivered; and (d) development of a transitional feeding care plan or termination of a nutrition support care plan, as appropriate. Other activities may include management of nutrition support services, including developing policies and procedures and supervising personnel and budgets; recommending and maintaining enteral and parenteral formularies; evaluating equipment for enteral feeding delivery; participating in nutrition support committees; and assuring optimal reimbursement for nutrition support activities.

The NSD should provide or assist with the education and training of patients, caregivers, and health care professionals concerning theories, principles, and practices of specialized nutrition support. Furthermore, the NSD may take an active role in research activities to include participation in or generation of research and outcomes studies, with evaluation, interpretation, and application of research results.

The NSD may practice in a variety of settings (eg, acute and subacute facilities, ambulatory/outpatient clinics, long-term care facilities, home care) for all age groups and across all developmental stages along the continuum of care. The NSD may not always work with a formal nutrition support service because the NSD practice may vary on the basis of the individual's position and practice environment, allowing the NSD to have independent, interdependent, and collaborative functions.

Standard 1: Competency

The NSD shall demonstrate competence to practice nutrition

FIG: American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.) Standards of Practice for Nutrition Support Dietitians. Reprinted with permission of the American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.) from Nutrition in Clinical Practice 15:53-59, 2000.

support. Education, knowledge, experiences, and abilities shall circumscribe the NSD's competence.

Intent of Standard
The practice of nutrition support varies with the specialty practice of the dietitian (eg, critical care, pediatrics, home care). Minimum qualifications are required of all dietitians who practice nutrition support and include:

1.1 Current, valid registration to practice as a professional Registered Dietitian in the United States of America by the Commission on Dietetic Registration (CDR).

1.2 A current, valid license or certification to practice professional dietetics in those states with regulatory requirements.

1.3 Documentation of three or more of the following:

1.3.1 Certification by the National Board of Nutrition Support Certification, Inc as a Certified Nutrition Support Dietitian (CNSD);

1.3.2 Formal education, training, or continuing professional education in nutrition support;

1.3.3 A minimum of 30% to 50% professional practice time devoted to the practice of nutrition support (1);

1.3.4 Participation in the health care institution's nutrition support activities;

1.3.5 Membership in professional societies devoted to nutrition support.

CHAPTER II: STANDARDS OF CARE

Standard 2: Screening and Assessment
The NSD shall work in collaboration with other health care professionals to assess the nutritional state of a patient (3).

Intent of Standard
The intent of assessing nutritional state is to establish baseline subjective and objective nutritional parameters, identify nutrition deficits, and determine nutritional risk factors for individual patients. The assessment of nutritional requirements establishes daily energy, macronutrient, micronutrient, and fluid requirements, based on subjective and objective findings. Nutrition assessment is documented in the medical record to facilitate subsequent communication, monitoring, and quality improvement.

2.1 The NSD may participate in the collection of data to determine if individuals are nutritionally-at-risk.(3)

2.1.1 The NSD works with other health care professionals to ensure that a mechanism for nutrition screening and rescreening, with established criteria for identifying a patient who is or may become malnourished, is operational and effective. The screening may include the patient's age, gender, diagnosis, past medical/surgical history, weight history or growth history, history of nutrient intake, special dietary requirements, current use of specialized nutrition support, drug-nutrient interactions, and food allergies; the ability to obtain food; and any factors that may interfere with nutrient intake.

2.1.2 The NSD should assure that results of the nutrition screening are documented in the medical record.

2.2 All patients who are classified as nutritionally-at-risk should undergo a comprehensive assessment.(3) The NSD should review the medical and nutrition history and evaluate the following:

2.2.1 Anthropometric measurements;

2.2.2 Physical assessment (eg, fluid balance, functional status, clinical signs of malnutrition);

2.2.3 Biochemical indices;

2.2.4 Clinical factors that may interfere with ingestion of optimal nutrients (mechanical, physiologic, or psychological);

2.2.5 Alterations in digestion, absorption, or metabolism of nutrients;

2.2.6 Dietary intake history, including consumption of nutrition/herbal supplements;

2.2.7 Medication usage (both physician-prescribed and self-prescribed);

2.2.8 Socioeconomic status and access to medical care.

2.3 The NSD shall complete a quantitative and qualitative nutrition assessment before initiation of specialized nutrition support. This includes:

2.3.1 Determination of nutrient and fluid needs based upon the patient's resting energy expenditure, activity, hemodynamic status, metabolic demands, disease state and treatment, organ system function, current nutritional state, medications, and goals of medical nutrition therapy;

2.3.2 Documentation of the results of nutrition assessment and recommendations in the medical record with appropriate communication to the health care team.

Standard 3: Medical Nutrition Therapy Care Plan
The NSD shall share in the development of a medical nutrition therapy care plan based on the results of the nutrition assessment.(3)

Intent of Standard
Patient-specific outcomes are achieved through the implementation of the nutrition care plan. Goals are defined, documented, monitored, and modified to facilitate the most efficient and effective clinical outcome(s). The medical nutrition therapy care plan addresses the specific patient needs identified in the nutrition assessment and serves as a guide to all health care professionals who collaborate in the care of the patient. All medical nutrition therapy care plans should be based on the most current medical evidence as it pertains to each patient's disease state and clinical condition.

3.1 The NSD shall establish a medical nutrition therapy care plan based upon the results of the comprehensive nutrition assessment.

FIG cont'd.

3.2 The NSD shall recommend the appropriate route of nutrition support based upon the patient's current medical condition. The recommendation shall provide the assessed nutrient and energy requirements and should ideally achieve nutrition objectives safely and cost-effectively.

3.2.1 The gastrointestinal (GI) tract should be used when there is no contraindication.

3.2.2 Parenteral nutrition should be initiated when nutrient and energy needs cannot be met by the enteral route.

3.2.3 The route of nutrition support should be reassessed periodically during the course of therapy, as indicated by the patient's physiologic/anatomic condition or response to therapy.

3.3 The NSD may recommend, write orders, or obtain verbal orders for enteral and parenteral formulations (as guided by professional licensure or delineated by clinical privileges of an institution); and adjust regimens on the basis of response to therapy, clinical condition, and nutritional parameters. The nutrition formulation recommended/selected shall be appropriate for the medical condition and estimated nutrient and energy needs and compatible with the route of access.

3.3.1 The medical nutrition therapy care plan should include recommendations for oral diets, enteral tube feedings, and parenteral formulations as appropriate.

3.3.2 The selection of disease-specific solutions should be based on established criteria.

3.3.3 Feeding formulations should be tailored to current medical condition constraints and clinical status that affect tolerance and nutrient utilization.

3.3.4 Recommendations for feeding formulations should be made with consideration of compatibility issues.

3.3.4.1 Enteral formulations: addition of modular nutrients and medications with regard to physical compatibility and drug-nutrient interactions.

3.3.4.2 Parenteral formulations: compatibility issues per the National Advisory Group's Safe Practices for Parenteral Feeding Formulations.(4)

3.3.5 When similarly effective preparations that meet patient nutrient requirements are available, the most cost-effective product shall be selected.

3.4 The NSD shall provide and document education/information regarding nutrition support techniques and nutrition intervention to the health care team, patient, or caregiver to assist them in making informed decisions before initiating therapy.

3.4.1 Short- and long-term goals of medical nutrition therapy should be established and re-evaluated.

3.4.2 Educational needs of the patient and caregiver should be evaluated and met accordingly.

3.4.3 Medical necessity for specialized nutrition support in alternative sites should be documented.(5)

3.4.4 The individual's progress toward achieving nutrition goals should be detailed in the medical record and communicated to appropriate health care professionals.

Standard 4: Implementation
The NSD shall participate in the implementation of a medical nutrition therapy care plan to ensure appropriate, safe, and cost-effective nutrition care.

Intent of Standard
Provision of nutrition care may involve many health care professionals. The NSD may be involved at several levels of the medical nutrition therapy care plan implementation, dependent upon job responsibilities, professional licensure, and credentialing and delineated by clinical privileges of an institution.

4.1 The NSD shall participate in an interdisciplinary process for recommendation of placement and management of enteral access devices.

4.2 The NSD with specialized training, demonstrated competency, and delineated clinical privileges may place nasoenteric access devices.

4.3 The NSD with specialized training and delineated clinical privileges may recommend or perform proper maintenance of enteral feeding devices (eg, tube patency) and tube site care.

4.4 The NSD may recommend placement of access devices for parenteral nutrition.

4.5 The NSD should assure that enteral formulations are prepared according to established guidelines (Hazard Analysis Critical Control Point) for safe, aseptic, and effective nutrition therapy.(6)

4.5.1 The NSD shall assure that enteral feeding formulations are prepared to prevent contamination and incompatibility of ingredients (eg, medications, modular components).

4.5.2 The NSD shall assure that written guidelines for the preparation and storage of enteral feeding formulations are maintained, to include proper labeling (eg, including patient's name, type of formula, and date the formula expires). Policies and procedures shall specify allowable hang time for enteral formulations.

4.6 The NSD shall verify that specialized nutrition support is administered in accordance with the prescribed medical nutrition therapy care plan and consistent with patient tolerance.

4.7 The NSD should participate in the monitoring of written orders for specialized nutrition support by verifying comprehension of written orders with other health care professionals to minimize errors in formulation composition or administration.

4.8 The NSD should collaborate with other members of the health care team to develop protocols that ensure the administration and delivery of safe and effective nutrition support to provide optimal patient care.

FIG cont'd.

4.8.1 Protocols will be established and should include guidelines for administration, monitoring, and infection control.(4)

4.8.2 Protocols will be reviewed regularly to ensure that they are consistent with current knowledge of feeding formulations and access devices.

Standard 5: Monitoring
The NSD, in collaboration with other members of the health care team, shall monitor and evaluate the patient's clinical status, the effectiveness and appropriateness of medical nutrition therapy, and progress toward attainment of desired outcomes.(3) The NSD shall participate in the development and implementation of policies and procedures for monitoring patients receiving specialized nutrition support.

Intent of Standard
Patient monitoring is essential for determining the success of the medical nutrition therapy care plan. It is imperative in the evaluation of the patient's progress toward fulfilling the medical nutrition therapy goals.

5.1 The NSD, with interdisciplinary collaboration, shall monitor the clinical and metabolic response to specialized nutrition support to provide a basis for modifying the medical nutrition therapy care plan. The evaluation shall include use of multiple sources of data, including patient interview, medical records, clinical and nutritional status, laboratory indices, and discussion with caregivers as appropriate.

5.1.1 The NSD's role in monitoring patients may include any of the following: A nutrition-focused physical examination (including but not limited to signs of fluid, energy, or nutrient depletion or excess); inspection of nutrition access devices; assessment of adequacy of nutrient intake (eg, oral, enteral, parenteral); evaluation of weight changes; fluid balance; acid/base balance; review of pertinent, nutrition-related laboratory data; review of medications; assessment of organ function and hemodynamic status; tolerance of nutrition therapy (see 5.4.1); substrate tolerance (eg, glycemic control, triglyceride levels); evaluation of appropriateness of medical nutrition therapy (use of oral, enteral, or parenteral route); scheduling of formula administration; transitional feeding; functional performance status; and discontinuation of therapy.

5.1.2 The NSD shall monitor patients for physical, social, psychological, cognitive, and environmental factors that may influence the response to nutrition support.(3)

5.1.3 The NSD shall evaluate and document drug-nutrient and nutrient-nutrient interactions in order to minimize adverse side effects.

5.2 The NSD shall be involved in the development of protocols for timely review and documentation of the patient's clinical, metabolic, and nutritional status.

5.3 The NSD, based upon delineated clinical privileges, may recommend or order laboratory tests and other monitoring methods (eg, intake and output, body weight measurements, blood gases) necessary for evaluating and adjusting the medical nutrition therapy care plan.

5.4 The NSD shall document that the feeding formulation progresses toward or meets the nutrient needs of the patient. Feeding formulation progression will be based on patient tolerance.

5.4.1 GI tolerance to the initiation and advancement of tube feedings should be reviewed. GI tolerance includes evaluation of stool frequency and consistency, gastric residuals, reflux, abdominal distention, presence or quality of bowel sounds, presence of flatulence, aspiration, nausea, vomiting, and malabsorption. Recommendations for alteration in the feeding plan (route, formula, amount) based on GI tolerance should be made as appropriate.

5.4.2 The frequency of monitoring shall increase for patients who are critically ill, have debilitating diseases or infections, are at risk for refeeding syndrome, or are transitioning between parenteral, enteral (tube), and oral nutrition.(3)

5.5 The NSD should recommend adjunctive services for optimization of nutrition care (eg, physical, occupational, or speech therapy; social services; psychology; or dental services) as indicated.

5.6 The NSD should evaluate compliance of patient, family, and health care professionals with nutrition care protocols or medical nutrition therapy plans.

5.7 The NSD shall document results of the evaluation in the medical record and communicate them to the appropriate health care professionals. The plan of care shall be reviewed and modified accordingly. Modifications of energy or nutrient delivery to the patient will be based upon the specific disease state, current clinical condition, medical/surgical therapy, nutritional status, and the anticipated duration of inadequate oral intake or need for specialized nutrition support.

Standard 6: Reassessment, Updating, and Termination of Medical Nutrition Therapy Care Plan
The NSD will participate in the reassessment and updating of the medical nutrition therapy care plan (3) and changes in stated goals of the patient and family when appropriate. Reassessment promotes the continued provision of adequate and appropriate nutrition support.

Intent of Standard
The NSD plays a key role in reassessment and transitioning the patient between the different methods of nutrient delivery. The nutritional regimen is modified as dictated by the patient's clinical status and monitoring parameters. Determining the optimal mode of nutrient delivery, evaluation of nutrient consumption, and identifying the appropriateness of termination of specialized nutrition support is important for providing optimal and cost-effective patient care.

6.1 The NSD shall monitor the transition from parenteral to enteral (tube) nutrition/oral diet, from enteral (tube) nutrition to an oral diet, and for the termination of specialized nutrition support.

6.1.1 Parenteral nutrition should not be discontinued until a desired amount of energy, nutrient, and fluid requirements are met and documented by enteral intake.

6.1.2 Enteral (tube) nutrition should not be discontinued until a desired amount of energy, nutrient, and fluid requirements are

FIG cont'd.

met and documented by oral intake.

6.1.3 Recommendations should be made for the gradual decrease or cycling of parenteral nutrition or enteral (tube) nutrition in order to maintain adequate energy and nutrient delivery.

6.2 The NSD shall assure and document adequacy of energy and nutrient intake (approximately 60% of estimated requirements) before discontinuing parenteral or enteral nutrition support and progressing to the next stage of nutrition intervention (eg, oral diet).

6.2.1 A quantitative and qualitative estimate of intake should be determined.

6.2.2 Tolerance of enteral (tube) nutrition should include assessment of GI function (see 5.4.1); adequacy of energy, nutrient, and fluid intake; and metabolic status.

6.2.3 Tolerance of adequate oral intake and consistency of foods should include assessment of sucking ability in infants, chewing or swallowing difficulties, gag reflex, pain with eating, changes in elimination patterns, and GI function.

6.2.4 If appropriate, oral nutrition supplements should be recommended to improve oral nutrient intake.

6.3 The NSD shall play an active role in facilitating communication of the patient/resident/client's nutrition care plan between care sites to assure continuity of care.

6.4 The NSD shall assist with decisions regarding termination of specialized nutrition support when clinically indicated or when an advance directive is activated.

6.4.1 Protocols shall be developed that address the termination of nutrition support for patients with irreversible neurologic damage, metastatic and untreatable cancer, severe intractable end-organ failure, or other conditions not likely to benefit from nutrition therapy. Patients or their durable power of attorney for health care should be involved in the decisions regarding the withdrawal of specialized nutrition support.(3)

6.4.2 Protocols should ~~provide latitude of~~ clinical judgment in permitting the discontinuation of specialized nutrition support in accordance with local practice standards and current local, state, and federal law.

CHAPTER III: MANAGEMENT OF NUTRITION SUPPORT SERVICES

Standard 7: Administrative Management
The NSD may provide administrative management of the nutrition support program. The NSD may participate in management activities, to include directing the nutrition support service, as appropriate to the individual's job responsibilities, education, and practice environment.

Intent of Standard
The NSD may contribute to the development of practice guidelines and institutional policies and procedures that ensure that a patient receives an appropriate nutrition care plan and safe delivery of parenteral and enteral nutrition support.

7.1 The NSD shall participate in the development of policies and procedures (guidelines for use) for patient care aspects of specialized nutrition support.

7.1.1 There shall be documentation of the regular review and revision of policies and procedures for the provision of specialized nutrition support.

7.2 The NSD may participate in the development of policies and procedures for operational aspects of nutrition support, including continuous quality and process improvement (CQI).

7.2.1 The NSD may develop CQI indicators that help facilitate continuity of care throughout the health care delivery system.

7.2.2 The NSD may collect data for analysis of whether standards have been met over the course of a patient's therapy.

7.2.3 The NSD may participate in the review of collected data and the appropriate plan of action resulting from CQI.

7.3 The NSD may serve as a member of the nutrition support service, committee, or team to coordinate the provision of specialized nutrition support.

7.4 The NSD may direct, coordinate, or manage all or some of the activities of an interdisciplinary nutrition support team/service/committee (eg, rounds, human resources, financial resources, educational programs).

7.5 The NSD should participate in the development, review, and maintenance of an adequate and cost-effective nutrition support formulary and should participate in the selection of nutrition support devices (eg, feeding systems, enteral access devices).

CHAPTER IV: PROMOTION OF NUTRITION SUPPORT

Standard 8: Education, Training, and Communication
The NSD shall actively participate in nutrition support-related educational and training activities. The NSD will disseminate information regarding current accepted nutrition support techniques and practices through organizational education efforts.

Intent of Standard
Patient care issues are often complex and need interdisciplinary collaboration to solve problems and improve processes. It is important to work as a team to support continual learning that promotes optimal patient care. This education process may be achieved by presenting educational lectures or inservices or by publishing articles related to nutrition support practice standards or advancements.

8.1 The NSD shall assess learning needs of patients/caregivers, provide education on the basis of needs, and evaluate effectiveness of teaching. The NSD shall develop or use patient/caregiver educational materials related to nutrition support administration and management applicable to the patient/caregiver's learning ability and needs and inform the

FIG cont'd.

patient/caregiver about community resources.(3)

8.2 The NSD should contribute to the educational and professional development of other dietitians, students, and health care professionals through formal and informal teaching activities.

8.3 The NSD shall maintain professional competence by participating in formal education and continuing education programs.(3)

8.4 The NSD shall supervise or mentor other dietitians interested in pursuing a certification in nutrition support, along with incorporating and coordinating their help, and assist physicians or other health care providers in pursuing a nutrition-related fellowship or training.

Standard 9: Research
The NSD should actively participate in nutrition support related research activities as related to the individual's job responsibilities, education, experience, and practice environment.

Intent of Standard
The NSD needs to retrieve and evaluate available scientific findings regarding nutrition in order to advance individual patient care, oversee management of services, and provide education to the patient, health care professional, and others.

9.1 The NSD shall critically evaluate and apply research findings to assess, provide, and improve patient care, manage services, and educate patients, health care professionals, and others. The NSD should identify or develop research-based policies, procedures, and clinical pathways as a basis for medical nutrition therapy.

9.2 The NSD may perform and collaborate with others to perform nutrition support research. The NSD may identify research issues, participate in designing and implementing research projects, facilitate research activities, or disseminate research findings.

9.3 The NSD may participate in studies designed to examine clinical outcomes for medical nutrition therapy in specific patient populations.

9.4 The NSD may present research findings to the lay public, hospital administrators, and at national, state, and local meetings (eg, oral presentation, publication).

9.5 The NSD shall participate in the evaluation of new nutrition support products and equipment to assure optimal and cost-effective medical nutrition therapy.

Definitions
Medical nutrition therapy. The assessment of the nutritional status of a patient followed by nutrition therapy, ranging from diet modification to the administration of enteral and parenteral nutrition.(2)
Specialized nutrition support. Provision of specially formulated and/or delivered parenteral or enteral nutrients to maintain or restore optimal nutrition status.(7)

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Correspondence and reprint requests: American Society for Parenteral and Enteral Nutrition, 8630 Fenton Street, Suite 412, Silver Spring, MD 20910.
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Figure addendum: Please note the following references that are updated from the citation given above:
**2.* Medical Nutrition Therapy Across the Continuum of Care *2nd ed. and* Medical Nutrition Therapy Across the Continuum of Care: Supplement 1. *American Dietetic Association and Morrison Health Care, Chicago, IL: American Dietetic Association, 1998;1997.*
**3. JCAHO Board of Directors: Comprehensive Accreditation Manual for Hospitals. Oakbrook Terrace, IL, JCAHO, 2000.*

FIG cont'd.

Appendix H

Data Collection Form

Medical Record Review Form

Site: University Southdale Subject ID: _____/Admit # _____
Sex: Male Female Age: _____ (Must be between the ages of 18 and 70)
Type of leukemia and stage: AML ALL (untreated, remission, recurrent/refractory)
CML (chronic, accelerated, blastic, refractory)
CLL (0, I, II, III, IV, refractory)
Date of admission: _____
Date of discharge: _____ Treatment received: _____
LOS: _____
Reason for admission (principle diagnosis): _____
Charlson Comorbidity Index Score: _____
Date of initial RD/DT assessment: _____ Risk level: _____
Patients estimated nutrient needs per day from RD assessment:
Calories: _____ Protein (g): _____ Fluid (mL): _____
Did the RD use: REE *or* kcal, g pro, and g fat/kg IBW *or* AB
Body weight on admission (kg): _____ Height: _____ %IBW: _____
Date of TPN initiation: _____
Who recommended TPN? RD Physician Other _____
Who wrote the TPN prescription? RD Physician Other _____
What is the volume of TPN/lipids achieved? _____
_____
Formula Provides: _____kcals _____g pro _____% fat
Non-standard additives: No Yes

Dates of RD follow up notes: _____ _____ _____
_____ _____ _____ _____
_____ _____ _____ _____
_____ _____ _____ _____
_____ _____ _____ _____
(more than just a note of pharmacy following patient)
Did the RD recommend a change in the TPN prescription? No Yes
If yes, date: _____ changes:_____
_____
Formula Provides: _____kcals _____g pro _____% fat
Changes made (physician's orders): No Yes

Admit serum albumin (g/dL): _____ Low: _____ Discharge serum albumin (g/dL): _____
Admit platelets: _____ Low: _____ Discharge platelets: _____
Admit WBC (μg/dL): _____ Low: _____ Discharge WBC (μg/dL): _____
Admit TLC (mm^3): _____ Low: _____ Discharge TLC (mm^3): _____
Did the patient have a line infection? No Yes (If yes, date first noted: _____)
Did the patient acquire any other infection? No Yes (If yes, type:
_____)

The patient was transitioned to: Oral (date _____)
Enteral (date _____)
Home TPN (date _____)
Total number of days on TPN _____
Weight on date of discharge or the last wt taken (kg): _____ (Date: _____)

Appendix I

Approval Forms

RECEIVED
OCT 31 2000
GRADUATE SCHOOL

The Graduate College
University of Wisconsin-Stout

PRELIMINARY STATEMENT OF RESEARCH: APPROVAL OF RESEARCH TOPIC AND PROTECTION OF HUMAN SUBJECTS

Student Christine (First) Dawn (Middle) Mattson (Last) Stout I.D. # 0183598

Address 300 West Elm Ave (Street) Menomonie, WI (City/State) 54751 (Zip)

Date 10/27/00 Degree Major Food and Nutritional Sciences

Tentative Research Area or Title Outcomes of dietitian involvement with leukemia patients on TPN at

Statement of Problem to be Investigated:
Check one: ✓ Thesis-Plan A ___Problem-Plan B ___Ed.S. Field Study

The purpose of this study is to determine if registered dietitian involvement with leukemia patients on total parenteral nutrition (TPN) improves outcomes.

Qualifications of Student for Study:

- Bachelor of Science Degree in Dietetics, May 1999
- By the time the data is collected, will have completed 27 credits of graduate work, including a Clinical Nutrition course.

Tentative Design of the Research:

This is a retrospective study in which data will be collected from already filed medical records. The inclusion criteria for selecting the medical records includes diagnoses of leukemia, TPN administration, and between the ages of 18 and 65. The review of medical records will begin with records filed on December 30, 2000 and continue back in time until 300 patient charts which meet the inclusion criteria have been reviewed. Before any collection of data is started, approval will be received by the UW-Stout IRB and Medical Center's IRB.

(over)

Proposed Use of Findings:
The findings from this research will be disseminated to medical center, Agency for Health Care Policy and Research, and a written article about this research submitted to three peer-reviewed journals. The findings will define the role of dietitians in nutrition support and may open more positions for dietitians. The results may also demonstrate cost effective methods for

Is information being collected from or about people in this study? Yes ✓ No ____

(THE PROTECTION OF HUMAN SUBJECTS FORM AND ALL OTHER PERTINENT INFORMATION MUST BE ATTACHED TO THIS FORM)

In accordance with my research advisor and my graduate program, my research report will be prepared according to the specifications of the following style manual:

A Manual for Writers of Term Papers, Theses, and Dissertation
(Name of Style Manual)

I am working with my graduate research adviser and subcommittee for the protection of human subjects in graduate study research. I am submitting this preliminary research plan and understand that legislation requires that protection of human subjects is assured and that my plan for protection is approved before I collect any data.

Student's Signature [signature] **Date** 10/27/00

---

1. Acceptance by Research Adviser:
   I recommend and approve the research plan as delineated.

Carol Seaborn (Research Adviser's Signature) 10-30-00 (Date)

2. Approval by Graduate Program Director:

Janice Coker (Program Director's Signature) 10/30/00 (Date)

When each signature above is affixed, bring to the Graduate College Office where it will be forwarded to the Chair of the Committee on Protection of Human Subjects in Graduate Student Research. **Gathering of data should not begin until approval from the Committee on the Protection of Human Subjects in Graduate Student Research has been received.**

FOR OFFICE USE ONLY

Protection of Human Subjects in Graduate Student Research Action:

____ The Research Design/Protocols are sufficient to protect the Human Subjects and the Researcher

____ This research does not involve human subjects, approved as presented retrieval data only

Approval Signature [signature] (Committee Chair) Date 10-31-00

Distribution of copies:
(1) Graduate College (2) Research Advisor (3) Program Director (4) Student

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Research Subjects' Protection Programs
Institutional Review Board: Human Subjects Committee (IRB)
Institutional Animal Care and Use Committee (IACUC)

December 21, 2000

Christine D. Mattson
Food Science & Nutrition (CHE)
300 W. Elm Ave.
Menomonie WI 54751

Re: "Outcomes of Dietitian Involvement with Leukemia Patients on TPN at a Hospital"

Human Subjects Code Number: **0011E74701**

Dear Ms. Mattson:

The IRB: Human Subjects Committee determined that the referenced study is exempt from review under federal guidelines 45 CFR Part 46.101(b) category #4 EXISTING DATA; RECORDS REVIEW; PATHOLOGICAL SPECIMENS.

The code number above is assigned to your research. That number and the title of your study must be used in all communication with the IRB office.

Upon receipt of this letter, you may begin your research. If you have questions, please call the IRB office at

The IRB wishes you success with this research.

Sincerely,

Assistant Director

CS/ki

CC: Carol Seaborn

January 8, 2001

Dear Human Subjects Committee:

I am writing to request an addendum to my study, entitled *Outcomes of Dietitian Involvement with Leukemia Patients on TPN* I have qualified for exemption from committee review category #4. The human subjects code number I have been assigned is 0011E74701. I have started to collect my data and discovered that I will not come at all close to my original sample size of 300. I am writing to request a change in the age range I originally filed (age range of 18 through 70). I would like to extend the age range as to include all patients above age 18. This would increase the number of subjects for my study by about 30. I will still not have the sample size I had planned on, but this would greatly help.

I am currently in the process of collecting data, so if you could notify me by fax as soon as possible that would be very much appreciated.

Thank you for your time and consideration.

Sincerely,

Christine Mattson

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