Evaluating nutritional status in the pediatric patient

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2011
Dedication and Acknowledgements

I would like to thank my amazing family for all of their love and support. Thank-you for always believing in me and encouraging me to be the best I can be. A huge thank-you goes out to professor Sharon Gentry, PA-C, for her passion, inspiration, and determination. She is a remarkable PA, professor, mentor, and woman. I hope to continue your legacy.
Table of Contents

Introduction ......................................................................................................................................1

Chronic Diseases and Childhood Nutrition .....................................................................................1

Current Methods for Assessing Nutritional Status ........................................................................16

Alternative Screening Methods ......................................................................................................22
  Part A: FFQ, 24 HR Recall, and Food Diaries ........................................................................22
  Part B: Nutritional Biomarkers ..................................................................................................24
  Part C: Other Disciplines Approach ..........................................................................................32

How to Address the Results ...........................................................................................................37

Proposed Indications and Recommendations ................................................................................53

Future Outlook ...............................................................................................................................54

References Cited ............................................................................................................................55

Abstract ..........................................................................................................................................73
Introduction

The diets of children and adolescent in the United States are energy-dense and nutrient-poor (Nicklas & Hayes, 2008). Many children do not meet nutritional recommendations consequently putting them at risk of macronutrient overconsumption and micronutrient deficiencies. Strong evidence supports the link between suboptimal nutritional intake and the development of chronic diseases. Current and future generations are projected to suffer a lifetime of health ailments as the emergence of chronic diseases continues to present earlier in adolescents and childhood as a direct reflection of national eating trends. US research studies have revealed failure to meet nutritional recommendations very early in life. Fox et al., reported 18-33% of infants and toddlers between seven and 24 months of age do not consume discrete vegetables (Fox, Pac, Devaney, & Jankowski, 2004). In 15-18 month olds, the most common vegetable consumed was french fries (Fox et al., 2004). It is debatable whether french fries should even be considered a vegetable. Similarly, 23-33% of infants and toddlers between seven and 24 months of age do not consume discrete fruit (Fox et al., 2004). In order to prevent iron deficiencies, the CDC recommends children over six months of age consume plain meats, yet less than 5% of infants of any age met the recommendation. Over 50% of infants and toddlers consume desserts daily, most of which are commercial baby food desserts marketed towards infants (Fox, et al., 2004). Eating behaviors and patterns of this nature are alarming, especially since these learned behaviors do not spontaneously regress. As young as nine to eleven months of age, eating patterns emerge and remain relatively consistent throughout their lifetime (Fox et al., 2004). Infants and toddlers quality of diet is putting many young children at risk of nutritional deficiencies.
Poor diet quality trends have been documented in the US for more than 30 years. Kranz et al., documented between 1977 and 1998, the average preschooler’s diet was lacking adequate servings of fruit and vegetables, but was overabundant in saturated fat, juice, and added sugar (Kranz, Siega-Riz, & Herring, 2004). Since then, the United States diet quality has continued to spiral downward. Based on the USDA Healthy Eating Index, 64-88% of children’s diets “needed improvement” or were “poor” (Carlson, Lino, Gerrior, & Basiotis, 2001). Two predominant consequences have emerged; the obesity epidemic and increasing chronic diseases. Healthy People 2010 stated the number one leading health indicator as obesity (“U. S. Department of Health and Human Services”, 2000). In 2007-2008, the percentage of obese children between the ages of 2-19 escalated to 17% (Ogden, Carroll, Curtain, Lamb, & Flegal, 2010). The number continues to ascend at a distressing rate, especially among low income and less educated populations (Ogden et al., 2010). The interdependence between obesity and chronic disease is continually becoming more apparent. Overweight children have a significantly higher risk for developing cardiovascular disease (Dietz, 2001). In 2001, approximately 46% of the world suffered from a chronic disease; experts project the burden to increase to 57% by the year 2020 (Murray & Lopez, 1996; World Health Organization, 2002). The energy-dense, low-nutrient American diet is directly responsible for the projected increase in the prevalence of chronic diseases.

**Contributing Factors to Dietary Quality**

Multiple influences have contributed to the current dietary trends of U.S. pediatrics. One major influence is parents/caregivers. Parents determine what foods are available, plan meals, model eating behavior, and exhibit various food-related parenting skill; all of which determine childhood food practices (Nicklas & Hayes, 2008). Children are extremely dependent on their
parents/caregivers to provide nutritious foods to support their optimal growth and development. Nutrition is passed down from generation to generation; therefore poor dietary habits of adults are reflected in their children as well (Michels, 2003). A study conducted by Lee et al discovered, the mother’s own eating patterns were more influential in impacting the daughters eating habits than forced attempts to control their daughters intake (Lee, Mitchell, Smiciklas-Wright, & Birch, 2001). Children model the behaviors of their parents; if the parents do not meet nutritional recommendations, most likely neither will their children. In addition, there is a growing mentality that it is easier to appease children’s desire to consume unhealthy foods than to battle for the broccoli. Parents often use the phrase, “He/ She is a picky eater,” but scientific evidence shows children’s food preferences are learned through repeated exposures to foods (Birch &Marlin, 1982). Furthermore, multiple exposes to the food helps children conquer their “neophobic response” and progressively increase their preference for that food (Birch &Marlin, 1982). Parents are not advocating their children to meet the current dietary recommendations; therefore they are putting their children at risk for micronutrient deficiencies and chronic diseases.

The growing phenomenon of fast-food restaurants is inversely correlated with the quality of the American diet (Bowman, Gortmaker, Ebbeling, Pereira, & Ludwig, 2004). Approximately 30-50% of children eat fast food in a given day (Bowman et al., 2004). Paeratakul et al. conducted a study to assess the dietary and nutrient intake profile of children consuming fast-food (Paeratakul, Ferdinand, Champagne, Ryan, & Bray, 2003). Children who consumed fast-food had a higher intake of energy, fat, saturated fat, sodium, carbonated soft drink, and lower intake of vitamin A and C, milk, fruits and vegetable compared to those who did not consume fast-food (Paeratakul et al., 2003). This trend was also observed between days when fast-food
was consumed and days when it was not consumed, suggesting even occasional fast-food intake affects overall diet (Paeratakul et al., 2003). Fast-food marketing to children, as seen in the “happy meal,” promotes the consumption of hamburgers, cheeseburgers, french fries, and soda. These calorie-rich, low nutrient-dense foods have evolved to become a mainstay in the American diet.

Over 60% of public school children participate in school lunch services, therefore schools largely influence the diet of American children (American Academy of Pediatrics [AAP], 1992). In the recent decade, schools have received severe scrutiny by government and health care officials regarding the quality of food they served. In 1995, congress mandated school lunches adhere to the U. S. Dietary Guidelines, in an attempt to improve food quality (Nicklas & Hayes, 2008). In 2006, Local Wellness Policies placed pressure on schools to create healthier environments by changing the types of foods sold in school stores, vending machines, and at sporting events (Nicklas & Hayes, 2008). Yet, a recent study in 2009 revealed 80% of public school children consumed excessive amounts of saturated fat and 92% excessive sodium (Clark & Fox, 2009). The study documented a 15% or greater prevalence of inadequacy for vitamin A, C, E, magnesium, phosphorus, and zinc, using the Estimated Average Requirement (EAR) as a reference. The EAR is the level at which a nutrient is adequate for 50% of the population (U. S. Department of Agriculture [USDA] & U. S. Department of Health and Human Services [DHHS], 2010), meaning 50% of the population required more of the nutrient for optimal health. Based on the given information, it is reasonable to conclude many children in public schools are at risk of micronutrient deficiencies and are consuming excessive amounts of fat and sodium. Also, several school districts have contracts with soft drink companies which generate over 200 million dollars in unrestricted revenue to ensure exclusive sales of their company product on
school property (Henry, 2001). On average, 56-85% of children consume at least one can of soda a day, 20% consume four or more (Gleason & Suitor, 2001). Children who have high sucrose diets consume less vitamin E, niacin, calcium, iron, zinc, and dietary fiber (Routtinen et al., 2008). The American Academy of Pediatrics does not support soft drinks in schools. The growing trend suggests students are consuming soda instead of milk in schools (AAP Committee on School Health, 2004). Schools ought to culminate a healthy environment that supports sound nutritional choices rather than engage in a political battlefield that seeks economic gain over the welfare of children.

Social inequalities put minorities and children of lower socioeconomic status (SES) at an increased risk of nutrient deficiencies and poor diet quality. Mexican-American children have the highest prevalence of being overweight (Ogden, Carroll, & Flegal, 2008). A few of the risks factors Hispanics and many other minority populations face include: parental obesity, low SES, recent immigration, acculturation to the US diet and lifestyle, limited insurance coverage and access to medical care (Kumanyika, 2002). Wilson et al.'s Viva La Familia study projected “suboptimal” long-term health of the Hispanic population due to their poor diet quality (Wilson, Adolph, & Butte, 2009). According to Dietary Guidelines for Americans, many Americans do not consume optimal intake of certain nutrients, even though they have financial resources to support a comprehensive diverse diet (USDA & DHHS, 2010). Minorities and low income individuals in general are less educated. A large percentage of low income adults do not comprehend the health related consequence of their dietary practices or what foods they should consume on a regular basis (Gleason, Rahgarajan, & Olson, 2000). A substantial amount of US low SES individuals have inadequate intake of micronutrients and over consume macronutrients (Gleason et al., 2000). Meaning, the foods they are consuming are high in calories but low in
other essential nutrients. They possess a large amount of macronutrients such as protein, carbohydrates, and fats, yet lack the essential vitamins, minerals, and trace elements our bodies rely on for physiological functions. They also have an increased risk of not meeting dietary guidelines. For example, 41% of high income preschoolers met the recommendations for dietary fat compared to only 24% of low income preschoolers (Gleason et al., 2000). The increased risks minorities and low SES children have of low diet quality also places them at an increased risk of obesity and chronic diseases.

Societal influences have an astounding effect on health and overall attitudes regarding nutrition. Social norms and the prospective of others influence consumption of fruits and vegetables in children (Zeinstra, Koelen, Kok, & de Graaf, 2007). Zeinstra et al. asked children if fruits and vegetable were appropriate food to eat at a party. Many children responded that fruits and vegetables were “too healthy” for a party (Zeinstra et al., 2007). The American culture defines holidays and social events as opportunities to overindulge in high calorie foods of minimal nutritional value. When friends get together it more commonly involves a restaurant than an activity. Conversely, the American society has placed great value on thinness, beauty, and youth. This has implications on nutrition and the habits of children as well. Approximately 0.5% of adolescent females have anorexia nervosa, and 1-5% bulimia nervosa (AAP Committee on Adolescence, 2003). Many children and adolescents do not meet DSM IV criteria for anorexia or bulimia, yet still experience similar physical and psychological harm that is typically associated with having an eating disorder (AAP Committee on Adolescence, 2003). Unfortunately, a backlash of the obesity epidemic has been an emphasis on detrimental dieting practices and weight loss among children and adolescents (AAP Committee on Adolescence, 2003). This is concerning because it can result in malnutrition and have irreversible
consequences on health. The American culture promotes unhealthy eating habits on both ends of the spectrum, overconsumption of unhealthy foods as well as extreme dieting.

Corporations specifically target advertisements toward children because they know it will increase food intake of their product (Halford et al., 2007). A third of all television ads are for food; most commonly snack foods, cereal, or fast-food (Furnham, Abramsky, & Gunter, 1997). Brody et al. conducted a study to determine the effect advertisements had on children by observing them in the grocery store after they watched advertisements. Brody found children tried to persuade the parents to purchase the items advertised (Brody, Stoneman, Lane, & Sanders, 1981). Interestingly, in a study that asked children to recognize eight food advertisements, 60% of obese children and none of the non-obese children remembered all of them (Halford et al., 2004). The implications advertisements have on obesity cannot be concluded by this finding, however it does suggest advertisements may be influential on children’s food preferences and consumption.

Sahud et al. studied the effects of marketing fast-food in children’s hospitals (Sahud, Binns, Meadow, & Tanz, 2006). Fifty-nine of the two hundred hospitals they observed with pediatric residencies had fast-food restaurants in them. The hospitals welcomed the fast-food companies to “promote the physical environment, attract patients, and boost revenue” (Sahud et al., 2006). Salud et al. found in-house McDonalds significantly increase McDonalds’ purchases from outpatients. However, it also led patients and their families to believe the corporation financially supported the hospital. They also ranked McDonald’s food as healthier than other fast-food corporations based on the assumption it was supported and encouraged by the hospital (Sahud et al., 2006). Hospitals embraced the revenue from the fast-food companies, yet their presence caused people to incorrectly perceived them as “credible and beneficial to good health”
(Kearns & Barnett, 2000). The health system itself is guilty of supporting advertisement of unhealthy foods in return for financial gain.

Children in America are not meeting nutritional recommendations for several reasons. Environmental influences, social inequalities, societal norms, and advertising all contribute to the growing discrepancy between what the American diet is and what it should be. The average American diet does not support optimal health. Children are particularly vulnerable because adequate nutrition is critical during periods of growth and development. Improper amounts of essential vitamins and minerals have acute and chronic health implications on pediatric patients.

**Food Quality**

By the time the average American child consumes their meal, it possesses only a fraction of the nutrition benefits it once had. Numerous factors affect the nutritional composition of food including: cultivation, industrial processing, storage, and preparation (Severi et al., 1998; Tarozzi, Marchesi, Cantelli-Forti, & Hrelia, 2004). Although research results are inconsistent, most agree fresh-picked produce stored for a short period of time consumed raw provides the maximal nutrition benefits (Rickman, Bruhn, & Barrett, 2007). Nevertheless, the US population consumes more processed fruits and vegetables than fresh (Rickman et al., 2007). Tarozzi et al. estimated the health benefit equivalent to one fresh picked apple was two apples that were cold stored for six months (Tarozzi et al. 2004). Six months seems like a long period of time; however consider how long it takes to pick, ship, purchase, and finally consume the product. Also, home-food preparation vitamin retention ranges from 0-94% and mineral retention from 63-96% (Severi et al., 1998). Based on typical consumption and preparation patterns in the US, food has much less nutritional value than it is assumed.

**Genetic Variations and Individual Needs**
The assessment of nutritional status is difficult due to the complexities of diet, nutrients, and biochemical individuality (Boerner, 2001). Current methods to assess nutritional status do not account for individual differences. It is theorized, as no two people are identical neither are their nutritional requirements (Boerner, 2001). In 1902, British physician Archibald Garrod theorized genetic individuality affects nutrient requirements and when those requirements are not met, disease may result (Boerner, 2001). In fact, a single base pair change can result in an increased nutrient requirement of the individual (Boerner, 2001). Eckhardt hypothesized the possible number of alternative genotypes leading to various nutritional needs are greater than 200 trillion (Eckhardt, 2001). Possible causes of nutritional deficiencies include but are not limited to: genetic variations, inadequate intake, diseases, medications, stressors such as trauma and surgery, poor lifestyle choices such as smoking, long term depletion of nutrients in soil and food, and increased toxins in the environment (Boerner, 2001). Increasing knowledge supports Boerner’s theory that subclinical chronic nutrient deficiencies during childhood may form the foundation for future medical ailments (Boerner, 2001). The necessity to reliably assess nutritional status in patients is more apparent today than ever before.

Adequate nutrition in the pediatric population is essential. It sets the foundation for the child’s lifetime. The average American child does not meet nutritional intake recommendations. There is reason to believe many children may be at risk of micronutrient deficiencies and macronutrient excesses. Chronic diseases have been linked to inadequate and poor dietary intake of specific nutrients starting in early childhood. Chronic diseases are difficult to treat; often resulting in premature morbidity and mortality. They also decrease quality of life and are extremely costly. The clinical assessment of childhood nutritional status focuses on international growth charts, and a brief history and physical exam. In addition, pediatricians routinely ask
about adherence to government dietary recommendations. However, the current gold standard used to assess nutritional status is not specific or sensitive enough to measure macronutrients excesses and micronutrients deficiencies; which have been shown to impact the development of chronic diseases in children. Several alternative methods have been proposed. A new gold standard needs to be developed to ensure the health of future generations.
Chronic Diseases and Childhood Nutrition

Specific foods have detrimental or protective effects to overall health and the development of chronic diseases (Dandona, Ghanim, Chaudhari, Dindsa, & Kim, 2010). It seems the US society has difficulty grasping the concept that food choices starting in early childhood significantly affect health 20-30 years later. The obesity epidemic has forced many Americans to reconsider their food choices as diseases which were once believed to affect adults have increased in prevalence in childhood and adolescents. One of the most notable examples is non-insulin dependent type II diabetes mellitus; which used to be called adult-onset diabetes mellitus. There is a direct correlation between childhood nutrition and the risk for cardiovascular disease, diabetes mellitus, cancer, and osteoporosis (Gonzalez, 2006).

Cardiovascular Disease

Cardiovascular disease is a slow progressing disease of the arteries commonly manifesting itself in middle to late adulthood; however autopsy studies have shown the presence of cardiovascular pathology in children (McGill et al., 2000). One autopsy study revealed one forth of adolescents 15-19 years old had fatty streaks in their aorta (McGill et al., 2000). Cardiovascular disease is the leading cause of death and mortality in the United States affecting 37% of the population (USDA, 2010 ; Gidding et al., 2009). Monumental strides toward prevention and control of risk factors effectively reduced overall mortality by nearly half in past decades (Gidding et al., 2009). However, the last decade has exhibited a reversal in this trend. Experts believe the recent resurgence in mortality rate is directly related to the average Americans overconsumption of calories and trends toward less healthy eating habits (Gidding et al., 2009). The AHA stressed the importance of “overall diet quality” yet as discussed previously, the average American child’s diet is not meeting dietary recommendations (Gidding
et al., 2009). The excessive intake of energy, fat, saturated fat, cholesterol, and sodium negatively impact cardiovascular risk factors (Ganji, Hampl, & Betts, 1998). As few as two and a half servings per day of fruit and vegetables have been associated with reduced risk of cardiovascular disease, yet many children are missing even this mark (USDA, 2010). In addition, the obesity epidemic plays a substantial role in the resurgence as obese children have a higher frequency of cardiovascular risk factors (Reinehr & Toschke, 2009). The resounding conclusion is healthy dietary patterns early in life reduce the incidence of chronic disease later in life (Johnson, Guthrie, Siciklas-Wright, & Wang, 1994). If the current dietary trends continue, an exponential number of today’s youth will inevitably face cardiovascular disease in the future.

**Type II Diabetes Mellitus**

Children born in 2000 have a one in three risk of developing type II diabetes mellitus in their lifetime (Narayan, Boyle, Thompson, Sorensen, & Williamson, 2003). Currently, 11% of the population has diabetes and 35% are pre-diabetic (USDA, 2010). Even more alarming is the number of children and adolescents being diagnosed with type II diabetes. The prevalence continues to grow and the age of onset becomes significantly younger (Rosenbloom, Joe, Young, Winter, 1999). The pathophysiology of type II diabetes is theorized to be a result of chronic inflammation (Dandona et al., 2010). Aljada et al. found a high fat high carbohydrate meal caused an increased generation of reactive oxygen species (ROS) (Aljada et al., 2004). ROS cause the activation of pro-inflammatory transcription factors which are believed to interfere with insulin transduction (Dandona et al.; Hotamisligil et al., 1996). Ghanim et al. conducted a similar study to assess the generation of ROS after a high fiber and fruit meal. They determined there was not an induction of either oxidative or inflammatory stress (Ghanim et al., 2009). Further, adding onto the previous findings, Dandona reported intake of orange juice after a high
fat high carbohydrate meal led to “total neutralization of the pro-inflammatory effects” and significant inhibition of the ROS generation (Dandona et al.). These studies suggest diet affects the inflammatory cascade and most likely contributes to the development of type II diabetes mellitus.

Cancer

Nutrition is the second leading cause of cancer behind tobacco (Gonzalez, 2006). An estimated 30-40% of cancer worldwide could have been prevented by healthy eating, weight control and appropriate physical activity (International Association for the Study of Obesity, n.d.). Essentially three to four people out of ten would not have had cancer had they made the appropriate lifestyle modifications. A review of 22 studies which induced cancer in animals found “fewer tumors, smaller tumors, fewer metastasis, and less DNA damage” in animals fed a high fruit and vegetable diet compared to those who were not (Steinmetz & Potter, 1996). Although meta-analysis, case reports, and cohort studies have lots of inconsistent evidence, epidemiological studies clearly show individuals with diets high in fruits and vegetables have lower incidence of cancer (Gonzalez, 2006). Cancer is a multi-factorial disease therefore it is impossible to control for all compounding variables in small scale studies which could be responsible for the inconsistencies. In the review, “nutrition and cancer: the current epidemiological evidence,” Gonzalez concludes the relationship is “evident” despite some inconsistencies in reporting (Gonzalez, 2006). Cancer is not a disease that spontaneously develops in middle to late adulthood, rather a carcinogenic progression often begin in early childhood (Tercyak & Tyc, 2006). Tercyak and Tyc believe the key to prevention of cancer occurs early in life, and more emphasis needs to be placed on behaviors learned in childhood (Tercyak & Tyc, 2006). Evidence is building to suggest a diet high in fruits and vegetables is
protective against cancer; however a National Cancer Institute survey reported only 8% of people thought they should eat five or more servings of fruit and vegetables a day. In addition, 66% thought two or fewer was sufficient (Subar et al., 1995). The American public does not understand the importance of dietary modifications which could significantly reduce their risk of cancer. In addition, so much emphasis is placed on cure rather than cause that most children do not realize their dietary choices could potentially put them at risk for the development of cancer.

**Osteoporosis**

Osteoporosis, a “skeletal disorder characterized by low bone mass and deterioration of the micro-architectural structure” is often diagnosed in middle-late adulthood; however it has recently become recognized as a disease which initiates in childhood (Moyer-Mileur, Xie, Ball, & Pratt, 2003). This may appear counterintuitive; however 40% of total lifetime bone mass is accumulated in a 3-4 year period during adolescents (Greer & Krebs, 2006). New evidence suggests 85-90% of adult bone mass is acquired by age 18 in girls and 20 in boys (USDA, 2010). It is well understood that calcium and vitamin D are essential in the development of bone formation, mineralization, and maximum bone acquisition during critical periods of development. Moyer-Mileur et al. reported females 12-15 years of age on average consume less than 65% of the recommended dietary intake (Moyer-Mileur et al., 2003). Greer et al. found only 10% of adolescent girls meet the 1300 mg/day calcium recommendation (Greer & Krebs, 2006). To put it into perspective, an adolescent would need to drink four 8-10 ounces glasses a milk a day to meet the recommendation (Greer & Krebs, 2006). The prevalence of vitamin D deficiency is estimated to range between 15-80% of the US population, especially high among non-Hispanic black, overweight females (Saintonge, Bang, & Gerber, 2009). The number of children and adolescents with inadequate calcium and vitamin D intake suggests many may not
reach optimal bone mass accumulation; therefore they are at high risk for the development of osteoporosis.

Vitamin D has received a lot of press recently due to emerging scientific evidence supporting higher intake recommendations and additional importance in overall health well beyond bone formation. The new recommended minimum intake for children is 400 IU, replacing the 200 IU recommendation (Wagner & Greer, 2008). It is now believed vitamin D may play an essential role in: bone mineralization, cardiovascular disease, insulin resistance, hypertension, tuberculosis, myocardial infarction, allergies, atopic diseases, autoimmune diseases, cancer, immune function and susceptibility to viral diseases (Saintonge et al., 2009; Walker & Modlin, 2009). An estimated billion people in the world are either vitamin D insufficient or deficient (Walker & Modlin, 2009). Given the average American child’s diet and the few dietary sources of vitamin D available, children are at a high risk for vitamin D deficiencies (Wagner & Greer, 2008). Also, rapid growth and physiological changes children go through presents an increased vulnerability to vitamin D deficiencies (Wagner & Greer, 2008). Additional research is needed to determine the correlation between vitamin D consumption in children and chronic diseases.
Current Methods for Assessing Nutritional Status

International Growth Charts

The US screening method for nutrition in children is based primarily on International Growth Charts (Grummer-Strawn, Reinhold, & Krebs, 2010). The Center for Disease Control (CDC) recommends clinicians utilize the 2006 World Health Organization (WHO) International Growth Charts for children <24 months and the 2000 CDC growth charts for children 2-19 years of age. The WHO charts are based on averages of the growth of “healthy children in optimal living conditions” worldwide; whereas the CDC charts are based on the growth of children in the US over a 30 years span. Growth charts assess: weight for age, height for age, weight for height, and body mass index for age. Growth charts have been used for greater than a century to assess childhood nutrition and to screen for inadequate growth which could suggest unfavorable health conditions (Grummer-Strawn et al., 2010). This is the intended role of growth charts; however increasing evidence suggests this role in not being upheld in the United States.

Given the US population demographics and the industrial nutritional concerns it possesses, International Growth Charts are not an adequate measurement of pediatric nutritional status. There are two major categories regarding nutrition: malnutrition and over-consumption. There are two sub-types of malnutrition: protein-calorie and micronutrient. International Growth Charts only assess protein-calorie nutrition. Although, protein-calorie malnutrition is a huge concern throughout the world, it is extremely rare in the United States outside of severe disease states. Furthermore, by the time height and weight problems are detected, significant adverse health implications are already present. In fact, height deficits are most-likely the results from past malnutrition which may or may not represent current nutritional status (Allen, 1990). In addition, poor growth as a consequence of past malnutrition cannot be corrected, the damage has
already occurred. The only benefit would be to prevent further damage by correcting the nutritional deficiencies if still present. Also, genetic implications can cause a child to deviate from the normal growth curve without adverse health outcomes (Grummer-Strawn et al., 2010). The obesity epidemic is resounding evidence of the failure of International Growth Charts to assess adequate nutrition in children in the Unites States (Grummer-Strawn et al., 2010). Adequate nutrition is often referred to in regard to under-consumption, rather than both under-consumption and over-consumption. International Growth Charts only look at malnutrition, not over-nourishment. Over-consumption is an excessive intake beyond optimal levels which can lead to adverse health effects as well. The Unites States population, in general, is in a state of macronutrient over-consumption and micronutrient malnutrition. The consumption of nutrient-poor, energy-dense foods has resulted in epidemic obesity and micronutrient deficiencies.

This first became evident in obese patients seeking bariatric therapies. In general, the assumption had previously been, obesity was due to overconsumption of nutrients and therefore deficiencies should not be of concern. Conversely, recent evidence suggests patients with a BMI greater than 30 kg/m^2 have a higher incidence of deficiencies of micronutrient than their non-obese counterparts (Ernst, Thurnheer, Schmid, & Schultes, 2009). Ernst et al conducted a study of 232 morbidly obese patients to assess their micronutrient status prior to bariatric surgery. They discovered a substantial number of patients displayed significant micronutrient deficiency that required medical attention (Ernst et al., 2009). The most prevalent deficiencies included: 25.4% for a severe 25-Oh vitamin D3 deficiencies, 24.6% for zinc, 32.6% for selenium, 18.1% for B12 (Ernst et al., 2009). Interestingly, a strange phenomenon has been observed suggesting obesity is increasing more rapidly in regions of the world where micronutrient deficiencies are more prevalent (Garcia, Long, & Rosado, 2009). There appears to be some evidence to support
micronutrient deficiencies may be contributing to skyrocketing obesity rates and alternative evidence suggests micronutrient deficiencies may be the result of obesity (Garcia et al., 2009). Further research is needed to understand the complex relationship between obesity and micronutrient deficiencies. Toh et al. highlighted a key principle to keep in mind; deficiencies widely vary from patient to patient and population to population (Toh, Zarshenas, & Jorgensen, 2009). For example, patient A may have a BMI of 36 and consume a diet entirely consistent of high-calorie low-nutrient dense foods, where as patient B may also have a BMI of 36 and consume a well balanced diet with excessive portion sizes. Both patients are obese, but not for the same reason or with the same health consequences. It is reasonable to draw the conclusion based on national survey dietary data that most likely many Americans, obese and non-obese alike, suffer for micronutrient deficiencies which currently go undetected.

**Dietary Questions and Physical Exam**

Most clinicians incorporate dietary questions in the medical history and physical exam findings in conjunction with International Growth Charts for a more complete assessment of the nutritional status of a pediatric patient. The dietary questions attempt to quickly determine if the patient is meeting national dietary recommendations and to gain insight into their overall diet quality. Dietary questions asked are non-standardized and are entirely based on clinician preference. The majority of clinicians use the questions as a means to engage in an educational conversation about making healthy choices and meeting current national recommendations, as opposed to an assessment of nutritional status to determine their health and chronic disease risk. This may be a result of their inability to determine what specific nutrients are deficient (Allen, 1990). National survey data presented in the background information of this paper suggests this method is either ineffective or not being utilized to its full potential. Furthermore, the validity of
self-reported diet information is strikingly poor and will be discussed in detail under the section dietary questionnaire, 24 recalls, and food diaries. Likewise, physical exam findings suggestive of micronutrient deficiencies offer little diagnostic value and are relatively insensitive (Allen, 1990). Physical exam findings suggestive of nutritional deficits only reflect severe or chronic states, and miss the window of opportunity to address subclinical deficiencies before disease processes progress (Allen, 1990). The comprehensive assessment tools many pediatricians are using lack the sensitivity required for early detection of nutritional shortcomings.

**DRI Recommendations**

Many clinicians ask their patients if they are meeting the Dietary Reference Intakes (DRI) recommendations and believe adherence to the recommendations results in sufficient intake of all macronutrient and micronutrients. The Recommended Dietary Allowance (RDA - now referred to as the DRI) was developed by the government Committee on Food and Nutrition in 1943. Originally, it was developed to prevent diseases associated with starvation, since they then have been modified to determine optimal intake levels for overall health (Harper, 1985). In 1997, the Food and Nutrition Board (FNB), the Institute of Medicine (IOM), and the Canadian Institute of Nutrition and Health, updated the RDA and renamed it the DRI (IOM).

The DRIs are “intended to serve as a guide for good nutrition and provide the scientific basis for the development of food guidelines” (IOM). There are five main components: Estimated Average Requirement (EAR), Recommended Dietary Allowance (RDA), Adequate Intake (AI), the Tolerable Upper Intake (UL), and the Estimated Energy Requirement (EER) (IOM). The EAR is the “average daily nutrient intake level estimated to meet the requirement of half of the healthy individuals in a particular life stage and gender group” (USDA, 2010). The RDA is two SD above the EAR, where the level is sufficient for nearly everyone (97-98%)
The AI is used in the event of insufficient data to determine an EAR. It is based on observations (Lee & Nieman, 2007). The AI is the “approximations or estimates of nutrient intake by a group of apparently healthy people that are assumed to be adequate” (USDA). The UL is the highest intake that likely has no adverse health effects. The EER is the predicted amount of energy needed (USDA).

The DRI has some limitation to it as well. First, it is based on general population data, individual biological variation of metabolism and absorption may vary from the DRI (Lee & Nieman, 2007). Also, data is still incomplete on special populations, minorities, and people with acute and chronic diseases (Lee & Nieman, 2007). There is limited information on children and adolescents as well. In fact, “when necessary because of insufficient data on nutritional requirements of children, adolescents, and pregnant/lactating females the DRI committee may choose when appropriate to adjust the adult EAR on the basis of differences in reference to weight of a younger person or to account for increased nutrient requirements” (Lee & Nieman, 2007). Children are not simply smaller versions of adults. The public has lost confidence in the information provided by the government. It is understandable why the public has reason to doubt government recommendations and take an interest in supplements when they continue to release recommendations without sufficient evidence to support them. As previously discussed in the background section of this paper, few Americans are meeting the DRI recommendations.

**USDA Recommendations**

In addition to the DRI, the Unites States Department of Agriculture (USDA) created its own recommendations. In 2010, the USDA released the updated Dietary Guidelines for Americans. It is intended to assist in the development of educational materials, support
policymakers in creating nutrition-related programs, and to serve as the basis for nutritional information (USDA, 2010). The dietary guidelines also address nutrient-related health problems such as heart disease, cancer, stroke, hypertension, and diabetes (Lee & Nieman, 2007). Based on the Dietary Guidelines, My Pyramid was developed as a campaign to motivate and encourage healthier food choices by consumers (Lee & Nieman, 2007). The USDA has done a remarkable job stressing the importance of nutrition and chronic diseases. However, the average American cannot tell the difference between the DRI, the dietary guidelines, and My Pyramid. A great example of this is the previously mentioned research study that incorrectly used the EAR to assess if school lunches provided adequate nutrition (Clark & Fox, 2009). This is a major problem and may be a driving force behind the growing discontent in the American population. It appears many people do not have faith in the importance of the government recommendations; evident by their actions. Some people do not attempt to follow them, while almost one fourth of the population has started taking nutritional supplements despite government insistence that diet alone is sufficient (Kemper, Vohra, & Walls, 2008).
Alternative Screening Methods

Part A. FFQ, 24-Hour Recall, and Food Diaries

If a patient’s nutritional status is in question, further evaluation using a 24-hour recall, food frequency questionnaire (FFQ), or a food diary is often conducted. In regard to children, it is generally accepted children greater than 10 years old can accurately self-report dietary intake (Rockett, Wolf, & Colditz, 1995). Young children need varying levels of assistance from a parent/caregiver (Rockett et al., 1995). A 24-hour recall is conducted by an interviewer to code the foods and beverages consumed in the preceding full day (Biro, Huldshof, Ovesen, & Amorim Cruz, 2002). A 24-hour recall is easy to administer, requires relatively 15-20 minutes, and reasonably inexpensive (Biro et al., 2002). It is important to keep in mind, a single 24-hour recall more accurately reflects a group or population’s average intake than the individual’s actual intake (Biro et al., 2002). Multiple 24-hour recalls can evaluate typical dietary intake at an acceptable level of reliability (Cullen & Zakeri, 2004). Memory and portion sizes can skew reliability of this method (Biro et al., 2002). Since diet varies day-to-day and multiple 24-hour recalls are not always practical, food diaries have gained popularity. They are typically conducted over three days; two weekdays and one weekend (Biro et al., 2002). Every time the individual consumes a food or beverage, he or she is to immediately document it on paper or via a dictaphone (Biro et al., 2002). The amount is to be recorded based on weight which is the gold standard or estimated by household instruments such as cups, tablespoons, etc (Biro et al., 2002). It has been observed customary eating habits may be altered by the recording process (Biro et al., 2002). When forced to write down and expose the food diary to someone else, sometimes it can influence consumption of different types of food, amounts, or cause individuals to not report honestly. Studies have shown the reliability of this method to decrease over time as a result of
respondents’ fatigue (Biro et al., 2002). Food frequency questionnaires seek to define the average frequency of consumption of foods listed on a questionnaire over a predetermined period of time, commonly the past few months or year (Biro et al., 2002). This method allows for easy classification of food groups and high or low intake patterns (Biro et al., 2002). A disadvantage of this method is it is limited to generally 50-150 food items, which may misrepresent foods consumed but not on the list (Biro et al., 2002). Memory and accurately recalling portion sizes is a weakness of FFQ (Biro et al., 2002). Food diaries, 24-hour recalls, and FFQ have remained the most popular method to assess dietary intake despite their limitations.

These methods however, may be phased-out in the near future due to technological advancements and growing evidence supporting the use of alternative methods. Dietary recalls and FFQs cannot account for the complexities of the average American diet therefore resulting in significant errors (Jenab, Slimani, Bictash, Ferrari, & Bingham, 2009). These methods are subject to both systematic and random errors (Biro et al., 2002). Possible causes of error include: errors in portion estimation, food coding, limited composition tables, daily variations, response bias, and sample bias (Biro et al., 2002). For example, FFQ cannot account for all recipe ingredients or the effects of cooking methods on nutrient content (Jenab et al., 2009). Several studies have reflected the tendency of subjects to inappropriately report food intake (Jenab et al., 2009). Kipnis et al. found up to 60% underestimated energy-adjusted protein intake on a 24-hour recall (Kipnis et al., 2003). Macdiarmid et al. observed under-reporting to be more prevalent in overweight individuals (Macdiarmid & Blundell, 1998). This trend has also been observed in obese adolescents and female endurance athletes (Biro et al., 2002). The Women’s Health Initiative: Nutrient Biomarkers, a highly respected and well conducted large population study, found strong evidence of systematic bias of FFQ (Prentice 2009). Kipnis et al. also found
FFQ associated error, when applied to epidemiological research, reported relative risks of 1.1 or smaller when in actuality more sensitive measurement determined them to be two (Kipnis et al., 2003). These biases and reliability flaws may have skewed data and may be responsible for the inconsistencies of research studies related to diet and chronic diseases. Pressure and importance have mounted on the search for more reliable methods to determine nutrition intake.

**Part B. Nutritional Biomarkers**

A nutritional biomarker is “any biological specimen that is an indicator of nutritional status with respect to intake or metabolism of dietary constituents” (Potischman & Freudenheim, 2003). The utilization of biomarkers is most commonly in research and nutritional epidemiology. However, scientists are optimistic about potential uses in other clinical domains in the near future. Changes in biomarkers are detectable before the appearance of clinical signs, optimizing early detection and disease prevention capabilities (Thurnham, 1981). Biomarkers are advantageous because they account for absorption, influences of microbiota, nutrient-nutrient interactions, metabolism and excretion of nutrients, as opposite to standard intake estimates which only assess frequency and quantity (Jenab et al., 2009). There are four major classifications: direct/ static, metabolite/ metabonomics, functional, and stable isotopes (Sauberlich, 1999). Currently, nutritional biomarkers are used to validate other dietary instruments, assess nutritional intake, and to research the effects of diet on disease processes (Potischman & Freudenheim, 2003). The use of biomarkers to assess nutritional status has promising applications for the future and may lead to a better understanding of nutrients’ role in chronic disease processes.

**Static: Serum and Urine Analysis**
One of the first alternatives considered to replace FFQ and dietary recall methods was serum and urine analysis. In fact, nutritional epidemiologists incorporated the use of serum measurements in National Health and Nutrition Survey (NHANES III) to gain a more comprehensive view of micronutrient intake of the US population (Schleicher, Carroll, Ford, & Lacher, 2009). NHANES III realized the biases associated with questionnaires and decided to incorporate a more standardized means of measurement to decrease the risk of misrepresentative data. Based on new knowledge of the role of vitamin D, many clinicians are recommending screening all patients, especially children, for vitamin D deficiencies using serum 25-OH-D concentrations (Wagner & Greer, 2008). Pollard et al. conducted a study in the UK to compare food diaries and serum samples of ascorbic acid and four carotenoids. They found a positive association between estimated intake and plasma concentrations. Overall, they concluded plasma biomarkers are “good indicators” of intake and “useful to measure nutrient status at the tissue level” (Pollard et al., 2003). Pollard et al. emphasized plasma biomarkers reflect physiological functions as opposed to solely dietary intake (Pollard et al., 2003). The ability to assess physiological functions in addition to intake allows for a better understanding of overall nutritional status.

Qian et al. conducted a study to examine markers of aflatoxin exposure in relation to liver cancer (Qian et al., 1994). According to food tables, the relative risk was 0.9 and deemed insignificant. Urinary biomarkers of the same population demonstrated a substantial relative risk of 6-10. Errors associated with estimated food consumption directly impacted the perceived risk of aflatoxin exposure (Qian et al., 1994). The risk would have been missed if the more sensitive and reliable urine biomarker test had not been performed. A weakness of serum and urine analysis is they only reflect short-term nutrient consumption (Prentice et al., 2009). In addition,
they cannot determine an individual’s capacity to utilize the nutrient appropriately (Boerner, 2001). Natural homeostasis mechanisms may maintain adequate serum levels at the expense of nutrient stores (Boerner, 2001). Also, urine analysis cannot be performed on minerals which are not excreted by the kidney (Hambridge, 2003). The use of serum and urine biomarkers is becoming more prevalent; however several limiting factors still exist.

**Metabolites/Nutritional Metabonomics**

It is well understood marginal vitamin deficiencies affect the body’s metabolism (Thurnham, 1981). Macronutrients and micronutrients play a vital role in almost all metabolic pathways (Jenab et al., 2009). Recently, a new field of research has emerged called nutritional metabonomics. Nutritional metabonomics is “the identification of metabolic profiles as dietary biomarkers” (Nicholson, Lindon, & Holmes, 1999). High resolution nuclear magnetic resonance (NMR) spectroscopy and mass spectroscopy are used to generate specific metabolite patterns which reflect the metabolic phenotype or status of the organism. The phenotype can then be used to discover chronic disease etiology and potential metabolic consequences of various nutritional intakes (Jenab et al., 2009). A unique benefit of metabonomics is its integrative approach and ability to account for genetics, dietary habits, and environmental factors (Jenab et al., 2009). It also enables researchers to obtain a more holistic assessment as it can simultaneously measure a wide variety of metabolites across various metabolite classes (Rezzi, Ramadan, Fay, & Kochhar, 2007; Jenab et al., 2009).

Nutritional metabonomics’ goal is to discover biomarker patterns for prognostic or diagnostic purposes which can also evaluate the efficacy of nutritional interventions (Rezzi et al., 2007). Potential patterns have been suggested for cardiovascular disease, type 2 diabetes, hypertension and epithelial ovarian cancer (Rezzi et al., 2007). In addition, metabolite
measurements may be more sensitive than serum measurements of specific nutrients. Joosten et al. conducted a study to determine the prevalence of vitamin deficiencies in the normal elderly population. According to serum assays, less than 10% had vitamin deficiencies, as opposed to 63% when evaluated by serum metabolite assays (Joosten et al., 1993). A major limitation of metabolite tests is their expense (Boerner, 2001). Also, although metabonomics is an established field of research, nutritional metabonomics is still in the infantile phase. The progress thus far is encouraging, however the field is venturing into unknown territory. More research needs to occur before studies can be conducted to discover new biomarkers. Then, the new biomarkers must undergo scrutinizing research to prove their efficacy, reliability and utilization. After new biomarkers are firmly established, they can be considered for clinical application. Nutritional metabonomics is a brand new field of research which has the potential to revolutionize nutritional knowledge, but it may take several years before the fruit of this new field reaches the clinical arena.

**Functional: The Lymphocyte**

Lymphocytes provide information about the status of the immune system as well as overall nutritional health (Boerner, 2001). Lymphocytes possess similar metabolic pathways to most other cells, and they can reflect the body’s nutritional status over their lifetime of 3-12 months (Boerner, 2001). Lymphocytes unique ability to reflect long-term dietary patterns rather than recent intake is of great value. For example, consider the importance of A1C testing of diabetic patients compared to daily glucose testing. Both are important, but yield difference information critical for therapeutic control. In addition, lymphocytes are not significantly altered by fasting or short-term nutritional changes (Boerner, 2001). Emadi-Konjin et al. stated lymphocytes provide a more reliable assessment than serum and plasma vitamin C measurements.
because blood levels do not necessarily represent tissue levels and unlike blood indices lymphocytes are not acutely affected by circadian rhythms or dietary variability (Emadi-Konjin, Verjee, Levin, & Adeli, 2005). Lymphocytes provide a unique ability to analyze nutrition because they are not easily influenced by other external factors.

Dr William Shive, from the University of Texas, led the way in application of lymphocytes as a nutritional biomarker. Shive developed Spectracell micronutrient testing which measures more than 31 vitamins, nutrients and antioxidants (Boerner, 2001). His patented method uses 8-16cc of blood (non-fasting) kept at an ambient temperature, processed within 24-30 hours. In the laboratory, the sample is centrifuged and inoculated onto a special medium for five days. Finally, 22 tests are performed to determine specific nutrient deficiencies as well as the subject’s overall nutritional status. Spectracell can also detect abnormal glucose utilization and measure antioxidant capacity. Antioxidant capacity is defined as “the ability of lymphocytes to resist growth inhibition when introduced to free radicals” (Boerner, 2001). Spectracell theorizes it is more advantageous to obtain a physiological balance between oxidants and antioxidants than to have an over-abundance of antioxidants and therefore Spectracell’s quantitative measurement is valuable for therapeutic monitoring (Boerner, 2001). Matthews et al. created a similar medium for mice in order to determine the direct effects of altered diets (Matthews, Mrowczynski, & Matthews, 1994). They concluded the method was accurate and “may provide a novel tool for the assessment of nutritional status” (Matthews et al., 1994). Spectracell’s technology may allow physicians to obtain a more reliable and comprehensive nutritional assessment of their patients than ever previously possible.

A study conducted by Spectracell on over 5,000 individuals found a strange phenomenon; they were unable to determine specific nutrient deficiencies or trends of subjects
with similar disease conditions (Bucci, 1994). This unexpected finding may support theories about nutritional diversity and genetic influences of nutritional requirements. If such theories are determined to be true, it could explain a major contributor to research error. It may be the cause for contradicting research study results. However, significant research is needed to elaborate on their findings before any conclusions can be determined.

Several case studies using the Spectracell lymphocyte technology have shown promising results. A case study of a five year old girl with severe neuro-muscular symptomatology revealed a riboflavin deficiency. Urinary excretion (gold standard) tests did not show a deficiency. They decided to give her a 10mg supplement daily and after several weeks she returned to normal functional activities of daily living and play (Bucci, 1994). Another case study on an eight year old boy with autism revealed deficiencies in B2, B6, and glutamine. After supplementation his teacher and parents noted improvements in behavior and personality development (Bucci, 1994). These case studies, along with several others not mentioned, may suggest individuals are too unique to apply general population parameters. The clinical approach to nutrition may be headed in the direction of personally customized health therapies rather than blanket recommendations (Boerner, 2001).

Spectracell is a Clinical Laboratory Improvement Amendments (CLIA) accredited laboratory. It follows the Health Insurance Portability and Accountability Act (HIPPA) regulations and is accepted by Medicare and most private insurance companies for diagnostic purposes (Spectracell Laboratories, 2011). Many clinicians have started to use Spectracell to assist in the diagnosis of nutritional deficiencies. Spectracell appears promising for future clinical application. However, the case studies and published articles have affiliations with the
company. Extensive studies conducted by researchers not affiliated with Spectracell are needed to prove unbiased efficacy and reliability.

**Stable Isotopes**

Stable isotopes are non-radioactive isotopes (carbon, oxygen, nitrogen, hydrogen) which can be measured with spectroscopy to determine nutritional status. This method is commonly used by the International Atomic Energy Agency (IAEA) in collaboration with the World Health Organization (WHO) and United Nations International Children’s Emergency Fund (UNICEF). Stable isotopes are used to measure: micronutrient status and bioavailability, food assimilation, food consumption, toxic elements, and nutrient interactions (International Atomic Energy Agency [IAEA], 2003). The isotopes are administered orally in water, food, or a capsule (IAEA, 2003). They are then incorporated into metabolic products which can be measured via mass spectrometry, infrared absorption spectroscopy, or atomic emission spectroscopy (IAEA, 2003). Presently, stable isotopes are used to evaluate the effectiveness of fortification and supplementation programs in developing countries. This utilization has yielded insightful information. A study in Indonesia of fortified wheat flour discovered when zinc sulfate was combined with iron sulfate, the bioavailability of iron sulfate decreased significantly (IAEA, 2003). Stable isotopes have expanded our current understanding of nutrition and have allowed international agencies to optimize nutrition in extreme poverty stricken locations around the world.

There are several other uses for stable isotopes as well. They have enabled researchers to tailor nutritional guidelines to local communities based on their individual needs, soil differences, food availability, etc. Furthermore, stable isotopes can gauge total energy expenditure using the
doubly labeled water technique (DLW). The DLW technique is non-invasive, non-restrictive, and can be used in field conditions throughout the world (IAEA, 2003). Typically, the assessment is taken over a two week time period by measuring products found in urine samples. This method is also being used to establish energy requirements for children two to eighteen years of age. The IAEA is currently supporting research to utilize the DLW technique as an instrument in prevention and treatment of childhood obesity. Stable isotopes are relatively inexpensive, pose no known health risks, can be administered to large populations, and are easily used in a variety of demographic conditions (IAEA, 2003). Originally, stable isotopes were implemented in malnutrition assessments worldwide. Advancements in their use could potentially lead to their use in the assessment of overall nutritional status and micronutrient deficiency screening. More research and large scale studies are needed; however stable isotopes are another potentially promising technique.

**Biomarkers Conclusion**

The need to develop standardized, reliable biomarkers to assess nutritional status is evident. Currently, most biomarkers are limited to research applications. There is significant potential for their utilization in the clinical setting; however a clearer understanding of biomarkers and their reliability in various conditions and uses must be determined (Potischman & Freudenheim, 2003). The future is optimistic for biomarkers, and in time this technology will improve and become more cost-efficient (Jenab et al., 2009).
Part C. Other Disciplines Approach

The Acute Hospital Setting

Patients are at an increased risk of malnutrition in the hospital setting, which undetected can lead to increased morbidity, length of stay, and significant financial burden (Dzieniszewski et al., 2005). In 2003, the Joint Commission mandated all inpatients receive a nutritional risk screening within 24 hours of admittance (Joint Commission, 2007). Chima et al. conducted a survey of 522 members of the Clinical Nutrition Management Dietetic Practice group to assess how US hospitals were primarily meeting this recommendation (Chima, Dietz-Seher, & Kushner-Benson, 2008). Approximately 84% of hospitals reported nursing staff as primarily responsible for the initial screening; 57% also conducted a secondary screening by nutritional service staff such as dietitian (Chima et al., 2008). Most nursing staffs obtained a dietary history and asked basic questions about weight loss, poor intake, chewing/swallowing issues, and assessed skin breakdown (Chima et al., 2008). The nutritional staff determined the diagnosis, assessed the need for nutritional support, overall protein intake, and wrote special orders/diets accordingly. When inquired the reason nurses administer the primary nutritional assessment, 70% of responders said nurses “do not require clinical expertise”, 60% said “the ease of use,” and 59% said “readily available” (Chima et al., 2008). In addition, most responders’ institutions had not formally evaluated their screening systems for sensitivity or specificity; clearly emphasis on fulfilling the Joint Commission mandate was the priority (Chima et al., 2008). Ironically, only 34% felt the nursing screening was effective and could correctly identify at risk patients (Chima et al., 2008). Pattison et al. compared nurses and dietitians ability to correctly identify undernourished patients. Pattison found only 58% of nurses compared to 85% of dietitians correctly identified the undernourished patients (Pattison et al., 1999). The Joint Commission
mandated all hospitals screen patients for nutrition because they recognized its importance. Hospitals however, have not recognized its importance and have poorly met the recommendation. The inability to properly assess the nutritional status of inpatients illustrates the vast inability to properly assess nutritional status. The lack of a reliable means to assess nutrition affects multiple disciples and has significant consequences.

In 2005, Dzieniszewski et al. studied the nutritional status of hospitalized patients in Poland using a unique method which included: anthropometric measurements, biochemical indices, and levels of vitamins A, C, E, B12, and folic acid. Since the study was conducted in Poland, the results cannot be assumed equivalent to the US; however their findings illustrate a dire need for similar research in the US. Dzieniszewski et al. discovered over 20% of admitted patients had protein-energy malnutrition based on serum albumin levels (Dzieniszewski et al., 2005). Vitamin malnutrition was observed in the majority of patients and slightly worsened during their inpatient stay. Interestingly, they found vitamin deficiencies were equally present in malnourished, overweight, and obese patients (Dzieniszewski et al., 2005). This observation has also been documented in US studies of bariatric patients (see current methods for assessing nutritional status). Dzieniszewski et al. concluded the prevalence of specific vitamin malnutrition was significantly higher than protein-calorie malnutrition in hospitalized patients (Dzieniszewski et al., 2005). Currently, most US nutritional screenings on inpatients focus on protein-calorie malnutrition and do not objectively assess micronutrients (Chima et al., 2008). The methodology used in this study is far too complex and time consuming to use in all patients; however studies following their protocol on selected population may provide great insight into nutritional needs of US inpatients.
SGA- Subjective Global Assessment

The subjective global assessment (SGA) is a standardized tool to evaluate patients who are undernourished or at risk of becoming undernourished. Few settings are using this method, however many practitioners are encouraging institutions to implement it in the hospital setting. The SGA was originally designed for adults, but studies have suggested its reliability in pediatric populations as well (Mahdavi, Ostadrahimi, & Safaiyan, 2010). The SGA is a bedside assessment tool based on medical history and physical exam findings (Mahdavi et al., 2010). The history includes questions regarding: weight changes, change in intake, gastrointestinal symptoms, and functional capacity. The information generated is then used to “assume metabolic demand of underlying disease” (Mahdavi et al., 2010). The physical exam assesses: loss of subcutaneous fat, muscle wasting, and presence of edema (Mahdavi et al., 2010). Mahdavi et al. determined the SGA correctly diagnosed 88.235% of undernourished patients and 45.8% of well-nourished patients (Mahdavi et al., 2010). Based on his results, it may be concluded the SGA yields a high percentage of false positives because it can only identify less than half of well-nourished patients. Mahdavi recommends use of the SGA because it is easy to perform, non-invasive, yields quick results, and can be conducted at the bedside (Mahdavi et al., 2010). The major limitation of this method is it only assesses macronutrient, protein-energy malnutrition. The results indicate it may be a better method than the current gold standard, yet due to its inability to assess micronutrient deficiencies the overall gain from mass implementation of this method would be fairly small. That being said, since this method is already established, it may be worth considering temporary utilization in the select clinical settings until better methods are developed.
ARTIFICIAL NUTRITION

The purpose of artificial nutrition has evolved from a supportive care measure to a “primary therapeutic strategy of favorably altering patient outcome” (Gupta & Chopra, 2008). Patients are primarily selected for artificial nutrition based on their medical diagnosis (Gupta & Chopra, 2008). Once artificial nutrition has been established, continuous evaluations monitor the patient’s general, inflammatory, and nutritional status (Donini et al., 2009). Plasma serum levels are used to monitor levels of zinc, chromium, iron, copper, selenium, sodium, potassium, carbon dioxide, urea, creatinine, calcium, phosphorus, and magnesium (Gupta & Chopra, 2008). Serum biomarkers have become a mainstay in artificial nutrition therapy, and have literally saved thousands of lives (Gupta & Chopra, 2008). That being said, there is still opportunity for improvement. The most common complications associated with artificial nutrition are metabolic in nature (Gupta & Chopra, 2008). Nutritional requirements vary from patient-to-patient due to different metabolic requirements. The current methods used to evaluate artificial nutrition therapy cannot account for this level of individual variability. Perhaps some of the biomarkers previously discussed, may better assess artificial nutrition requirements to prevent these potentially serious complications.

Additional Screening Methods: Conclusion

Numerous alternative screening methods have been proposed, each with unique strengths and weaknesses. Several methods exhibit potential for future applications. Extensive research is critical; especially gold standard double-blind randomized control trials in order for any of these methods to be used in the clinical setting. Inconsistencies among the definition of malnutrition and under-nutrition must be rectified. Malnutrition can no longer be understood as macronutrient protein-energy deficiency; rather the definition must be broader to incorporate
micronutrients and overconsumption. The mentality of practitioners must change. They must acknowledge the importance of nutrition, the current limitations of the gold standard to assess nutritional status, and embrace new alternatives in an effort to promote better evaluation techniques. If clinicians do not place more emphasis on the importance of nutrition, it may take over 100 years to develop an accurate assessment tool for clinical application. This could be a catastrophic tragedy considering the key to unlocking prevention and early treatment of chronic diseases may be right under scientists’ fingertips.
How to Address the Results

After a nutritional deficiency is discovered, how should the practitioner address it? There is a general consensus in medicine that stopping at a diagnosis is unacceptable. It is the responsibility of the health care provider to adequately address the situation and not abandon the patient. Unfortunately, there is not a consensus regarding treatment of nutritional deficiencies. In fact, opinions greatly vary between health care providers, government officials, family members, and complementary and alternative medicine (CAM) supports. It would be impossible to address all of the issues related to this complex quandary. The “cookie-cutter” treatment plan may not be the answer. Multiple treatment options may result in acceptable outcomes, therefore patient-provider preference may be superlative in determine the method that best suits the patient.

CAM

One of the most highly debated methods to address nutritional deficiencies is the use of complementary and alternative medicine (CAM), specifically supplementation. The National Center for Complementary and Alternative Medicine (NCCAM) of the National Institute of Health (NIH) defines CAM as “practices and products that are not presently considered to be part of conventional western medicine” (National Center for Complementary and Alternative Medicine, 2011). The use of CAM has dramatically increased (Kemper 2008). It is estimated 20-40% of healthy children, and greater than 50% of children with chronic/recurrent/ incurable conditions use some form of CAM (Kemper & O’ Connor, 2008). In addition, it is almost always in conjunction with mainstream medicine (Kemper & O’ Connor, 2008). Strikingly, in 1997, the number of visit to CAM providers exceeded the number of visits to primary care providers (Eisenberg et al., 1998). CAM use in America continues to steadily increase as more
individuals are searching for alternatives to mainstream medicine. Many parents do not believe their children are receiving optimal healthcare and are searching for different means to provide it.

The use of supplementations to support optimal health is popular among CAM providers, and is slowly increasingly in conventional western medicine. It is estimated 41% of children take a multivitamin (Kemper & O’ Connor, 2008). The use of prenatal vitamins has become a mainstay in the treatment of obstetrics as it is well-known to reduce the risk of low birth weights and improve outcomes for both baby and mom (Shah & Ohlsson, 2009). Cardiologists regularly incorporate niacin and fish oil into their patients’ regiments because research has shown promising cardiovascular effects validating their extensive use in clinical practice (Hill, Fleming, & Kris-Etherton, 2009). Numerous randomized control trials have suggested several nutrients to be preventative for diseases. For example, vitamin E may be protective against colorectal cancer (Albanes, 2009). The nutritional intervention trial found a 21% decrease in gastric cancer when administered a combination of selenium, beta carotene, and vitamin E (Albanes, 2009). Several studies have suggested the immense benefits of nutritional supplements and overall health.

However, not all studies reflect this positive sentiment. Albanes’ editorial reflection on where randomized control trials (RCTs) currently stand on vitamin supplements and cancer prevention, and state the evidence on supplementation is diverse ranging from highly effective to potentially dangerous (Albanes, 2009). Like prescriptions, supplements must be individually assessed for efficacy and safety. This is a major complication with supplement RCTs because the supplement is not standardized. Each manufacture has different formulas, dosages, nutrient combinations, and therefore across the border comparison methods is impossible. Yet, studies continue to attempt this, resulting in erratic, contradicting findings.
There is growing evidence of the prevalence of vitamin deficiencies which must be addressed. For instance, vitamin D deficiency is prevalent; however food sources are not enough to combat the deficiencies in a large majority of the population. Alternative methods to increase vitamin D consumption largely rely on fortification and supplementation options. Walker et al states oral supplements “lack uniformity or standardized regulations” even though they are a widely utilized resource to treat nutritional deficiencies and inadequacies (Walker & Modlin, 2009). A significant percentage of health care providers and the public see the benefit of taking supplements to meet nutritional needs. Studies have shown immense potential for certain supplements. Standardization and safety methods are needed in order for supplements to become a well-accepted means for prevention and treatment of nutritional deficits.

A major hindrance to the widespread acceptance of CAM supported supplements is the direct result of the Dietary Supplement Health and Education Act 1994 (DSHEA). The DSHEA defines dietary supplement in a separate classification from food and drugs (Kemper et al., 2008). This loophole has resulted in supplements falling outside of the jurisdiction of many safety and regulatory rules which apply to food and drugs (Kemper et al., 2008). As a result, unlike prescription medications, under DSHEA supplements may be marketed without proven efficacy or safety (Kemper et al., 2008). The FDA has limited authority under DSHEA; in fact manufactures do not have to report any information regarding adverse events to them (Kemper et al., 2008). The FDA cannot deem a supplement unsafe until after it is already on the market (Kemper et al., 2008). This is extremely dangerous because before the FDA has authority to remove a dangerous supplement, many individuals have suffered its potentially life-threatening adverse effects (Venhuis et al., 2011). The FDA is heavily dependent on MedWatch (U. S. Food and Drug Administration, 2011), a voluntary reporting system which enables healthcare
providers to anonymously inform the FDA of suspected dangers associated with a supplement (Kemper et al., 2008). Serious issues regarding the quality, safety, efficacy of supplements have resulted from the inability to the FDA to regulate supplements appropriately.

Supplements are not created equally. Supplements can be synthetic, contain isolated nutrients, or contain whole food preparations (Ellithorpe, 2001). Various manufacturing practices and quality variations can also make two supplements claiming to contain the same thing different. Like prescription medications, the efficacy and safe of each supplement must be individually determined. Under the DSHEA legislation, the FDA does not have the authority to regulate supplements like prescription medications. The U. S. Pharmacopeia Convention has developed voluntary standards for quality and purity of supplements, which several health care professionals have recognized as valuable when making recommendations to patients (U. S. Pharmacopeia Convention, 2011). Some supplements may be effective and safe, however until there is a standardized way to assure health care professionals of this, supplementation use will continue to be highly debated and cautioned by many health care providers.

Researching CAM therapies requires twice the effort and is often disregarded by the medical community. A major publication bias exist, negative studies are more commonly accepted in well-known journals where as positive studies are more likely to be published in foreign-language journals (Pham, Klassen, Lawson, & Moher, 2005). Kemper et al. proposed a possible cause as the “relative lack of CAM expertise in conventional institutions resulting in inadequate peer review and undue difficulty when attempting to obtain IRB approval” (Kemper et al., 2008). A major argument against the use of CAM is the lack of scientific evidence behind it. Yet, it appears some members of the medical society are not supporting its research and are
not fairly publishing results. Various CAM therapies may or may not be safe and effective; however it should be base on sound research rather than people in positions of power.

**Referrals: CAM Providers**

Referral to a CAM professional is a potential option in addressing nutrient deficiencies. One major issue prohibits this; licensing requirements for CAM providers vary state-to-state. Currently, lobbying efforts by CAM providers for state recognize of licensure and broader scopes of practice are ongoing (Kemper et al., 2008). If a CAM provider is licensed, he or she must perform within their scope of practice following statues and regulations (Kemper et al., 2008). State licensing helps to monitor safety and hold practitioners accountable. In addition, if the state chooses to not license CAM practitioners, it prevents physician referral to them because the referring physician may become liable for a negligent referral (Kemper et al., 2008). It is unknown if states are executively exercising their authority with the safety of patients in mind, political gain or financial interests. One could make a valid argument for any of the above.

Health care professionals cannot come to an agreement about CAM therapies due to all of the controversies involved in their use. The vast majority of health care professionals truly have their patients’ best interest in mind. Ethically practitioners are mandated to advocate and educate their patients in the use of therapies that are safe and effective (Kemper et al., 2008). Based on the information currently available, health professionals have individually developed their own opinions of CAM therapies. Greater than one third of pediatricians’ families or themselves use CAM (Kemper et al., 2008), however several others do not support it whatsoever. In 2001, the American Academy of Pediatrics survey of Fellows found only 54% agreed pediatricians “should consider the use of all potential therapies, not just those of mainstream medicine, when treating patients” (Kemper & O’Connor, 2004). Their unwillingness to consider all potential
therapies is alarming. This statement reflects a close-mindedness that regardless of outstanding circumstances is never acceptable in the medical community. For example, consider if 50% of physicians had decided penicillin was outside of mainstream medicine. It is honorable for clinicians to scrupulously evaluate a therapy and then make a decision regarding whether or not to recommend it. It is audacious that a clinician would not consider evaluating potential therapy solely on the basis of mainstream medicine.

**ADA Recommendation**

The American Dietetic Association promotes a wide variety of foods as the best strategy to meet nutritional needs (American Dietetic Association [ADA], 2001). Dietary Guidelines for Americans 2010 eloquently stated, “a healthy pattern is not a rigid prescription, but rather an array of options” (USDA, 2010). The ADA supports government nutritional guidelines and believes there are many unidentified constituents in natural foods which may not be in supplements (ADA, 2001). In addition, little evidence is available regarding nutrient-nutrient interactions, drug-nutrient interactions and other adverse effects of supplements. Nonetheless, the ADA recognizes in specific circumstances food fortification and supplementation may be desirable (ADA, 2001). The ADA recommends individual dietary assessment and counseling to determine special circumstances when implementing additional resources may be advantageous. The ADA believes “food fortification of commonly consumed foods may be a reliable and effective way to obtain health benefits” (ADA, 2001). They also encourage supplementation is special circumstances such as B12 in adults greater than 50 years of age with atrophic gastritis (ADA, 2001). In regard to supplementation, the ADA strongly suggests Congress reevaluate DSHEA to determine if the legislation has fulfilled its intended role and whether consumers comprehend claims allowed under the act (ADA, 2001). They also recommend the government
examine if DSHEA is less stringent than for food regulations and if so to change the law. Overall, the ADA supports food as the best means to correct nutritional deficits; however they do acknowledge special circumstances exist when food fortification and supplementation may be necessary.

**Current Counseling Methods**

The responsibility for nutritional counseling in the healthcare setting largely falls on primary care providers. In the past, counseling attempts have show minimal results. According to the American Heart Association (AHA) there is an assumption among health care providers that acquisition of the facts will positively and dramatically change patients’ maladaptive behaviors (Gidding et al., 2009). Unfortunately, numerous research studies have illustrated fundamental problems with simply providing the facts. First, it assumes all patients are ready and motivated to change (Gidding et al., 2009). Also, it does not take into account patient health literacy (Gidding et al., 2009). Children are concrete thinkers, therefore information geared towards children needs to be direct and straight forward (Riley, Locke, & Skye, 2011b) If information is not administered in a way it can be understood, it simply becomes a waste of time, effort, and resources. A common misconception in health care is if someone is familiar with a word, or has heard of a phrase, it means the individual fully understands what it means. Also, the facts cannot take into consideration the patient’s accessibility to foods, their diverse economic predicaments, or social factors that influence their decisions (Gidding et al., 2009). Blanket recommendations are impractical, individual considerations must be at the forefront of all recommendations. Practitioner’s also struggle with this method because several are uncomfortable confronting patients in regard to sensitive issues like weight and child rearing practices (Gidding et al., 2009). Practitioners must be conscious of the first line between health
information, cultural practices, and parenting strategies. In addition, time constraints and reimbursement restrictions make it difficult to adequately counsel patients (Gidding et al., 2009). Practitioners often have many obstacles to overcome when attempting to inform patients about nutrition, which unfortunately may affect the quality of counseling they provide.

A major problem according to the AHA is historically primary care physicians have decreased self-confidence with regard to nutritional counseling (Gidding et al., 2009). Many do not feel adequately prepared educationally to counsel their patients, and many are not convinced dietary interventions are effective or their personal effort will substantially alter the individuals’ dietary habits (Moore, Adamson, Gill, & Waine, 2000). Moore et al., presents the case that there is a discrepancy between the attitudes of public, who appear eager to learn dietary advice from primary care providers, and the disinclination of these professionals to execute this role (Moore et al., 2000). Moore et al. is specifically addressing concerns in the UK, however this concern may be present in the US as well. Buttriss survey revealed UK physicians believed the number one obstacle preventing patients from eating more healthily was apathy (Buttriss, 1997). Interestingly the number one obstacle according to patients was lack of knowledge (Buttriss, 1997). The mismatch evidence in the UK may also be a contributing factor in the United States. Physicians’ attitudes regarding the efficacy and delivery of educational counseling greatly impact its effectiveness.

Standard counseling methods in the primary care setting may not be the answer. Yet, significant changes to assist medical professionals in their ability to council patients may be a beneficial option. If physicians felt more comfortable providing these services and policies were developed to breakdown some of the barriers, counseling could become more effective and beneficial. The AHA also recommends incorporating motivation interviewing skills into every
educational opportunity and counseling session (Gidding et al., 2009). Motivational interviewing is a style of counseling which follows the Transtheoretical Model of Health Behavior Change (Prochaska & Velicer, 1997). It is used to assess the patient’s readiness for change (Prochaska & Velicer, 1997). Once the provider determines what level the patient is at, he or she may then address their information accordingly. For example, if a patient states he does not wish to change his diet whatsoever, it is more advantageous to counsel him with information in regard to why he should change his diet. Information regarding how to change his diet would be useless because he has already told you he does not want to change (Kelly, 2011; Prochaska & Velicer, 1997). In essence, the provider is motivating the patient to consider changing their viewpoint. If the same patient at the next visit states he has thought about what the provider said and thinks he may want to make a few changes, then the provider can offer information regarding healthy lifestyle choices and food selection. This technique has become popular and effective with smoking cessation, but it can be used in regard to a wide variety of counseling topics (Cabezas, Advani, Puente, Rodriguez-Blanco, & Martin, 2011). New techniques and attitudes are needed in the primary care setting in regard to nutritional counseling. The primary care setting provides an advantageous environment to prevent, address, and educate parents and patients about nutrition. New methods are needed to improve the efficacy of these brief encounters and explore future possibilities to enhance the role of the primary care setting in preventing and treating nutritional issues.
Recommendations for the PCP/ Pediatrician Regarding Preventative Care

Prevention is the hallmark of pediatrics (Krebs & Jacobson, 2003). It is the main focus of most pediatric visits and well-child screenings. Practitioners routinely conduct newborn screenings, give immunizations, ask about car seat and helmet use to mention a few (Krebs & Jacobson, 2003). Preventative care however is lacking when it comes to screening for obesity and nutritional risk factors related to suboptimal health (Krebs & Jacobson, 2003). This delicate matter is often glossed over. Practitioners need to raise parental awareness without judgment or blame, and carefully address issues to avoid negatively impacting the child’s self-concept (Davidson & Birch, 2001). Simply asking questions regarding these topics can open the door into meaningful conversations about problem areas.

The main limitation to providing preventative care according to surveys is time (Riley, Locke, & Skye, 2001a) This is an excuse; the true limitation is financial reimbursement. Interestingly, insurance companies are more than willing to pay a physician to treat hypertension, but refuse to reimburse the physician for counseling on prevent of hypertension. Doctors cannot afford to council their patients because they are forced to do it for free or at best a minimal reimbursement. A baker cannot be expected to give out free bread; likewise physicians cannot educate patients without receiving payment for it. Ironically, for every patient that prevention methods and counseling effectively work could save insurance companies hundreds of thousands of dollars over a person’s lifetime. Health providers need to continue to push for preventative care regardless of obstacles which may be hampering its progression.

Physician assistants (PA) may play an important role in the future to help alleviate some of the financial restraints currently dampening physician’s ability to provide preventative care and educational counseling. PAs are educated under the medical model and work
interdependently with physicians (American Academy of Physician Assistants [AAPA], 1999). It is a relatively young profession but has quickly gained respect for their value. They enhance accessibility and affordability of health care and embrace multidisciplinary teamwork (AAPA, 1999). One of their many qualities is their ability to fill-in the gaps of health care thus strengthening continuity of care and patient education (AAPA, 1999). PAs may play an even larger role in the future in regard to educating parents and children regarding awareness, education, and application of better dietary practices.

A little creativity and ingenuity by health care providers could revolutionize the future of medicine. For example, educational waiting rooms could be developed. Games strategically placed in waiting rooms could teach children portion control, healthy decision making, disease prevention, and safety. Rather than individually educating each parent, how about using a website with videos parents could listen to on various educational topics. The website could cover every topic imaginable, come from a reputable source, and health care providers could prescribe “homework” (specific topics for their patients and parents to learn about). At the end of each educational session there could be a certificate of completion. The certificate could be printed and given to the health care provider for five dollars off the next visit to provide incentive for completing their homework. Consider a topic of the month. The entire office could be focused on the selected topics’ promotion and education. Every patient could be given a handout about the topic with a 2-3 minute explanation of its importance. Handouts made by students could provide a great educational opportunity for students and ease time constraints on providers. Health care providers could hold seminars and charge a small entrance fee on topics of interest. For example, a cooking class to teach parents how to prepare foods in a more
appealing fashion for children (colorful arrangements, fun shapes, healthy sauces to encourage vegetable consumption). The opportunities are as endless as the imagination.

**Referrals: Dietitians and Other Dietary Specialists**

Dietary specialists are expertly trained to deliver individualize nutritional interventions (Franz et al., 1995). They are a cost-effective resource not being utilized to their full potential in the US (Franz et al., 1995). Medical nutritional therapies have substantial improvements metabolic control of non-insulin dependent type II diabetes mellitus patient management, as well as numerous other medical conditions (Franz et al., 1995). Yet, their services are largely under-utilized. A major barrier to providing sufficient counseling and education in primary care is the limited patient contact time with health care professionals (Castle, 2010). Registered dietitians (RDs) when integrated into a multi-disciplinary team can help alleviate this problem. RDs can offer: one-on-one counseling, group classes, seminars, and many other educational opportunities that may not be possible in the primary care setting (Castle, 2010). A Canadian study found only 30% of primary care physicians reported utilization of any nutritional-related resources (Wynn, Trudeau, Taurnon, Gowans, & Scott, 2010). The role of dietary counseling should not fall entirely on dietary services; rather the integration of dietary service into a multi-disciplinary team to address patients with nutritional concerns.

**Parents**

The AHA recognizes “underdeveloped parenting skills” as a specific barrier to dietary counseling efforts (Gidding et al., 2009). As previously discussed, the role of parenting in dietary interventions is critical. Parents are the ultimate role model. Children cannot be expected to make healthy decisions when their parents are not; especially at young ages when
they are completely dependent on the parent for selecting food. Parents are equally responsible for educating their children on healthy eating and the development of decision making. It is the parent who should teach their child while in the grocery store how to select a ripe cantaloupe, or read the nutritional label on their cereal box. The ADA recommends parents discuss marketing strategies of companies to help children understand the influence of marketing (ADA, 2008). For example, misleading advertisement strategies of fruit juices claiming “100% Daily Value of vitamin C”, not to be confused with “100% juice” (USDA, 2010). Also, parents need to use caution selecting canned fruits in regard to what it is packed in: heavy syrup, light syrup, water, or 100% juice (USDA, 2010). Simple parenting skills have been abandoned in the American society. The role of a parent is to allow a child to exercise autonomy within appropriate boundaries. Rather than asking a child what he or she wants for a snack, consider giving the child a list of healthy choices and allowing the child to choose from them. Some parents need counseling on child rearing practices to optimize childhood nutrition.

Parents can easily influence their children’s food choices. The art of cooking and gardening has not been passed down through the generations as it had been in the past (USDA, 2010). Simple practices such as food presentation, making a vegetable a stable component of every dinner, and setting grapes out so the children can grab a handful as they walk past can positively alter a child’s diet. Another idea is to substitute soda with dinner for a glass of milk. Consider, rather than rewarding a child with candy for behaving in the grocery store, why not let them pick out a unique fruit of their choice to try at home. Then, trying new fruits becomes exciting, fun, and a special treat. These are simple suggestions health care providers can offer parents in an attempt to empower individuals and families and encourage their participation in nutritional promotion (USDA, 2010). Parents may be the most influential component in
determining a child’s diet. If parents are not reinforcing healthy eating habits other methods may be of little benefit.

**Schools**

Schools have received substantial criticism about their nutritional educational programs and the quality of foods provided. Numerous interventions and programs have been researched, but most will little effectiveness (Tercyak & Tyc, 2006). Tercyak commented on several intervention results such as: a 0.2 increase in fruit and vegetable intake from the Gimme five program (Davis et al., 2000), and a difference of 31.6% energy intake from fat in the control to 30.6% in the CATCH program (Luepker et al., 1996). Story et al. conducted a Five-a-day Power Plus program and found some positive results, however was unable to implement the “parental involvement” aspect of the program (Story et al., 2000). Gidding et al. emphasized the ineffectiveness is likely due to an absence of environmental change (Gidding et al., 2005).

Schools cannot single-handedly turn an entire nation’s eating practices around. Schools play a fundamental role in the process, along with parents, government regulations, and health care systems. Each aspect is intimately related to the other and must collaborate to promote change.

**Government Regulations**

Local, state, and federal government regulation of health related policies is highly debated. Some people highly advocate it, while others feel regulations are unnecessary and take away personal freedom. Rolls et al found a positive association between portion size of a packaged snack and increased energy intake in both men and women (Rolls, Roe, Kral, Meengs, & Wall, 2004). Should the government put pressure on manufacturing companies and restaurants regarding portion sizes or is it the responsibility of the individuals to make wise choices and control their own consumption? Mandating menu labeling has become a highly
debated issue as well. A RCT asked parents of 3-6 year old children to select from a McDonald’s menu a meal from themselves and their child (Tandon, Wright, Zhou, Rogers, & Christakis, 2010). The parents were separated into two groups with identical menus except one had nutritional information. The parents with the nutrition information menus ordered a meal with 102 fewer calories than the control group. Tandon et al. concluded two potential benefits from the inclusion of nutritional information of the menu; positive influence on parental food choices, and pressure on restaurants to offer healthier selections (Tandon et al., 2010). A potential benefit not mentioned is the shift of responsibility from the restaurant to the individual; an informed consumer is able to make educated decisions regarding consumption. Federal standards for menu labeling have been proposed in both the House of Representatives and the Senate (Tandon et al., 2010). Another hot topic is advertisement. Several European countries have restricted advertisements towards kids and school-based marketing (Gidding et al., 2005). The US currently does not limit or restrict advertisements toward children with the exception of tobacco and alcohol. Several studies have shown significant increases in preventative care when collaboration methods between government, community agencies, and physician offices united (Ortiz, 2011). Collaboration is essential; the more people working together for the same purpose, the better the outcome and the larger the impact. In areas of controversy, the question is of responsibility. Who is responsible for making and promoting healthy decisions? Is it the consumer, the government or both? The questions become challenging when all aspects are considered such as government health care costs, individual freedoms, and so on. The government is made by the people for the people, and they determine its role. The government most definitely plays a role in health care and the people of the United States must determine exactly what that role is in regard to nutrition and preventative care.
When to Intervene?

Anytime is the perfect time to make health conscious interventions. With few extreme exceptions, interventions result in significant health benefits regardless of the person’s age or current health status. Early interventions are recommended, it is much easier to prevent or correct unhealthy behaviors right when they start rather than years later when they have become deeply integrated into the person’s lifestyle (Riley, Locke, Skye, 2011b). Picciano et al. believes a unique window of opportunity exists during the transitional period into early childhood (Picciano et al., 2000). The transition period between milk/formula to adult style diets sets the child’s nutritional foundation for life (Picciano et al., 2000). At no other time in the person’s life, will their diet change as rapidly (Picciano et al., 2000). Picciano highlights the lack of nutritional education, support, and parental guidance available to aid in this transitional period. More emphasis and intentional interventions geared towards this age group may be beneficial.
**Proposed Indications and Recommendations**

Every child should be screened on multiple occasions to determine nutrient excesses and deficiencies. Throughout a child’s lifetime, their diet and nutritional needs rapidly evolve. The ideal screening setting is in primary care/pediatrician offices where adequate monitoring can occur. As previously reflected there are several promising nutritional evaluation methods; however most are currently in the elementary stages. More emphasis needs to be placed on their development until a new gold standard emerges. Potentially, the future gold standard screening tool could become an essential aspect of a well-child visit. Once established, insurance companies should cover all costs associated with the screening. After a deficiency or excess is diagnosed, the practitioner and patient must collaboratively determine the best treatment option. Many minor nutrient issues may be corrected with diet modification, where as others may require more intensive therapies such as referrals and individualized supplementation.
Future Outlook

The effects of under-nutrition and over-nutrition on non-communicable diseases have placed a heavy burden on health care systems (IAEA, 2003). The government is overly concerned with the development of treatment options rather than the discovery of nutritional information which could explain a potential cause for chronic diseases, leading to their prevention all together. The American health care system cannot afford to treat diseases; it is time to shift the focus to preventative therapies. The development of reliable nutritional assessment screening tools would be a giant step in the right direction.

The development of a valid screening tool would not solve all of the nutritional issues in America. Americans do not place value on the importance of sound nutrition. The individual must be willing to make necessary changes to promote their health. As for providers, a shift toward preventative care is essential. A key aspect of preventative care is nutrition. Providers need to become more cognizant of the importance of nutrition and work toward progressing our understanding and ability to assess and address nutritional status.
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Abstract

OBJECTIVE: The average child in the United States is overfed and undernourished. Adequate nutrition sets the foundation for a child’s lifetime. Growing evidence links chronic diseases with poor nutrition starting in early childhood. Traditionally, pediatric nutritional status in pediatric is assessed with growth charts. Growing evidence indicates this method may be unable to detect suboptimal nutritional deficiencies that may lead to chronic diseases. Technological advancements and the growth of nutritional knowledge may enable better detection and treatment of nutritional deficiencies.

METHOD: Literature review was performed via PubMed, AAP, CDC, USDA, NIH, AHA, and ADA.

RESULTS: Over one hundred peer reviewed articles were used as well as official government documents.

CONCLUSION: Current methods to assess nutritional status in the pediatric population are unsatisfactory. Several alternative methods have been proposed, all of which have strengths and weaknesses associated with them. A gold standard needs to be developed to ensure the health of future generations.