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Integrative and Functional Nutrition Practices and use of the Integrative and Functional Medical Nutrition Therapy Radial Among Registered Dietitians

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Abstract

Background: The important role nutrition plays in Integrative and Functional Medicine, along with increased enrollment rates in the Dietitians in Integrative and Functional Medicine (DIFM) dietetics practice group points to the fact that dietitians are in need of effective tools to use to guide their integrative and functional nutrition practice. The Integrative and Functional Medical Nutrition Therapy Radial was created as a conceptual framework to assist dietitians in providing personalized nutrition care. We do not know, however, what integrative dietitians are currently doing in their practice or if they are utilizing this conceptual framework. The objective of this research is to investigate the Integrative and Functional Medicine practices of Registered Dietitians as well as assess their use and perceived effectiveness of the Integrative and Functional Medical Nutrition Therapy Radial.

Methods: This is a cross-sectional study utilizing a self-administered web-based survey. Participants included Registered Dietitians belonging to the Dietitians in Integrative and Functional Medicine dietetic practice group. Statistical analysis utilized SPSS software. Analysis included descriptive statistics and X^2 analysis for independence. Qualitative responses were coded and analyzed for similarity in responses. Main outcome measures included reported functional nutrition related assessment and treatment practices, as well as familiarity with, use, and perceived effectiveness of the Integrative and Functional Medical Nutrition Therapy Radial.

Results: Two-hundred and eleven surveys were completed and analyzed. The most frequently assessed client history items included physical activity, use of

supplements, and digestive wellness. Eighty-four percent of respondents (n = 178) reported they assess client biochemical status, while only 70 participants reported providing nutrition focused physical exams for their clients. One-hundred and three participants reported having previous exposure to the IFMNT radial, of those participants, 49 had utilized it in their professional practice. The most frequently utilized areas of the radial include Lifestyle and Systems Signs and Symptoms. Participant feedback regarding the IFMNT radial indicates additional education and training is necessary.

Conclusions: Reported integrative medicine practices appear similar to those provided on the IFMNT Radial. The IFMNT Radial may provide guidance to Registered Dietitians practicing Integrative and Functional Medicine, however, education and training regarding this tool is needed.

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Introduction

Integrative and Functional Medicine is of growing interest in the healthcare field at present and the field of dietetics is no exception. Over the last century there has been a shift in the trajectory of disease, from one of infectious to that of chronic disease. Many chronic diseases have ties to lifestyle behaviors, including nutrition, and develop over a lifetime[1]. Dietitians are in a position to promote health by recommending dietary interventions that can positively impact health outcomes over the lifespan. A parallel interest has been observed in consumers for interventions which focus on the prevention and treatment of chronic disease, rather than the symptoms alone. This consumer demand has fueled an increased interest in the use of Integrative and Functional Medicine by health care professionals[1].

Many of the modalities involve nutrition, and based on increased enrollment rates (over 3,200 members) in the Academy of Nutrition and Dietetics practice group, Dietitians in Integrative and Functional Medicine (DIFM), it is clear that there is a strong interest in using Integrative and Functional Medicine modalities in dietetics practice[2]. All of this points to the fact that it is of utmost importance that dietetic professionals have the necessary tools to provide comprehensive as well as effective patient centered care. The Integrative and Functional Medical Nutritional Therapy (IFMNT) Radial is a conceptual framework for Registered Dietitians (RDs) practicing Integrative and Functional Nutrition. It was developed in 2011 by advanced-practice members of the DIFM practice group for use by dietitians in their integrative nutrition practice.

The Radial focuses on assisting the RD in providing personalized nutrition care by addressing five domains, each describing an important area of assessment in integrative and functional nutrition. Five key areas of assessment in Integrative and Functional Nutrition are included in the radial: (1) lifestyle, (2) systems, (3) biomarkers, (4) metabolic pathways and networks, and (5) core imbalances. Ideally, dietitians utilizing this conceptual framework would assess each of these five key domains with their clients to obtain a systems understanding of their health status. In addition to these five domains, the radial emphasizes putting the patient at the center of care, and recognizes the important and complex role that food plays in the maintenance of health and the development of disease characterized by core clinical imbalances. Surrounding the Radial are DNA helixes, emphasizing the role that individual genetic variations have on disease development and health, as well as other contributing factors which may precipitate disease, such as pathogens, allergens, and exposure to environmental toxins. Personalized and effective care may be provided when taking into consideration all that makes the individual patient unique.

We do not know, however, the actual extent of use of the Radial in practice. The radial is new and there is no research on its use or applicability. An understanding of RDs' uses and perceptions of the Radial will enable us to understand how current reported practices compare with those suggested in the tool. The objective of this research was therefore to assess the Integrative and Functional Medicine practices of RDs who belong to the DIFM dietetics practice

group, and to assess their awareness regarding the Integrative and Functional Medical Nutrition Therapy Radial as well as the areas of the radial that are being used by dietitians.

Literature Review

Since the middle of the last century, there has been a shift from acute or infectious to chronic disease. It is estimated that there are roughly 109 million Americans who suffer from at least one chronic disease, fueled by a rise in obesity rates and sedentary lifestyles[1]. The Center for Disease Control and Prevention estimates that roughly 70% of recorded deaths are the result of chronic disease [3]. Fifty-percent of deaths in America each year are the result of cancer, stroke, and heart disease, and almost 50% of Americans have at least one chronic illness[3].The health care costs associated with those suffering from chronic illness such as stroke, diabetes, cancer, and hypertension is roughly $277 billion annually. The focus of conventional modern medicine as is generally practiced in the United States is on addressing the symptoms but not the root cause of the disease[1]. The Academy of Nutrition and Dietetics' position paper on the role of nutrition in health promotion and chronic disease prevention states the most cost efficient and effective method of preventing chronic disease across the lifespan is through dietary and lifestyle interventions[4]. Medical Nutrition Therapy, as provided by a Registered Dietitian, is recognized as a cost effective method of health care delivery. Studies show that Medical Nutrition Therapy improves the patient's quality of life and disease related outcomes, while reducing costs associated with treatment of chronic diseases[4].

Evidence is mounting that healthy lifestyles, including optimal nutrition, can improve the length and quality of life[5]. The rising healthcare costs and the increased incidence of side effects associated with pharmaceuticals for addressing disease symptoms has resulted in much dissatisfaction for many Americans regarding their treatment. As this dissatisfaction grows, many patients have sought complementary and alternative therapies that focus on treating the root cause of their illness, not just the symptoms[5].

Complementary and Alternative Medicine

Complementary and Alternative Medicine (CAM) is defined by the National Institute of Health as medical products or practices that are not a part of standard care. Standard care is described as the practices of Medical Doctors, Doctors of Osteopathy, and allied health professionals, such as nurses and physical therapists[6]. CAM can be divided into complementary medicine, which is used in conjunction with conventional medicine, and alternative medicine which is used in place of conventional medicine. According to the 2007 National Health Interview Survey, alternative medicine is used infrequently by Americans while it is estimated that roughly 40% of American adults have used some complementary therapy within the past twelve months[7]. Frequently used CAM therapies include the use of natural products and non-vitamin, non-mineral supplements, deep breathing exercises, yoga, meditation, massage, chiropractic treatment, and diet therapies[7]. More research needs to be done with these modalities regarding their effectiveness. A number of systematic literature

reviews have shown that CAM therapies involving massage, acupuncture, yoga, and naturopathy are effective for certain conditions, such as back pain[7].

Patients may seek CAM therapies for various reasons including improvement of overall health, to relieve symptoms of chronic disease, or those associated with a terminal illness[7]. Patients shown to be more likely to seek CAM therapies include those with chronic back, neck, or joint pain, depression and/or anxiety, and those suffering from the common cold[7]. CAM therapies may be sought to aid in the relief of symptoms associated with cardiovascular disease, lung diseases and the treatment of cancers[7]. A meta-analysis investigating uses among patients with cancer showed that the uses of CAM therapies has increased over the past thirty years, and on average roughly half of those studied have used CAM[8].

Studies have been done investigating patients' expectations regarding the delivery of health care as well as CAM uses in primary health care. van de Vijver et al found that the majority of patients surveyed reported having positive attitudes toward receiving advice from the general practitioner on using CAM modalities. However, roughly a quarter of those surveyed reported not speaking previously with their general practitioner regarding CAM modalities[9]. Patients' expected that their general practitioner would "listen to them" and support them to achieve shared decision making. Participants in this study additionally expressed that they felt it is important that a general practitioner be willing to work with a CAM practitioner if the patient should so desire[9]. Patient's perceived barriers to CAM use in a primary health care setting included difficulty in finding

quality information from licensed CAM practitioners and a lack of insurance coverage for CAM modalities[9].

One author compiled a number of case studies which utilized CAM therapies and patient centered care. These studies reported that patients believed that a combination of conventional medicine and CAM is the best approach to care and that this combination provided better care than when provided independently[5]. A focus group of patients reported that they desired having a number of different valid options regarding their health care. One focus group member explained that they enjoyed "having a doctor who is aware of the bigger picture"[5]. Another focus group member reported that they "appreciated that they really cared about how I felt. I was treated with respect-like I had a brain"[5]. An additional study investigating outcomes of patient centered care found patients' responses were positive, and they were overall highly satisfied with their treatment. Over 50% of those surveyed for this study reported their care was the "best care ever" or "excellent"[10].

Uses, Attitudes, and Knowledge of Complementary and Alternative Medicine among Primary Health Care Practitioners

There has been an extensive amount of research done in health fields other than dietetics regarding practitioner attitudes, knowledge and professional uses of CAM modalities. Much of this research has been done specifically for nurses, pharmacists, and physicians. One study investigating nurses showed that of the 322 individuals surveyed, roughly 50% used some form of CAM modality in their professional practice. The same study found that roughly 60% of

the nurses surveyed had little or no knowledge of CAM but had overall positive attitudes toward it[11].

Physicians and medical students are a group studied frequently with reference to attitudes, knowledge base, and potential uses of Integrative and Function Medicine, with examples of CAM modalities[12]. One study involving pediatricians in the Netherlands showed that 56% of those surveyed had used some form of CAM, however half of those surveyed had limited knowledge regarding such therapies, although they had overall positive attitudes toward CAM[12]. In a survey given to medical students regarding their own personal uses of CAM, it was found that attitudes declined as students moved through medical school. This implies that first year medical school students had a more positive attitude toward CAM than third year medical students surveyed[13]. This may be due to changes in curriculum at the academic institution being studied, the David Geffen School of Medicine at UCLA[13]. The researchers concluded that it is important to incorporate Integrative Medicine in the medical school curriculum to ensure that interest is kept and a basic knowledge base is provided to the medical students, as patient interest in Integrative and Functional Medicine is growing[13].

Integrative and Functional Medicine

Integrative Medicine combines the best of both conventional medicine and complementary and alternative medical (CAM) practices and puts the patient at the center of care. Some of the CAM modalities that may be used as adjuncts to conventional treatments include the use of whole, minimally processed foods,

acupuncture, chiropractic treatments, massage, herbal therapies, Reiki, Traditional Chinese Medicine, and Ayurveda to name just a few[5]. The patient-practitioner relationship is emphasized in Integrative Medicine. Treatment plans are based on patient empowerment, shared decision making, and strategies to ensure patient compliance[5,14]. Integrative strategies look at the whole person, as opposed to treating a set of symptoms.

Functional Medicine is a form of Integrative Medicine[15]. It looks at health as a complex continuum and explores latent nutritional deficiencies, which give an early indication of altered physiological processes that result in core clinical imbalances. Health care practitioners in this setting strive to obtain a better understanding of the patient's genetic and biochemical uniqueness through a variety of functional tests such as genomic testing and blood chemistry analyses, and then tailor a treatment plan based on their individual genetic predispositions and lab indicators[16]. Functional Medicine practitioners recognize the dynamic role the environment plays in health and chronic disease and factor this in during assessment, diagnosis, treatment, monitoring and evaluation of patients[16]. An in-depth assessment of the individual's physiological systems is conducted to better understand underlying dysfunctions that can contribute to chronic disease. This form of medicine emphasizes the notion that chronic diseases are foreshadowed by a time of declining functional status in one or more systems of the body[17]. Recognizing the underlying root causes therefore is key to optimal health and physiological functioning. To put this medical model into practice, several tools such as the Functional Medical Matrix and Timeline have been created by the

Institute for Functional Medicine to assist the health care practitioner in soliciting and organizing a detailed assessment of the patient[16].

Research has shown that Integrative and Functional Medicine is more cost effective than conventional medicine in corporate wellness. This is achieved through a combination of decreased utilization of pharmaceutical products and medical interventions, while emphasizing the prevention of chronic disease, thereby avoiding the costs of treatment[18]. Corporate employee wellness initiatives utilizing preventative medicine and Integrative Medicine therapies have investigated the use of modalities such as dietary and exercise interventions and stress reduction, and emphasize emotional well-being[18]. *Johnson and Johnson's* health and wellness program has a focus on disease prevention, resulting in a $225 reduction per employee per year over a four year period, beginning in 1995. This reduction included fewer mental health visits as well as fewer outpatient visits[18].

Patient Centered Care

Providing Patient Centered Care (PCC) is fundamental to practicing Integrative and Functional Medicine, as many Integrative Medicine modalities are focused on the biochemical individuality and genetic uniqueness of each patient. Research on PCC has shown a wide range of benefits including increased patient satisfaction, increased physician satisfaction, improved health status, better treatment outcomes, and lower rates of malpractice[5]. PCC highlights shifting the focus from the patient's disease state to the patient as a whole. The patient plays a central role in the health care process as shared decision making

is emphasized. The patient's families are additionally encouraged to play a role in the health care process[5]. In this health care model, the patient is empowered to take an active role in their health by working collaboratively with their health care provider.

To facilitate patient empowerment, the practitioner must work to provide the knowledge necessary for the patient to feel confident in moving forward with their treatment and to take control. The practitioner must also assist the patient in developing the skills and self-awareness necessary to move forward and improve their quality of life. Evidence based on case studies and focus groups show that patients who feel empowered adhere better to treatments, have improved health outcomes, and enjoy a higher satisfaction with their care overall[5]. To implement this type of practice, the practitioner spends longer periods of time with the patient. Spending additional time with patients may be prohibitive for many practitioners. Research has shown, however, that longer patient consultations with in depth assessments may result in more empowered patients, treatment of psychosocial problems and writing fewer prescriptions[5].

The manner in which the practitioner communicates with the patient is also vital in the PCC model. Some physicians may use the mnemonic PEECE when communicating with patients, which stands for "positive prognosis, empathy, empowerment, connection, and education" [5]. Using these strategies when working with a patient helps to harbor a positive patient-practitioner relationship and has shown to influence the creation of positive behavior changes[5].Motivational interviewing may be used by some practitioners to assist

the patient in assessing the potential pros and cons of their behavior change. This puts the patient in control of the change process and helps to direct change based on their own motivations[5].

PCC additionally emphasizes having one practitioner provide care at one site throughout the disease process, as well as continuing the relationship between practitioner and patient over time. Such a continuum of care not only strengthens the practitioner patient relationship but also creates trust, thereby enhancing the patient's adherence to treatment or behavior change. PCC is not without challenges, however. Patients may not necessarily desire to continue their care with the same practitioner over time, and communication can be difficult between practitioners of different medical modalities, resulting in poor coordination of care. For example, a primary care physician and an acupuncturist are trained using different languages which can be challenging when attempting to collaborate in caring for a patient[5].

Disease Treatment with Integrative and Functional Medicine

Research has been done to assess the use of Integrative and Functional Medicine in combination with conventional medicine in the treatment of disease. One modality of Integrative and Functional Medicine used often in an effort to treat disease or illness is the use of functional foods. Functional Foods are defined as foods that may contribute benefits to health outside of basic nutrition. An example of a functional food might be oatmeal due to its fiber content and its role in heart health[19]. One prospective observational study using 12 participants assessed the effectiveness of a naturopathic diet, in addition to nutrition

education and counseling on the management of Type 2 Diabetes. A naturopathic diet in this case is described as the use of functional foods, for example low glycemic index foods such as brown rice. Results showed significant differences in blood pressure, blood glucose levels, and self-reported healthful eating patterns[20]. Other areas of health that often used diet and food as adjuvants to conventional treatments are cancer prevention and treatment, cholesterol management, obesity and weight management, and prevention/treatment of osteoporosis to name just a few areas. Many of these areas involve lifestyle modifications using food and diet and employ the use of a dietitian. This requires that the dietitian be educated and competent in the uses of functional foods as well as other integrative modalities.

The Dietitians in Integrative and Functional Medicine Dietetic Practice Group

Nutrition is an integral part for those who are interested in Integrative and Functional Medicine, as the use of functional foods, therapeutic food elimination diets, detoxification programs, and nutritional and herbal supplements are popular modalities. Due to this interest from both consumers and dietitians, a specialty group was created through the Academy of Nutrition and Dietetics, called Dietitians in Integrative and Functional Medicine. This group, originally founded in 1998, was called the Nutrition in Complementary Care Dietetic Practice Group[2]. The vision of the DIFM dietetic practice group is “to optimize health and healing through integrative and functional medicine nutrition practices” while their ultimate mission is to “empower members to be leaders in

personalized genomics, holistic care, and integrative and functional nutrition therapies"[2].

Registered Dietitian's Use, Attitudes, and Knowledge of Integrative and Functional Medicine

There has not been an extensive amount of research done regarding dietitians' knowledge, attitudes, and use of Integrative and Functional Medicine. A select number of research studies have investigated this subject on a small scale limited to specific geographic areas. However, the findings of these studies provide valuable information on the topic. One study based in the state of Massachusetts looked at the knowledge base, attitudes, and personal use of herbal supplements among dietitians. The researchers found that 73% of the survey respondents (n=160) stated that they had little or no knowledge of herbal supplements and 22% responded they had recommended the use of herbs in the past year[21].

Another study based in the state of Oregon looked at the knowledge base, attitudes toward, and uses of functional foods, nutrient supplements, and herbs among RDs. This study found that 80% of RDs surveyed (n=162) felt positively about the uses of functional foods, however only 50% of those surveyed felt positively regarding the uses of herbal supplements. According to the researchers, there was strong interest in learning more about these types of modalities[22].

A study done in 2006 aimed to find the educational needs of RDS on the topic of Nutrigenomics. The study assessed dietitians' attitudes, knowledge base,

use, and barriers to practicing nutrigenomics through a self-administered survey[23]. The researchers found that the overall attitudes toward the benefits of nutrigenomics were positive, yet there were strongly perceived barriers in practicing nutrigenomics due to a lack of knowledge[23]. As nutrigenomics is a fairly new subject, many RDs have limited knowledge on the subject and thus feel uncomfortable applying it in their professional practice. Based on the survey results, researchers concluded that there were significant educational needs and continuing education was necessary to fill these gaps[23]. More current research needs to be done to make conclusions based on updated dietetic curriculums and continuing education offerings.

Putting Integrative and Functional Medicine into Practice

Integrative practitioners solicit a detailed assessment of the patient's past health history and understand that each patient is genetically and biochemically unique. They also recognize that the biological, psychological, social and environmental circumstances of the patient can influence the development of imbalance and thus disease. Eliciting a detailed assessment enables the practitioner to understand the patient's concerns as well as their whole "story", which allows the practitioner to better understand factors that may have led to disease and what the best course of action might be to address it[24].

Integrative and Functional practitioners use the heuristic GO-TO-IT, which represents the steps of: Gather, Organize, Tell, Order, Initiate, and Track. In using these steps the practitioner first collects the patient's information by the use of detailed intake forms, patient interviews, past medical history, and a nutrition

focused physical exam[25]. The information is then organized into three categories: antecedents, triggers, and mediators. Antecedents are comprised of factors that transpired before the patient became ill. Triggers include factors from the patient's history that may have started the onset of dysfunction[26]. Mediators include factors that keep the patient in a state of dysfunction. Patient information is additionally organized on a timeline which starts at birth and continues to the present time[25]. Information that is related to when the patient felt at their best and what has changed since that time is plotted on this timeline. Next, Integrative practitioners will organize the patient's information using a Matrix which was created by the Institute for Functional Medicine[2]. The Matrix provides space to organize information in three steps: first antecedents, mediators, and triggers that contribute to the patient's health state. Second, factors related to lifestyle habits such as sleep patterns, nutrition information, exercise patterns and personal relationships that influence the patient's state of health or disease are noted[2].

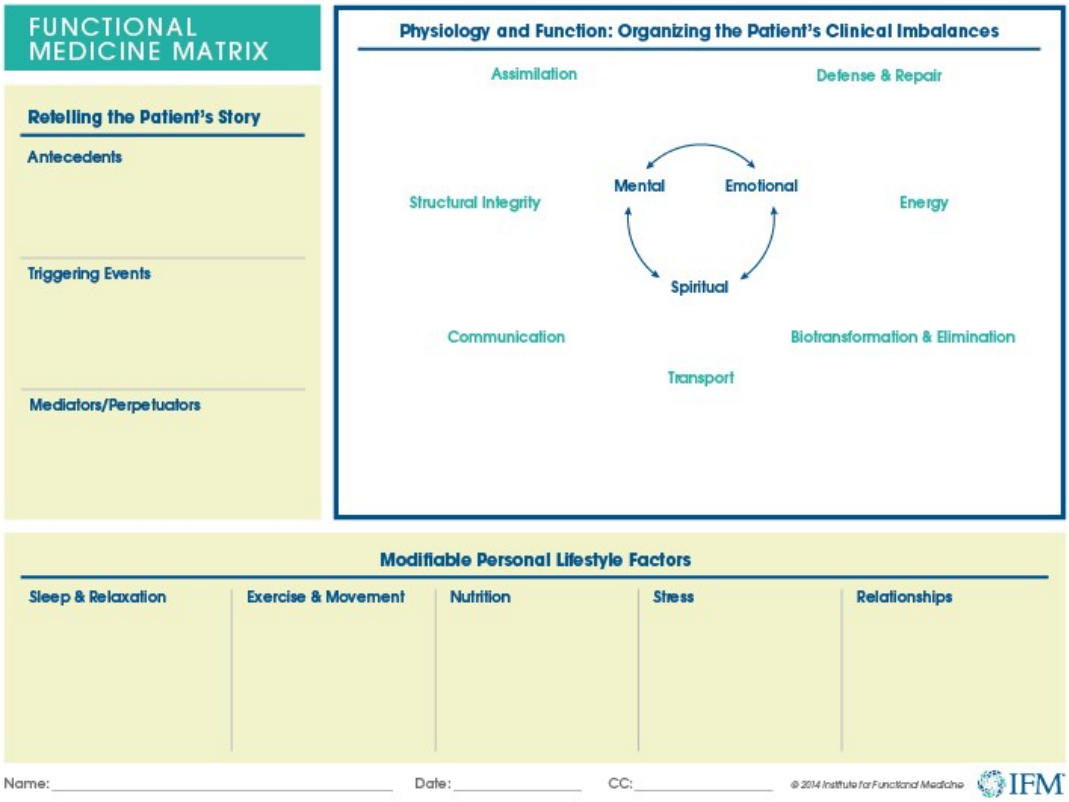

Figure 1. The Functional Medicine Matrix, reprinted with permission from the Institute of Functional Medicine.

Lastly, an assessment of core imbalances that contribute to or perpetuate the disease condition are plotted[2]. When all the information is organized on the Matrix, the practitioner is able to see the hierarchy of core imbalances resulting from altered physiological processes. This allows the practitioner to make decisions regarding further assessments as well as design interventions uniquely tailored to the individual, thus emphasizing the patient centeredness of the process[26]. Following the organization of the information, it is discussed with the patient, giving the patient opportunity to elaborate more upon their story if desired[25]. Priorities of what needs to be addressed (i.e. further testing) are determined by the identified core clinical imbalances that are plotted on the Matrix. These priorities are established through provider patient collaboration.

Interventions that are tailored to the individual patient needs are then developed, implemented, and assessed for effectiveness[25]. Tools such as GO-TO-IT and the Functional Medicine Matrix can be useful for a number of different health care fields. They can be helpful not only in organizing patient information and assisting in putting together the patient's "story", but also help the practitioner to better understand what needs further investigation[17].

Dietetics in Practice - The Nutrition Care Process and Model:

The Nutrition Care Process provides a standardized approach to implementing patient care in the field of dietetics. This process was developed with the intention of providing a framework for RDs to follow when working with patients, clients, or community groups. This process is generally used in a clinical setting but may be applicable in other settings within the nutrition field as well[27]. This model allows the RD to provide individualized care based on the patient while working through four standardized steps which include Assessment, Diagnosis, Intervention, Monitoring and Evaluation[27]. These steps are distinct, but interrelated. Accurate and thorough documentation is emphasized throughout each step of this process. The use of this process is encouraged by the Academy of Nutrition and Dietetics; it is included in the current dietetic didactic curriculum and is also supported by the Academy of Nutrition and Dietetics Evidence Analysis Library[27].

Upon conducting a thorough nutrition assessment, which will be discussed in detail later, the Registered Dietitian creates a nutrition diagnosis based on relevant nutrition related information. This nutrition diagnosis is formatted as a

problem statement in P-E-S format; P represents the problem, E represents the etiology, and S represents signs and symptoms. The nutrition intervention then is a plan which intends to carry out action that addresses the nutrition diagnosis[27]. Following the implementation of the nutrition intervention, the Registered Dietitian then will carry out the monitoring and evaluation step of the Nutrition Care Process. The purpose of this step is to reassess the patient for progress towards desired outcomes or goals[27].

The Nutrition Care Process is highlighted within the Nutrition Care Model, which is a graphic visualization of the Nutrition Care Process. At the center of this model is a circle illustrating the relationship between the patient/client/group and dietetic professional. Surrounding this inner circle are the four steps of the Nutrition Care Process, described in Figure 2[28]. There are two rings which surround the four steps of the Nutrition Care Process. The outer ring is intended to show various influences on delivery of care and how a patient would receive nutrition information. The next ring in the model is intended to illustrate the professional aspects of the dietetic practitioner that make them unique when compared to those in other health professions. This model is evidence based and has been consistently updated to reflect current practice[27].

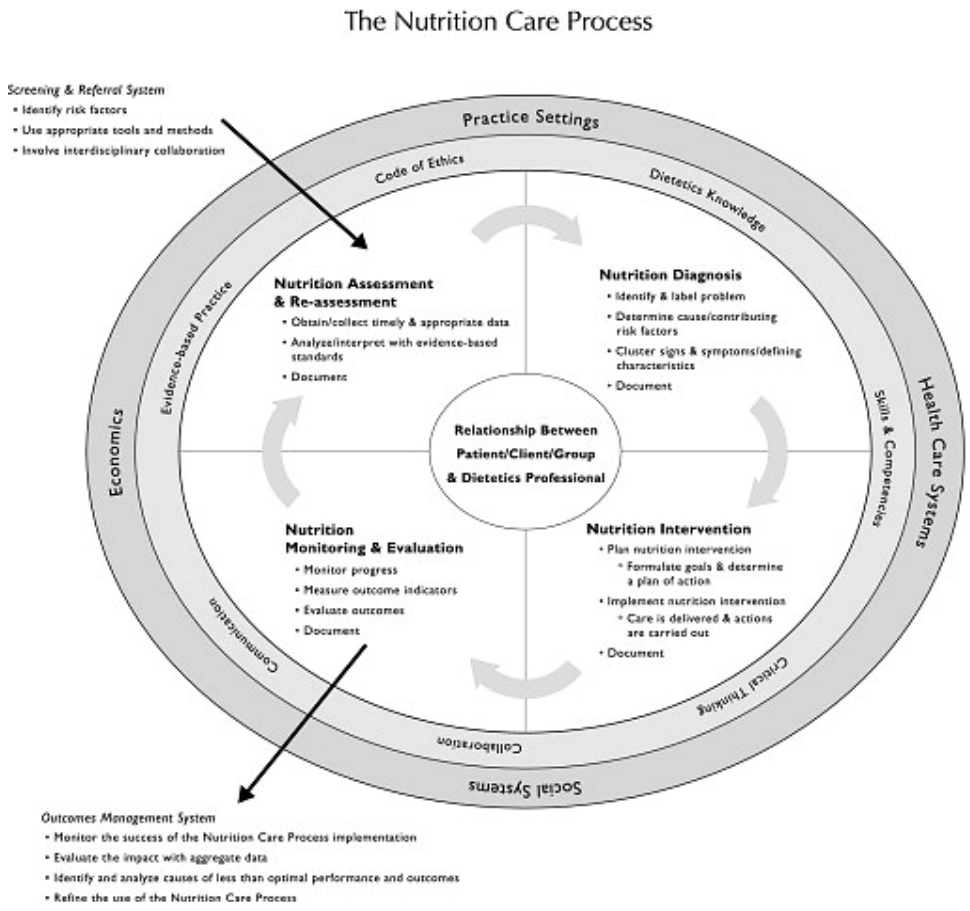

Figure 2. The Nutrition Care Process and Model

Nutrition Assessment:

Nutrition assessment is an integral component of the Nutrition Care Process. Here the nutrition professional's goal is to obtain relevant information needed to identify nutrition related issues. The process of obtaining data is ongoing throughout the entire nutrition care process, however it begins with an initial data collection[29]. Data can be organized into five categories: dietary and nutrition related history, anthropometric information, biochemical data, nutrition focused physical findings, and client history. Items that would be included into the food and nutrition related history category include "food and nutrient intake, food

and nutrient administration, medication, complementary and alternative medicine use, knowledge/beliefs, and food and supplies"[29]. This information can be collected using 24-hour food recalls, food frequency questionnaires, and 3-day food records. Anthropometric information that is often obtained includes height, weight, body mass index, weight history, waist circumference, and growth pattern indices. Results from various nutrition related laboratory tests would be organized into the Biochemical Data category. Nutrition focused physical assessment information may include swallow function, presence of muscle wasting, physical appearance, presence of swelling or edema, and skin turgor[29]. Lastly, information related to personal and social history, medical history, and familial health history would be organized into the Client History category. When appropriate, data that is collected is compared to relevant reference standards or criteria[29].

To establish consistency and safety in nutrition assessment, a standardized language has been developed which is used in practice. Nutrition assessment terminology is associated with different nutrition diagnoses. This standardized language supports communication between health professionals. It also assists the nutrition professional in developing problem statements based on consistency with the Nutrition Care Process[29]. Although this language was created for the purpose of consistency and safety, it may be limiting when working with patients or clients while practicing integrative and functional nutrition, as often times more personalized and in depth assessment, diagnosis, intervention, monitoring and evaluation techniques would not be included in this

defined language. Additionally, much of the nutritional issues that are managed with this process are already problems which may have had significant influence on health and disease outcome.

Personalized Nutrition:

The concept of personalized nutrition was first interpreted based on developing a diet based on the specific needs and desires of the individual[31]. Personalized nutrition has now been further developed based on the idea that the genetic and biochemical make-up of an individual affects the way nutrition influences their health or disease state[32]. Today's technology allows us to identify genetic differences such as single nucleotide polymorphisms, which influence different metabolic processes in the body, thus impacting the biochemical and genetic uniqueness of the individual and consequently their nutrient requirements. This may be assessed through Nutrigenomic testing and appropriate functional biochemical testing. There are companies which manufacture DNA-based tests that a consumer can purchase, provide the necessary sample, and send back to receive results regarding their genetic make-up and disease risks. An example of a business which specialized in functional lab testing is Metametrix Clinical Laboratory. The list of laboratory tests which may be ordered here are extensive, however some include amino acid profiles, fatty acid profiles, fat soluble vitamin profiles, and a comprehensive profile of the GI system[33]. Some companies will additionally provide nutrition recommendations based on the client's results[34]. The Registered Dietitian who practices Integrative and Functional Medical Nutrition Therapy can tailor an

intervention based on the client's unique genetic and biochemical make-up, and thereby create an intervention based upon what is needed and not currently available, as well as what is not needed and needs to be eliminated from the body[32]. The ultimate goal of personalized nutrition is to optimize individual wellness[32,34].

An important aspect to personalized nutrition is understanding how consumers perceive its usefulness, benefits, and risks. A survey of Americans showed that people felt positively towards Nutrigenomic testing and personalized nutrition as long as the obtained information was being used to provide individually-tailored disease prevention strategies[34]. Research has also shown that when health related information is tailored to the individual's needs, patients are more receptive to the information and more likely to follow through with changing behavior[35].

Nutrigenomics and personalized nutrition are not topics without controversy, however. Issues may arise regarding the privacy of the genetic information and who may have access to the results, for example, insurance companies[36]. Additional concerns include the versatilities in interpretation of laboratory results. For example, a patient may discover they are not genetically predisposed to cardiovascular disease, and as a result begin to consume a diet which is greater than the recommendations for saturated fat, trans-fat, cholesterol, and so on. Although this patient is not genetically predisposed to heart disease, the patient may still develop disease due to diet[36].

The Integrative and Functional Medical Nutritional Therapy Radial:

To ensure that Integrative and Functional Medical Nutrition Therapy practices are within the scope of dietetics, a set of standards were created by this practice group. The standards of practice and standards of professional performance (SOP, SOPP) address patient centered care as well as the four steps in the Nutrition Care Process: assessment, diagnosis, intervention, monitoring and evaluation[2]. The IFMNT Radial is a conceptual framework based on the traditional Nutrition Care Process model that is expected to help the dietitian work through the typical steps of Assessment, Diagnosis, Intervention, Monitoring, and Evaluation. The Radial focuses on putting the individual at the center of care, and emphasizes the vital role that food plays on health[12]. The circular architecture allows the integrative RD to evaluate complex interactions and interrelationships among the five key areas of Integrative and Functional Medical Nutritional Therapy[2]. These five key areas include lifestyle, systems signs and symptoms, biomarkers, metabolic pathways and networks, and core imbalances.

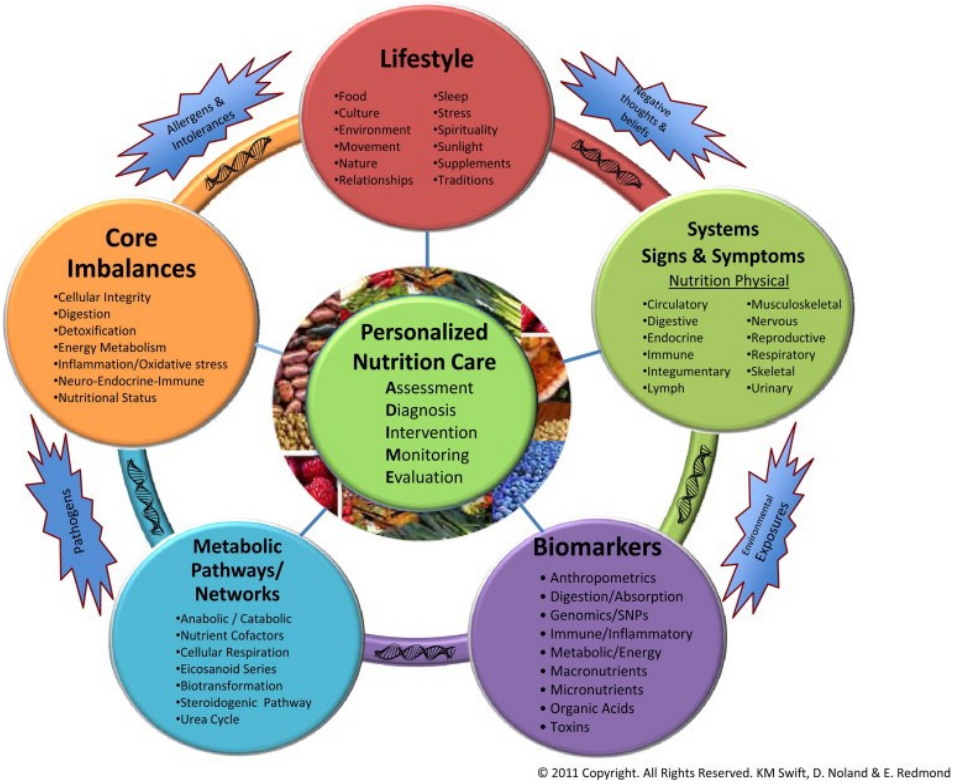

Figure 3. Integrative and Functional Medical Nutrition Therapy (IFMNT) Radial. Reprinted with permission from Kathie Madonna Swift, MS, RD, LDN; Diana Noland, MPH, RD; and Elizabeth Redmond, PhD, MMSc, RD, LD.

The radial is intended to be used as a road map for providing a comprehensive nutrition assessment by first investigating the individual's lifestyle. Information regarding the patient's stress levels, dietary habits, cultural needs, and sleep patterns, to name a few items. The systems portion of the radial focuses on an assessment of each of the body systems, such as circulatory, digestive, and endocrine. This portion of the radial is designed to use a thorough nutrition focused physical exam to identify physical signs of nutrition related problems[2]. For example, unintended weight loss and weight gain will be assessed along with changes in body composition. Hand grip strength tests are

performed if there is suspicion of malnutrition and muscle wasting [37]. Oral health will also be investigated as many times certain nutrient deficiencies can cause symptoms related to health of the oral cavity. In addition, many inflammatory processes have their beginnings in the oral cavity. Some symptoms include cracked corners of the mouth, swollen tongue, mouth sores, and bleeding gums[37]. An assessment tool that the dietitian will often use is the pitting test, which is utilized to detect and show the severity of edema. Assessing the patient's skin for pigment changes can provide important information regarding the nutritional status of the patient[37]. Assessing the patient's hair can also be a useful tool when doing a nutrition focused physical assessment as it can show signs of macro- and micronutrient deficiencies or excess.

The next circle of the radial investigates biomarkers. Here the dietitian may use information from a series of functional laboratory assessments that provide information on the client's genomic background, their organic acid profile, and their energy and metabolic efficiency. Biomarkers are intended to elaborate upon the abnormalities found in the nutrition focused physical exam administered earlier [2]. Some of the methods that are used for biochemical assessment include enzyme stimulation assays which were created to show clear indications of nutrient needs[38]. This type of test works by adding a large amount of a vitamin to an enzyme that is dependent on that vitamin as a cofactor. The utilization of this test, for example, can be seen with erythrocyte transketolase activity. This enzyme is dependent upon thiamin pyrophosphate (TPP). The enzyme activity is

first measured without any added cofactor, and then measured again after a large dose of TPP (in this case) is administered[33].

Nutrient concentrations and biochemical markers may be assessed by direct measurement of nutrients in the blood[38]. Load Tests or Saturation Measures are tests that measure how well the body absorbs a nutrient load may be used. If the body acts similarly to a sponge, soaking in the entire nutrient load, and excreting very little then we know the body was previously depleted of this nutrient[38]. To assess disease states related to immune function and allergic response, the dietitian will analyze laboratory results related to immunological markers such as Immunoglobulin G, Immunoglubulin E, and Immunoglobulin A[38]. These immunological tests play a vital role in the detection of food allergies and provide dietitians with opportunities to help mitigate the response through diet[26].

Stool analyses are often done because of the valuable information that they provide regarding gut heath and the balance of gut ecology, the efficiency of the digestive tract, and the presence of an inflammatory condition, gut permeability issues, and toxic metabolites[38]. As discussed, another series of tests that may be performed is a nutrigenomic screening. Tests may be done to assess the presence of mutations and single nucleotide polymorphisms (SNPs). The dietitian plays an important role in drawing relationships between detected SNPs and mutations, as they influence and can be influenced by nutrient needs[38].

The next sphere of the radial focuses on the efficiency of the client's metabolic pathways. Examples of pathways that should be assessed are the

anabolic and catabolic pathways, cellular respiration, the urea cycle, and biotransformation. The information gathered here enables the evaluation of appropriate micronutrient cofactors, enzymes, and hormones that drive key metabolic pathways[2]. Lastly, the dietitian organizes all of the information collected from the previous spheres to see the broader picture regarding the client's health (i.e. nutrition status, inflammatory responses, cellular integrity) using the sphere titled core clinical imbalances[2].

Connecting the circles of the radial are bands which show images of DNA helixes, suggesting that the individual's state of health or disease is influenced by his or her genetic makeup and predispositions[2]. Surrounding the radial are precipitating factors such as allergens and intolerances, negative thoughts and beliefs, environmental exposures, and pathogens, and are thought to influence the health and well-being of the client[2]. These precipitating factors can be summed into the "total load", which describes the total of all exposures that have an effect on human physiology[26]. Research done with patients who have chemical sensitivities showed that these patients had a number of nutritional irregularities and required supplementation. Chemical sensitivities can be defined as adverse reactions to toxic chemicals that can be found in the environment: air, water and food[39].

Utilizing these key area of the Radial, and having a thorough understanding of all that may influence the client's health, and lead to eventual imbalance and disease allows the Registered Dietitian to provide the most effective patient centered care possible. However, although the conceptual

framework of the radial is ideal and important, there is no evidence to indicate its current use and applicability.

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Introduction

Since the middle of the last century, there has been a shift in disease trajectory from one of infectious to that of chronic disease. It is estimated that there are over 100 million Americans who suffer from at least one chronic disease, fueled by a rise in obesity rates and sedentary lifestyles [1]. The Center for Disease Control and Prevention estimates that roughly 70% of recorded deaths result from chronic disease[2].The health care costs associated with those suffering from chronic illness such as stroke, diabetes, cancer, and hypertension is roughly $277 billion annually. The focus of conventional medicine is typically on addressing the symptoms but not identifying and finding a solution to the root causes of the disease[1]. The rising healthcare costs and the increased incidence of side effects associated with pharmaceuticals for addressing disease symptoms has resulted in much dissatisfaction for many Americans regarding their treatment. As this dissatisfaction grows, many patients have sought complementary and alternative therapies that focus on identifying and treating the root cause of their illness, not just the symptoms[3].

Over the last three decades, advances in the systems biology approach to chronic disease have resulted in the realization that chronic diseases are diet and lifestyle related[4]. There is a growing recognition that the majority of chronic diseases result from underlying physio-metabolic challenges of oxidative stress and inflammation, coupled with an inefficient immune system. Consequently, one imbalance such as poor detoxification capacity can result in a number of diseases (e.g. cancer), and the presence of a chronic disease such as diabetes

may harbor a number of physiological and metabolic imbalances such as inflammation and oxidative stress[4]. In order to deal with the complex etiology of chronic diseases, health care practitioners require special skills such as critical thinking and pattern recognition to identify and understand these underlying dysfunctions when working with patients.

Integrative and Functional Medicine focuses on the functionality of physiological systems and assessment of subtle biochemical changes that occur in the continuum, from optimal health to disease. An individual's health and susceptibility to disease are assessed through organizing patient information into Antecedents, or predisposing factors; Triggers, or factors that initiate the development of disease; and Mediators, or factors that perpetuate symptoms of the disease[5]. Antecedents, Triggers, and Mediators (ATMs) identify the root causes and primary dysfunction that contribute to core clinical imbalances in the body's seven physiological systems. Clinical imbalances are the result of interactions between environmental triggers e.g. toxins, allergens, microbes, stress and poor diet, with individual genetic predispositions[4]. Using the systems biology approach and the capabilities of the "omic "sciences, such as nutrigenomics and metabolomics, genetic predispositions and aberrations are assessed using a variety of biomarkers in physiological systems, as well as using a variety of functional diagnostic protocols[6]. The latter is supplemented by a comprehensive physical and lifestyle assessment, that enables the Integrative and Functional Registered Dietitian to answer two questions: (1) Is there a need to get rid of a factor in the environment that is an impediment to the patient's

health and (2) Is there something missing for optimal functioning in this patient, for example, nutrition, light, air, water, sleep, activity, or relaxation. Addressing these two questions enables the restoration of balance in each system and consequently optimal health[4].

Functional Nutrition is the cornerstone in the Functional Medicine approach to chronic disease prevention. It is an enhancement of the conventional Nutrition Care Process, representing an advanced practice of the steps of Assessment, Diagnosis, Intervention, Monitoring, and Evaluation (ADIME)[7]. Dietetic professionals belonging to the Dietitians in Integrative and Functional Medicine (DIFM) dietetic practice group of the Academy of Nutrition and Dietetics, may practice this discipline of Functional Nutrition. Three advanced practice members of this group took the lead in the development of a conceptual assessment framework called the Integrative and Functional Medical Nutrition Therapy Radial (IFMNT Radial) for Registered Dietitians (RDs) practicing Integrative and Functional Nutrition. This tool was introduced in 2011 in the *American Dietetic Association: Standards of practice and standards of professional performance for registered dietitians (competent, proficient, and expert) in integrative and functional medicine practice* paper[7].

The Radial was designed to assist the IFMNT Registered Dietitian in providing personalized nutrition care by addressing five domains, each describing an important area of assessment in integrative and functional nutrition[7]. The domains include lifestyle, systems signs and symptoms, biomarkers, metabolic pathways and networks, and core imbalances. Ideally,

RDs utilizing this framework would assess their clients in each of these five key domains to obtain a systems understanding of their health status. In addition to these five domains, the radial emphasizes the important and complex role that food plays on health and development of imbalance. Also emphasized in the Radial's framework is the role that individual genetic variations, pathogens, allergens, and exposure to environmental toxins play in disease development and health[7]. Personalized and effective care is possible when all that makes the individual patient unique is taken into consideration.

Although the Radial was designed as a road map for the RD in the assessment and diagnosis realms of the Nutrition Care Process, there is no information available on the Radial's appropriateness or perceived usefulness at this time. This study was therefore designed to examine the Integrative and Functional Medicine practices of RDs who belong to the DIFM dietetics practice group, in an effort to gauge their familiarity with, use, and perceived effectiveness of the Radial.

Methods

Survey Development and Administration

This cross-sectional study utilized a self-administered web-based Qualtrics survey (see Appendix A). Participants were asked both open-ended and closed questions to provide a more holistic understanding of their perspectives regarding the radial. This survey was face validated by three RDs who are advanced practitioners of Integrative and Functional Medicine, and who were instrumental in the development of the IFMNT Radial. Institutional Review

Board approval was obtained for research on human subjects through Syracuse University. Prior to beginning the survey, participants were provided with a consent form which detailed the purpose of the study, risks involved with participation, and provided the contact information for the primary investigators.

The survey instrument included demographic questions related to the professional background of the participants, number of years in dietetic practice, number of years devoted to practicing Integrative and Functional Nutrition, and the type of training received in Integrative and Functional Nutrition. Nutrition assessment methods were investigated in the areas of biochemical testing, nutrition focused physical exams, as well as client history. In addition, questions on gut dysbiosis and adverse food reactions were included because of the integral role that the digestive and immune systems play on overall health and chronic disease development. Information was also gathered on participants' awareness, use, and perceived educational needs in relation to the IFMNT Radial.

Members of the DIFM practice group who had the RD credential were invited to participate in this study. The DIFM practice group e-mail listserv was used for sample recruitment. A description of the research as well as a link to the survey on Qualtrics was provided, utilizing the anonymous administration mode. Directions on filling out the survey, an estimate of the time required, contact information for the primary investigator, and a final note thanking the participants were included in the e-mail. The survey was distributed for a three week period, beginning in January, 2014. A reminder e-mail was sent to participants two

weeks after the initial recruitment e-mail, and the survey was closed one week from that point.

Data Analysis

Data collected were statistically analyzed using the SPSS statistical package (version 21.0)[8]. Incomplete survey responses were excluded from analysis. Descriptive statistics and frequencies were determined and used to summarize and evaluate the data. The data were further analyzed using X^2 tests for independence, where variables were tested for a significant association with the following categorical variables: *percentage of professional practice that is devoted to providing Integrative and Functional Medical therapies, exposure to and familiarity with the IFMNT Radial.*

Independent variables analyzed include *number of years practicing Integrative and Functional Medicine, years practicing as a Registered Dietitian, and primary dietetic practice area.* Dependent variables assessed utilizing a Likert Scale for frequency included: *client history assessment techniques, nutrition focused physical exam practices, biochemical status assessment techniques, assessment and treatment of gut dysbiosis and adverse food reactions, previous exposure to the IFMNT Radial, previous use of the IFMNT Radial, and the utilization of individual domains of the IFMNT Radial in client assessment*. Categorical independent variables that were analyzed, but not reported due to lack of significant findings included: *training in Integrative and Functional Nutrition, and state affiliate membership*. Qualitative responses were coded and analyzed for meaningful themes. Key words and phrases were first

identified within the participant responses. Responses containing the same key words and phrases were grouped together to form concepts, and these larger groups were analyzed for themes and described in tables.

Results

Participants

The survey was e-mailed to 2,708 individuals. Two-hundred-and-seventy-three individuals initiated the survey for a response rate of 10%. One-hundred-and-ninety-one participants completed all of the survey's questions while 211 participants completed at least 90% of the survey. Due to a large number of non-finishing participants, analysis was done to investigate demographic information of those who did not complete the study. The demographic information for those who did not complete the survey is included in Table 1. "I do not practice Integrative and Functional Medicine" was most frequently reported by these participants, followed by those who reported practicing for 1-4 years.

Table 1: Demographic information for those who did not complete the survey

	Years as an RD		Years Practicing Integrative and Functional Medicine	
	n	%	*n*	%
I do not practice Integrative and Functional Medicine	-	-	14	33.3%
>1 year	3	7.1%	5	11.9%
1-4 years	6	14.3%	12	28.6%
5-9 years	7	16.7%	6	14.3%
10-14 years	5	11.9%	2	4.8%
15-24 years	9	21.4%	2	4.8%
25-34 years	8	19%	0	0.0%
>35 years	4	9.5%	1	2.4%
Primary Dietetic Practice Area				
	n		%	
Acute Care, Inpatient	7		17.1%	
Ambulatory, Outpatient Care	9		22%	
Rehab Facility	1		2.4%	
Long Term/Extended Care	2		4.9%	
Community/Public Health Program	3		7.3%	
Food Service Management	1		2.4%	
Private Practice	7		17.1%	
College/University Faculty	2		4.9%	
Integrative Medical Practice	3		7.3%	
Other	6		14.6%	

Two-hundred-and-eleven responses were analyzed. Seven percent (n = 15) had worked as an RD for >35 years, 20.4% (n = 43) for 25-34 years, 20.4% (n = 43) for 15-24 years, 9% (n = 19) for 10-14 years, 33.6% (n = 71) for 1-9 years, and 9.5% (n = 20) of respondents for <1 year. Twenty-eight percent of respondents worked in private practice, while 19.4% worked in ambulatory/outpatient care. Sixty-one percent of participants who devoted more than 75% of their dietetic practice to IFMNT worked in private practice. Additional demographic information is provided in Figure 1.

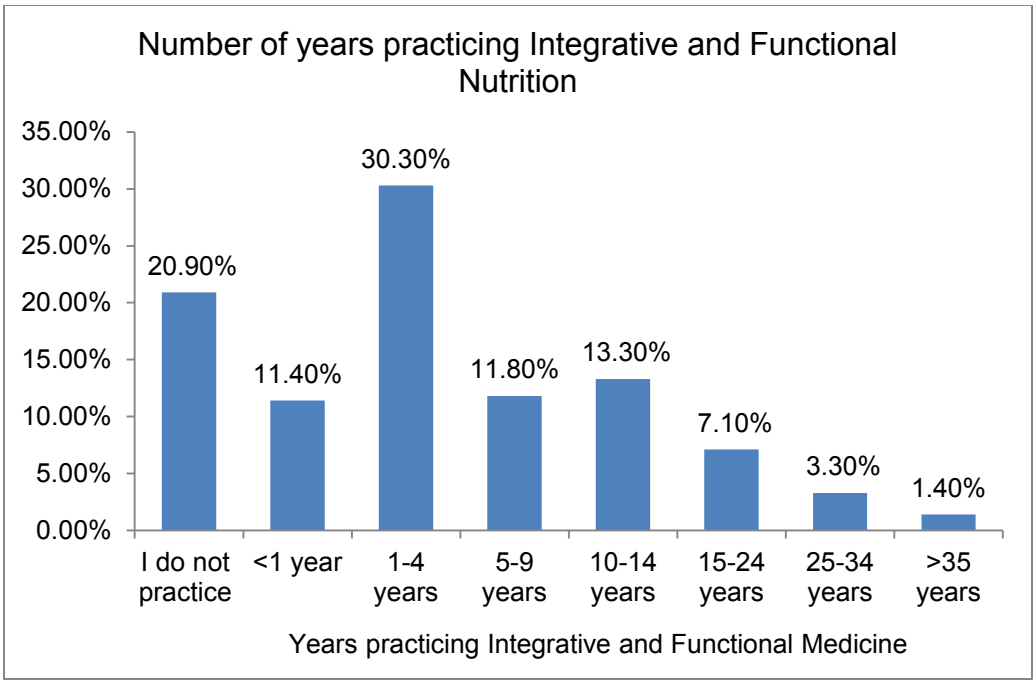

Figure 1 - Participant reports of years practicing Integrative and Functional Medicine

Integrative and Functional Medical Nutrition Therapy Radial

Forty-nine percent (n=103) of respondents reported having seen the IFMNT Radial previously. Forty-nine of these respondents (47%) reported having used the IFMNT Radial in their professional practice at some point in the past. Of these 49 respondents, 41 participants reported using the lifestyle domain for assessment. The systems signs and symptoms domain of the Radial was used by 38 participants every time, while the biomarkers domain was used by 21 participants every time. The core imbalances were used by 21 participants every time, while the metabolic pathways/networks portion was the least frequently used domain, with only 17 participants reporting using it every time.

Cross tabulations were used to explore the relationships between previous exposure to the IFMNT Radial and percentage of professional practice devoted to IFMNT. Exposure to the Radial appeared to be similar across the five groups

analyzed, although, those with more than 75% of their practice devoted to IFMNT had a slightly larger percent of Radial exposure. These results are summarized in Figure 2. Although Chi square tests showed no significant association between devoting a larger percentage of professional practice to IFMNT and previous exposure to the IFMNT Radial ($p = 0.576$); a significant association was seen between the percentage of professional practice devoted to IFMNT and having previously used the Radial ($n = 102$, $p = 0.022$). The number of participants who reported using the Radial tended to increase as percentage of professional IFMNT practice increased. This relationship is shown in Table 1 of Appendix B.

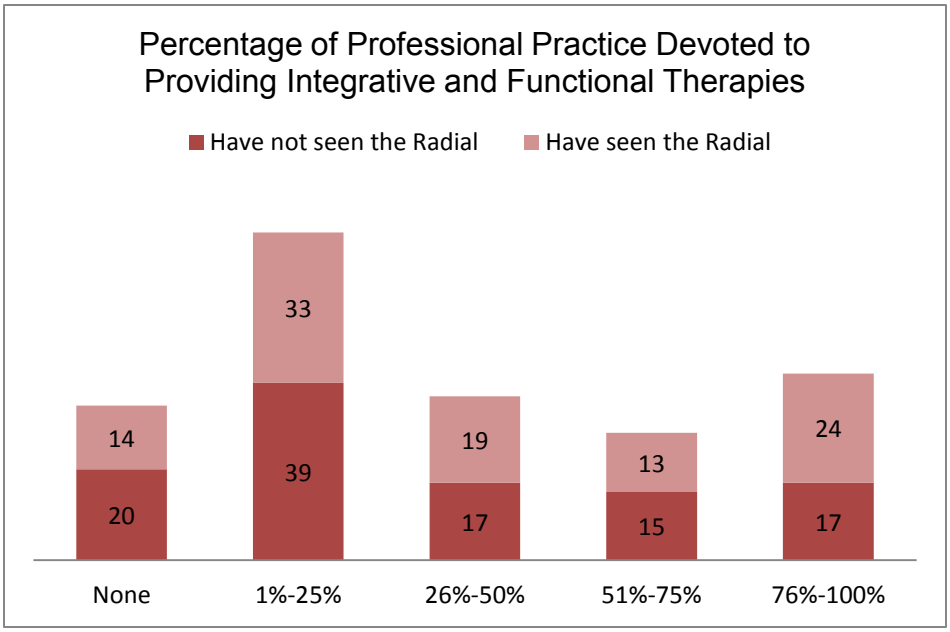

Figure 2 - Cross-tabulation investigating percentage of professional practice devoted to Integrative and Functional Nutrition and previous exposure to the IFMNT Radial.

Client History Assessment

Physical activity was most frequently assessed in this domain. Nearly 82% of respondents reported assessing physical activity every time they saw their clients; 85% assessed client's use of supplements every time; and 72.5% of

respondents assessed their client's digestive health every time. Nearly 15% and 19% of participants reported assessing for spirituality and exposure to environmental pollutants and toxins respectively every time.

Cross-tabulations investigating the relationships between percentages of professional practice devoted to IFMNT and client history assessment are summarized in Table 2 of Appendix B. Those who dedicated more of their practice (>75%) to IFMNT reported assessing for factors such as spirituality (n = 13), sleep (n = 35) and environmental toxin exposure (n = 25) with increased frequency. Conversely, those who did not practice IFMNT more frequently reported never assessing these factors (n = 22; n = 9; n = 22 respectively).

Further, those who previously used the Radial reported regularly assessing sleep patterns (n = 34), stress (n = 40), environment/toxin exposure (n = 18), and exposure to sunlight (n = 22) every time. Participants who reported not using the Radial did not assess these factors (n = 4; n = 2; n = 17; n = 15 respectively). These relationships are summarized in Table 3 of Appendix B.

Nutrition Focused Physical Practices

Seventy respondents out of 211 reported performing the nutrition focused physical assessment. Sixty-seven percent (n = 144) of respondents reported they did not provide nutrition focused physical exams. Participants reported frequent assessments for client's distribution of fat (71%, every time), presence of wasting (68%, every time), presence of edema (63% every time), and the health of the client's skin, hair, and nails (63% every time). Photophobia was the least frequently assessed item as reported by 16% (n = 11) of respondents.

Chi square tests for independence were done to investigate the association between percentage of professional practice devoted to IFMNT and nutrition focused physical exams (Table 4 of Appendix B). Respondents with the largest percentage (>75%) of their practice devoted to IFMNT reported assessing skin, hair, and nail health every time with the greatest frequency (n = 21) (see Table 5 of Appendix B). Chi-square tests investigating the associations between previous use of the Radial and nutrition focused physical assessment methods are provided in Table 6 in Appendix B. An increase in assessment of hyperkeratosis was found with those who have utilized the Radial in the past (n = 12). No other significant associations were found between nutrition focused physical practices and previous use of the Radial.

Biochemical Status Assessment

Eighty-four percent (n=178) of respondents reported that they assessed their client's biochemical status. Frequency of tools and criteria used to assess biochemical status are reported in Table 2. Chi square tests investigating associations between previous use of the Radial and biochemical status assessment are reported in Table 6 of Appendix B. Chi square tests were also done to investigate the association between percentage of professional practice that is devoted to IFMNT and biochemical status assessment. Results showed a significant association between percentage of professional practice devoted to IFMNT and the assessment of toxins (n = 177, p = <0.0001), hormonal imbalances (n = 178, p = <0.0001), and assessment of genomic information/SNPs (n = 178, p = <0.0001). Results are summarized and presented

in Table 4 of Appendix B. Those who reported devoting either none or less than 25% of their practice to IFMNT most often reported not assessing for toxins (none, n = 24; <25%, n = 46) or genetic predispositions (none, n= 23; <25% n = 51). However those who reported more than 75% of their practice was devoted to IFMNT reported regularly assessing for all factors with the greatest frequency.

Table 2 - Frequencies of assessment methods of those who reported assessing their client's biochemical status (n = 178)

Biochemical Status Assessment			
		n	%
Obtained information regarding:			
Micronutrient Status			
	Never	9	5.10%
	Sometimes	112	63.30%
	Every time	56	31.60%
Macronutrient Status			
	Never	14	7.90%
	Sometimes	75	42.10%
	Every time	89	50%
Genomic Information/SNPs			
	Never	126	70.80%
	Sometimes	49	27.50%
	Every time	3	1.70%
Toxins			
	Never	104	58.80%
	Sometimes	63	35.60%
	Every time	10	5.60%
Hormonal Imbalances			
	Never	66	37.10%
	Sometimes	95	53.40%
	Every time	17	9.60%
Utilization of biochemical assessment tools			
Stool Sample Analysis			
	Never	117	65.70%
	Sometimes	56	31.50%
	Every time	5	2.80%
Enzyme Stimulation Assays			
	Never	143	80.80%
	Sometimes	32	18.10%
	Every time	2	1.10%
Nutrient Loading Tests			
	Never	140	79.10%
	Sometimes	32	18.10%
	Every time	5	2.80%
Challenge Tests			
	Never	109	61.60%
	Sometimes	65	36.70%
	Every time	3	1.70%
Nutrigenomic Screenings			
	Never	142	79.80%
	Sometimes	32	18%
	Every time	4	2.20%
Static Tests			
	Never	139	79%
	Sometimes	28	15.90%
	Every time	9	5.10%

Gut Dysbiosis

Only 8% (n = 16) reported always assessing their clients for gut dysbiosis (Fig. 3). Nearly 6 %, 35% and 58.6% reported using stool sample assessments for gut dysbiosis always, sometimes and never respectively. Urinary sample analysis was used by 3.6% always and 32.4% sometimes, while 64% reported never using this analysis.

Of those who responded they assess their patients for gut dysbiosis, the most frequently utilized treatments were the supplementation with probiotics (43% every time, 56.4% sometimes, 0.7% never) followed by elimination diets (23.7% every time, 61.9% sometimes, 14.4% never), nutrient supplementation (22.9% every time, 66.2% sometimes, 10.7% never), and low carbohydrate diets (18.7% always, 57.6% sometimes, 23.7% never). The least frequently used treatment protocol was the replenishment of digestive factors and enzymes; 18.5% reported using this treatment every time, 54.1% sometimes and 27.4% never.

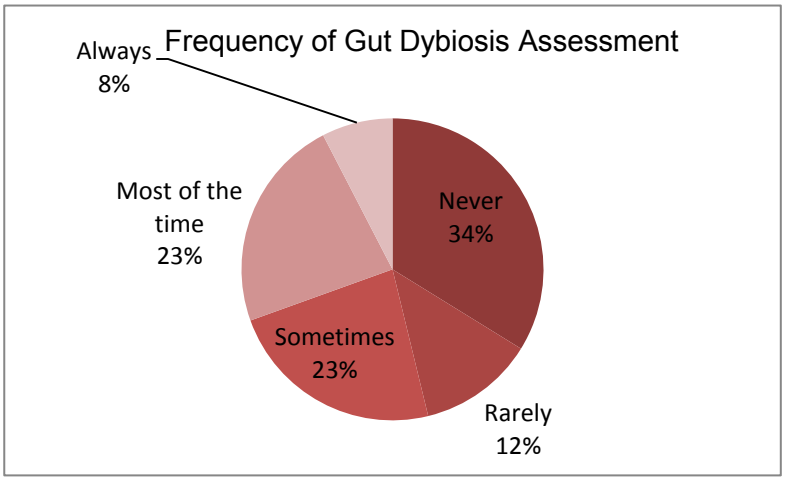

Figure 3 - Frequency of gut dysbiosis assessment for all participants (n = 210)

Chi-square tests investigating associations between percent of professional practice devoted to IFMNT and the assessment and treatment methods for gut dysbiosis are provided in Table 4 of Appendix B. The majority (62.5%) of those who reported always assessing their clients for gut dysbiosis (n = 16) were those who devoted over 75% of their practice to providing Integrative and Functional Therapies. Participants who reported they did not practice IFMNT reported never assessing their clients for gut dysbiosis (see Table 7 of Appendix B). Further, among participants who had used the radial previously, 8 and 30 participants respectively reported using low carbohydrate diets for gut dysbiosis every time and sometimes compared with participants who had not used the Radial (see Table 8 of Appendix B).

Food Allergies/Intolerances

The frequency with which participants assessed their clients for adverse food reactions are reported in Figure 4. Those who assessed for adverse food reactions most frequently utilized IgG antibody tests (50.8% never, 44.7% sometimes, 4.5% every time) and IgE antibody tests (52% never, 45% sometimes, 3% every time).

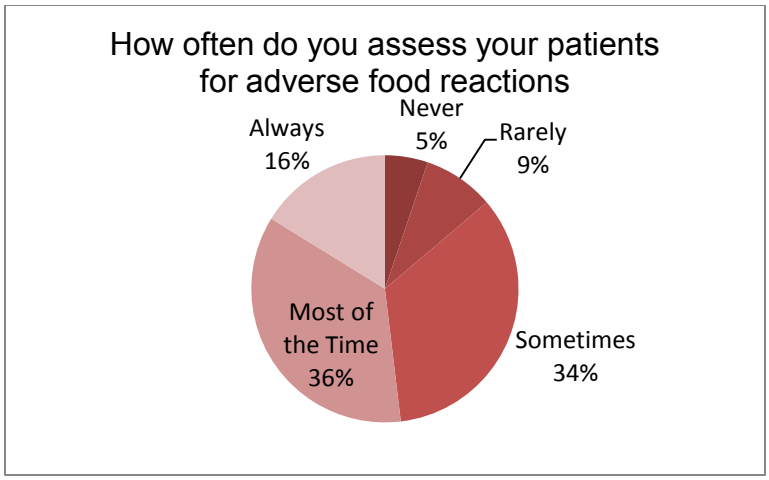

Figure 4: Participant's reported frequency for assessment of adverse food reactions.

Thirty percent and 53% reported coordinating care with other health professionals every time and sometimes, respectively. Nearly 26% of participants indicated using therapeutic elimination diets every time for treatment, while 64% of participants reported using them sometimes. Those who reported previous Radial use (n = 49) reported coordinating care with other health professionals with greater frequency (every time, n = 19; sometimes, n = 18). Those who had not previously used the Radial (n = 54) reported that they sometimes coordinated care (n = 35). A summary of these cross-tabulations are reported in Table 8 of Appendix B.

Need for training with IFMNT Radial

Participants' qualitative responses were coded and analyzed for meaningful themes. Seventy-nine participants responded to the open-ended question investigating possible alterations that may be made to the Radial so that it may be a more effective tool for practical use. Themes and participant's response examples are provided in Table 3.

Table 3: Qualitative responses regarding participant's needs and perceived effectiveness of the IFMNT Radial

	Description	Examples
1	More training/education needed	• "Have a training webinar on the radial." • "RDNs need more training in this approach. It should be included in nutrition coursework." • "More education to use it and apply it in different populations and settings"
2	Simply for easier use	• "It is too busy. Less words would make it easier to follow." • "Make less wordy." • "Simplify"
3	More exposure needed	• "Be more exposed to this tool." • "First we need to know it exists, how to access it and how to use it." • "I'm not familiar with the tool, RDNs need more exposure to it."

Discussion

The Integrative and Functional Medical Nutritional Therapy (IFMNT) Radial was developed in 2011 by advanced-practice members of the DIFM practice group[7]. This tool was designed for use by RDs in their integrative practice so as to allow for a holistic as well as in depth assessment of complex interactions between the individual, their genetic makeup, and the environment. The Radial is a road map of the personalized Nutrition Care Process. Food occupies the central core of the Radial indicating its dual role in maintaining homeostasis. Food can influence and be influenced by the other areas of the Radial such as genes, lifestyle, and the environment[9].

The Radial is an emerging tool for practice, yet little information exists on its applicability and use. Therefore**,** this cross-sectional study was conducted to examine the perceptions, uses, and awareness of DIFM RDs regarding this tool. Current assessment practices varied based on the extent to which the participant's professional practice was devoted to IFMNT. As the focus of their

Integrative and Functional Nutrition practice increased, participants reported performing more detailed assessments of lifestyle, biochemical/genetic tests, while also consistently providing nutrition focused physical exams. Some of the most frequently reported items which were assessed across all groups were those that are typically assessed by a traditional RD, such as physical activity habits and use of dietary supplements. Assessment of these lifestyle related items is still essential, however, as both have tremendous influence on health and nutrition status. It is well known that regular physical activity reduces the incidence of nutrition and lifestyle related illnesses such as diabetes and cardiovascular disease and contributes to successful weight management[10]. Supplement use among patients must be assessed due to the known array of interactions that supplements have with both food and medications[11]. Additionally, individuals who have taken dietary supplements for an extended period of time have been shown to have reduced levels of chronic disease related markers and optimal levels of serum nutrient concentrations[11].

Participants who reported using the Radial provided a more detailed assessment of client history as well as in depth assessments of biomarkers and genetic information. Based on this information it can be concluded that exposure to the radial as well as focus area of practice were important factors that determined the use of the Radial. Future widespread exposure to the Radial by increasing its visibility will certainly ensure extensive use of this tool for conducting in-depth assessments.

Of the 3 assessment methods analyzed, biochemical status assessment was found to be used with the least consistency. This may be due to a number of reasons, such as lack of knowledge of the array of tests available, lack of access to testing, ability to interpret the results, lack of knowledge regarding standards for comparison, questions related to specificity and sensitivity of tests, and added costs to order and analyze results. Dietetic practitioners may be limited within their scope of practice to order additional laboratory tests, depending on the state in which they practice. RDs often require a physician to sign off on all laboratory test orders[12]. This lack of ability to order testing is likely to be a main reason why we are seeing an underutilization of an in depth biochemical status assessment among RDs.

Further, it is possible that many of the participants who reported not performing these assessments experience such limitations within their individual practice settings, making it difficult to order non-routine laboratory testing. In addition to practice setting, the costs associated with ordering these additional laboratory tests may be prohibitive for both practitioners and clients. This idea is supported by the results, which showed the majority of those who reported more than 75% of their practice was devoted to Integrative and Functional therapies worked in private practice. In the private practice setting Integrative practitioners may not be as restricted with the laboratory tests that can be ordered. These dietetic practitioners may be working with clients who are specifically seeking out Integrative and Functional medical care who may be more interested in, and willing to pay for, an in depth biochemical assessment.

Personalized nutrition is based on the concept of adapting dietary needs according to an individual's needs, based on presence of inherited or acquired disease, their lifestyle choices, life stage, cultural belief systems, as well as sensory preferences[13,14]. Tailoring individual dietary needs means recognizing that processes of digestion, absorption, transport, biotransformation, uptake, binding, storage, excretion and cellular signaling by metabolites involve several genes. Each of these genes has common polymorphisms that could ultimately alter function and response to a dietary compound. In the last decade since the completion of the Human Genome Project, the "omic" sciences of nutrigenomics and nutrigenetics coupled with metabolomics, transcriptomics, and proteomics have experienced unprecedented growth particularly in the development of types of genetic tests and identification of biomarkers[14]. Some of these are well developed while others are still in the developmental stages and therefore lack validation with respect to specific health outcomes[15]. Some tests have also been reported as possibly misleading or even harmful due to lack of scientific proof of their claims[16].

Although it is evident that genetic information needs to be taken into account while formulating personalized dietary advice, and the "omic" sciences hold much promise, it must also be recognized that RDs need to be trained to evaluate the relevance and suitability of specific gene-nutrient interactions, the use of specific biomarkers, as well as the interpretation of these markers as influenced by human genetic variability[6].

Only 33% of participants reported providing nutrition focused physical exams. Of the five groups analyzed, those whose professional practice focused on providing Integrative and Functional therapies reported an increase in the frequency of use of nutrition focused physical exams. Increased familiarity with such clinical exam protocols as well as new knowledge gained through webinars and conferences such as those provided by the Institute of Functional medicine and/or the DIFM practice group may have contributed to this increased usage[5].

Bacterial imbalance in the gut has been shown to affect other organ systems resulting in several core clinical imbalances manifested as chronic diseases[17]. Further, antigenic substances produced both from bacterial imbalances and increased intestinal permeability are also related to the development of immune system related disorders[17]. Controlling the function of the gastrointestinal tract by avoiding gut permeability caused by bacterial imbalance is now understood to be key in preventing chronic disease and achieving good health[17]. Only 8% of participants regularly assessed for gut dysbiosis. Gut dysbiosis is a relatively new term, and although few participants reported regularly assessing for this, it is possible that many were unfamiliar with the wording and therefore reported sometimes or never assessing for this. This idea is supported by the results which showed that 72.5% of participants reported every time assessment of digestive wellness.

Normal digestion and absorption allows food products to be efficiently broken down, then absorbed as small molecules that are normally non-antigenic. However inefficient digestive processes coupled with deviations in resident gut

microbial communities result in dysbiosis allowing macromolecules to leak into the circulation[17]. This stimulates immune responses causing a variety of antibodies such as IgG and IgE to be produced[18]. When compared with gut dysbiosis assessment, a larger percentage of participants (86%) reported at least sometimes assessing their clients for adverse food reactions. Adverse food reactions are often the end result of multiple chronic problems of the digestive tract such as poor digestion, abnormal bacterial growth within the gut and chronic gut inflammation[18]. Since gut problems often precede the development of adverse food reactions, determining and removing foods that cause inflammation can be an important strategy to intervention[18]. Food sensitivity tests such as the ALCAT test coupled with elimination diet protocols are available to practitioners that allow the identification of a large number of foods that can activate the immune system[18,19].

One possible explanation for why we might be seeing increased utilization of food allergy and intolerance testing/treatment when compared with gut dysbiosis is because there are more defined assessment tools and comparative criteria for adverse food reactions when compared with gut dysbiosis. Furthermore, food allergy and intolerances have been well understood for a longer period of time when compared with gut dysbiosis. We may also be seeing this due to an increase in the prevalence of food allergies. According to the National Center for Health Statistics, in the 0-17 year old age group the prevalence of food and skin allergies has increased by 3.4% from 1997-2011[20]. Allergic conditions are cited as being one of the most common medical

conditions among children[20]. For the condition of food allergies and intolerances we see both a demand for testing and treatment, as well as a multitude of available testing options. Testing options available to the Integrative and Functional Practitioner are extensive, however some resources include the ALCAT system from Cell Science Systems, and testing through MetaMetrix[19, 21]. Familiarity with such tests in addition to the ability to take action to improve health and wellness of clients are possible motivating factors for such responses among participants. The prevalence for gut dysbiosis assessment and treatment may meet that for food allergies and intolerance as more research becomes available regarding the role that diet and lifestyle factors have on the micro biome, as well as the health implications of dysbiosis of bacteria in the gut.

Awareness, Perceptions, and Future use of the IFMNT Radial

The results of this study indicate that the use of the IFMNT Radial is currently limited. The lifestyle portion of the radial was used most frequently; an in depth assessment utilizing the Lifestyle domain provides practitioners with the information necessary to create a personalized and effective diet plan[9]. Those who devoted a larger percentage (>75%) of their professional practice to Integrative and Functional Medicine had previously utilized the Radial in their practice with more frequency. This group additionally utilized three out of the five key areas (metabolic pathways/networks, core imbalances, systems signs and symptoms) more frequently than any other group analyzed. This may be due to this group being more familiar with the assessment protocols as well as having

more autonomy in their individual work environments, with 61% of this group working in private practice.

Although not all factors investigated through this research were found to be assessed with greater frequency as the use of the Radial increased, these findings suggest that this tool may assist in providing a framework for detailed assessment. This framework may be more useful and accurate for those who contemplate expanding their IFMNT practice. Based on the qualitative responses, more effort needs to be directed toward promoting the Radial as well as educating and training RDs on using the tool.

A question that should be asked is whether or not the use of this tool and assessment methods described on it leads to more positive patient outcomes. One study from Michigan investigated the outcomes of patients being treated in an Integrative Medicine Clinic (n=85)[22]. These researchers utilized *The Holistic Health and Wellness Questionnaire (HHQ)* to assess patient outcomes. These outcomes included measures associated with improvements of the body, mind, and spirit[22]. The researchers found that significant improvements were seen in overall patient satisfaction and perceived physical health[22].

Patient centered care is a cornerstone of Integrative and Functional Medicine. Previous research has demonstrated the positive effects of patient centered care both on health related outcomes and patient satisfaction[23]. One study from California investigated this topic with 504 participants. The Medical Outcomes Study Short Form was utilized to collect baseline patient information. This study found that a patient-centered practice style was positively associated

with an increase in patient health status[23]. Furthermore, this study found that with the utilization of a patient-centered practice style there was a resultant decrease in financial costs for medical care, through decreased utilization of things like emergency room visits and diagnostic tests[23]. An additional study investigating this topic found that patient centered communication resulted in improved patient recovery from discomfort as well as improved emotional health of those who participated (n=315)[24]. It stands to reason that tools which utilize this approach may result in improved patient outcomes and satisfaction; however more research needs to be done which specifically investigate the tool's use and patient outcomes.

Strengths and Limitations

This study has a number of strengths, including the utilization of both closed and open ended questions. With this approach we were able to obtain a better understanding of the participant's perceptions of the functionality of the Radial. This information can be applied to the Radial so that it may be a more effective tool for practice. Due to the fact that this study was conducted utilizing a self-administered web based survey, little outside influence was placed on the study participants.

A limitation of this study is that roughly 63% of participants either do not practice Integrative and Functional Nutrition, or have been practicing for less than four years. This general lack of experience of more than half of the participants may have produced results that are dissimilar to what is actually being done by those who have more experience in the field of Integrative and Functional

Nutrition. Another limitation of this study is the use of the Likert Scale to assess the frequency of use of Integrative and Functional Nutrition practices. While this scale may be easy to understand for participants, the term “sometimes” encompasses a wide range of frequency, and does not tell us exactly how often certain assessment and treatment practices are being used. For example, “sometimes” may translate to once per month, once per year, once per day, and so on. Further, the survey instrument was only validated by the three DIFM members who created the survey. Validating the survey for content would have added strength to this study.

Additionally, this study only recruited participants from the DIFM practice group, and the perspectives of dietitians practicing Integrative and Functional Medicine but who are not members of this group may have been missed. As with any anonymous survey, a limitation of this study is the potential for participants to respond to questions inaccurately, which may skew the data. In addition, the survey was only open for a total of three weeks, which may have resulted in a loss of study participants who may have otherwise responded to the survey if provided with additional time. Further, there were a number of participants who did not complete the survey, and thus were eliminated from the analysis. This would be considered a limitation of this study due to the potentially vital information that was lost. The reasoning behind these participants withdrawal from the study is unclear. One reason may be that they did not feel familiar with the topic being investigated, which is evidenced by the third of these participants

who reported not practicing Integrative and Functional Nutrition. Additional reasons may include a lack of time or interest in the topic being investigated.

This study investigated the types of assessment and intervention methods currently in use, but not the preference for certain methods over others. For example, it was shown that low carbohydrate diets were used most often for the treatment of gut dysbiosis among those who have used the Radial, but we do not have information related to why this is so. Having this information would have provided more insight and understanding to Integrative and Functional Medicine practitioners. This research shows us that the Radial may provide an adequate blue print to practitioners interested in practicing IFMNT or expanding their practice in that direction. The Radial may be a more effective and useful tool when used in combination with other existing tools such as the Functional Medicine Matrix and Timeline and other patient centered questionnaires[7]. This study did not assess what additional Integrative and Functional tools are currently being used by participants. Having this information would have allowed a more thorough understanding of both how the Integrative and Functional RDs practice and strategies utilized to enhance their practice.

This exploratory study investigated the Integrative and Functional Nutrition practices of RDs, and their familiarity with and use of the IFMNT Radial. Future research should be conducted to investigate reasons why various assessment and interventions may or may not be used, what additional tools are utilized in practice, and whether or not the use of this tool, as well as additional Integrative and Functional tools leads to better patient outcomes. This may help researchers

to better identify and understand the barriers and enhancers that Integrative and Functional RDs face in their professional practice.

Conclusion

Integrative and functional medical nutrition therapies are patient oriented modalities that combine all appropriate therapeutic approaches from both conventional and/or alternative medicine[7]. Functional diagnostic assessments are a cornerstone of this personalized client practice in that core physiological and metabolic issues are identified much before the manifestation of overt clinical symptoms. This is based on the premise that even minor, seemingly unimportant physiological imbalances in the body can produce a “snowball” effect stimulating a myriad biological triggers eventually precipitating chronic disease through core clinical imbalances[25].

Time sensitive and functionally appropriate assessment protocols that combine nutrition focused physical exams and in depth lifestyle assessments with biochemical markers that identify core clinical imbalances that cause impairments in metabolic pathways are essential parts of this paradigm. Such a comprehensive approach helps address whether the person needs (a) to get rid of something in their environment that is an impediment to optimal health and (b) something that is needed for optimal function whether it is a nutrient, light, water, air, movement, community etc. It also underscores the need for a framework that enables a thorough evaluation of interacting factors that influence health and healing. To this end the IFMNT Radial is a first step to guide the Registered Dietitian in this direction. Food within the radial framework is central to health; it

can influence and be influenced by the five domains of the radial as well as the triggers such as food allergens and intolerances, negative thoughts and beliefs, pathogens and environmental exposures. Each of the radial's domains offers a checklist to the practitioner that facilitates a personalized plan of nutrition based on evidence and practice based concepts using assessment, diagnosis, intervention, monitoring and evaluation.

The present study provides preliminary evidence of the perceptions and use regarding the Radial among DIFM RDs. Those who have a larger percentage of their professional practices devoted to providing Integrative and Functional Therapies provide a more in depth assessment of client history, biomarkers, genetic information, and more frequently provide nutrition focused physical exams. It also points to the need to publicize the Radial further as well as spur more educational efforts surrounding it.

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Appendix A:

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Integrative and Function Nutrition Practices Among Registered Dietitians Belonging to the Dietitians in Integrative and Functional Medicine Practice Group

My name is Dana Kohut, and I am a Graduate Student studying Nutrition at Syracuse University. I am inviting you to participate in a research study. Involvement in the study is voluntary, so you may choose to participate or not. This page will explain the study to you and please feel free to ask questions about the research if you have any. I will be happy to explain anything in detail if you wish. I am interested in learning more about what your uses of Integrative and Functional Nutrition are in your dietetic career as well as investigating your familiarity and use of the Integrative and Functional Medical Nutrition Therapy Radial. You are being asked to fill out this survey. This will take approximately 20 minutes of your time. All information will be kept anonymous. This means that your name will not appear anywhere and your specific answers will not be linked to your name in any way. You may withdraw from the study at any time without penalty.

This survey has been developed in conjunction with the Dietitians in Integrative and Functional Medicine dietetic practice group of the Academy of Nutrition and Dietetics. Results will be utilized to obtain a better understanding of dietitian uses of Integrative and Functional Medicine and to compare reported practices to those listed on the Integrative and Functional Medical Nutrition Therapy Radial. Results of this study will be shared with the Dietitians in Integrative and Functional Medicine practice group.

Whenever one works with email or the internet; there is always the risk of compromising privacy, confidentiality, and/or anonymity. Your confidentiality will be maintained to the degree permitted by the technology being used. It is important for you to understand that no guarantees can be made regarding the interception of data sent via the internet by third parties.

Contact Information: If you have any questions, concerns, complaints about the research, contact Dana Kohut via email at dkohut@syr.edu or her faculty advisor Dr. Sudha Raj at sraj@syr.edu. If you have any questions about your rights as a research participant, you have questions, concerns, or complaints that you wish to address to someone other than the investigator, if you cannot reach the investigator, contact the Syracuse University Institutional Review Board at 315-443-3013. All of my questions have been answered, I am 18 years of age or older, and I wish to participate in this research study.

Please print a copy of this consent form for your records. By continuing to move on to the next page you are agreeing to participate within the terms of this research study.

Q1 As described by the Dietitians in Integrative and Functional Medicine practice group: Integrative Medicine emphasizes the importance of the practitioner patient relationship. Functional medicine addresses the root causes of disease and integrates conventional medical practices with alternative or complementary medical practices. Complex connections are made between information related to the patient's lifestyle, history, biochemical parameters, and physiology. Together, Integrative and Functional Medicine focuses on providing evidence based patient-centered care which focuses on the whole person, promoting health and wellness outside of the absence of illness.

What percentage of your professional practice consists of delivering Integrative or Functional Medical Therapies?

- ❍ 0%-25% (1)
- ❍ 26%-50% (2)
- ❍ 51%-75% (3)
- ❍ 76%-100% (4)

Q2 How many years have you been a Registered Dietitian Nutritionist?

- ❍ <1 (1)
- ❍ 1-4 years (2)
- ❍ 5-9 years (3)
- ❍ 10-14 years (4)
- ❍ 15-24 years (5)
- ❍ 25-34 years (6)
- ❍ >35 years (7)

Q3 How many years have you been practicing Integrative and Functional Nutrition?

- ❍ I do not practice Integrative and Functional Nutrition (1)
- ❍ <1 (2)
- ❍ 1-4 years (3)
- ❍ 5-9 years (4)
- ❍ 10-14 years (5)
- ❍ 15-24 years (6)
- ❍ 25-34 years (7)
- ❍ >35 years (8)

Q4 What forms of Integrative and Functional Nutrition training have you received? (please select all that apply)

- ❑ Continuing Education (1)
- ❑ Through an Academic Institution (formal classes) (2)
- ❑ Workshops (3)
- ❑ Webinars (4)
- ❑ Functional Medicine Certification Courses (5)
- ❑ Other (Please describe) (6) _____

Q5 Which state affiliate do you belong to?

- ❍ Alabama (1)
- ❍ Alaska (2)
- ❍ American Overseas Dietetic Association (AODA) (3)
- ❍ Arizona (4)
- ❍ Arkansas (5)
- ❍ California (6)
- ❍ Colorado (7)
- ❍ Connecticut (8)
- ❍ Delaware (9)
- ❍ District of Colombia (10)
- ❍ Florida (11)
- ❍ Georgia (12)
- ❍ Hawaii (13)
- ❍ Idaho (14)
- ❍ Illinois (15)
- ❍ Indiana (16)
- ❍ Iowa (17)
- ❍ Kansas (18)
- ❍ Kentucky (19)
- ❍ Louisiana (20)
- ❍ Maine (21)
- ❍ Maryland (22)
- ❍ Massachusetts (23)
- ❍ Michigan (24)
- ❍ Minnesota (25)
- ❍ Mississippi (26)
- ❍ Missouri (27)
- ❍ Montana (28)
- ❍ Nebraska (29)
- ❍ Nevada (30)
- ❍ New Hampshire (31)
- ❍ New Jersey (32)
- ❍ New Mexico (33)
- ❍ New York (34)
- ❍ North Carolina (35)
- ❍ North Dakota (36)
- ❍ Ohio (37)
- ❍ Oklahoma (38)
- ❍ Oregon (39)
- ❍ Pennsylvania (40)
- ❍ Puerto Rico (41)
- ❍ Rhode Island (42)
- ❍ South Carolina (43)

- South Dakota (44)
- Tennessee (45)
- Texas (46)
- Utah (47)
- Vermont (48)
- Virginia (49)
- Washington (50)
- West Virginia (51)
- Wisconsin (52)
- Wyoming (53)

Q6 What is your primary dietetics practice area?

- Acute Care, Inpatient (1)
- Ambulatory/Outpatient Care (2)
- Rehab Facility (3)
- Long Term/Extended Care (4)
- Community/Public Health program (5)
- Food Service Management (6)
- Private Practice (7)
- College/University faculty (8)
- Integrative Medical Practice (9)
- Other (Please describe) (10) _____

Q7 Please select all other areas in which you practice:

- Acute Care, Inpatient (1)
- Ambulatory/Outpatient Care (2)
- Rehab Facility (3)
- Long Term/Extended Care (4)
- Community/Public Health Program (5)
- Food Service Management (6)
- Private Practice (7)
- College/University faculty (8)
- Integrative Medical Practice (9)
- Other (Please Describe) (10) _____

Below are questions that intend to investigate your use of Integrative and Functional Medicine within your nutrition practice.

Q8 When assessing a client's history, how often do you obtain information regarding:

	Never (1)	Sometimes (2)	Every Time (3)
Sleep (1)	❍	❍	❍
Stress (2)	❍	❍	❍
Environment/ Toxin Exposure (3)	❍	❍	❍
Spirituality (4)	❍	❍	❍
Social Supports/ Relationships (5)	❍	❍	❍
Physical Activity Levels (6)	❍	❍	❍
Cultures and Traditions (7)	❍	❍	❍
Exposure to Sunlight (8)	❍	❍	❍
Supplement Use (9)	❍	❍	❍
Digestive Wellness (10)	❍	❍	❍

Q9 Do you perform nutrition focused physical exams?

❍ Yes (1)

❍ No (2)

If No Is Selected, Then Skip To Do you assess patient biochemical sta...

Q10 When performing a nutrition focused physical exam, how often do you obtain information regarding:

	Never (1)	Sometimes (2)	Every Time (3)
Oral/Gum Health (1)	❍	❍	❍
Skin/Nail/Hair Health (2)	❍	❍	❍
Presence of Edema (3)	❍	❍	❍
Hyperkeratosis (4)	❍	❍	❍
Wasting (5)	❍	❍	❍
Vision related health (i.e. night blindness) (6)	❍	❍	❍
Photophobia (7)	❍	❍	❍
Fat distribution (8)	❍	❍	❍

Q11 Do you assess patient biochemical status?

- ❍ Yes (1)
- ❍ No (2)

If No Is Selected, Then Skip To End of Block

Q12 When assessing a client's biochemical status how often do you obtain information regarding:

	Never (1)	Sometimes (2)	Everytime (3)
Micronutrient Status (1)	❍	❍	❍
Macronutrient Status (2)	❍	❍	❍
Genomic Information/ SNPs (3)	❍	❍	❍
Toxins (4)	❍	❍	❍
Hormonal Imbalances (5)	❍	❍	❍

Q13 When assessing a client's biochemical status how often do you utilize:

	Never (1)	Sometimes (2)	Everytime (3)
Stool Sample Analysis (1)	❍	❍	❍
Enzyme Stimulation Assays (2)	❍	❍	❍
Nutrient Loading Tests/ Saturation Measures (3)	❍	❍	❍
Challenge Tests (4)	❍	❍	❍
Nutrigenomic Screenings (5)	❍	❍	❍
Static Tests (6)	❍	❍	❍

Below are questions regarding your assessment and treatment practices of conditions often seen in an Integrative practice.

Q14 How often do you assess your patients for gut dysbiosis?

- ❍ Never (1)
- ❍ Rarely (2)
- ❍ Sometimes (3)
- ❍ Most of the Time (4)
- ❍ Always (5)

If Never Is Selected, Then Skip To How often do you assess patients for ...

Q15 How often do you utilize the following assessment tools when working with clients who may have gut dysbiosis?

	Never (1)	Sometimes (2)	Every time (3)
Stool Sample Analysis (1)	❍	❍	❍
Urinary Sample Analysis (2)	❍	❍	❍

Q16 How often do you utilize the following treatments when working with clients with gut dysbiosis?

	Never (1)	Sometimes (2)	Every time (3)
Oligoantigenic Diets (Elimination Diet) (1)	❍	❍	❍
Replenish Enzymes and Digestive Factors (2)	❍	❍	❍
Probiotic Supplementation (3)	❍	❍	❍
Nutrient Supplementation (i.e. vitamins C, E, and A etc...) (4)	❍	❍	❍
Low Carbohydrate Diet (5)	❍	❍	❍

Q17 How often do you assess patients for adverse food reactions?

- ❍ Never (1)
- ❍ Rarely (2)
- ❍ Sometimes (3)
- ❍ Most of the Time (4)
- ❍ Always (5)

If Never Is Selected, Then Skip To End of Block

Q18 How often do you utilize the following assessment tools when working with clients who may have an adverse food reaction?

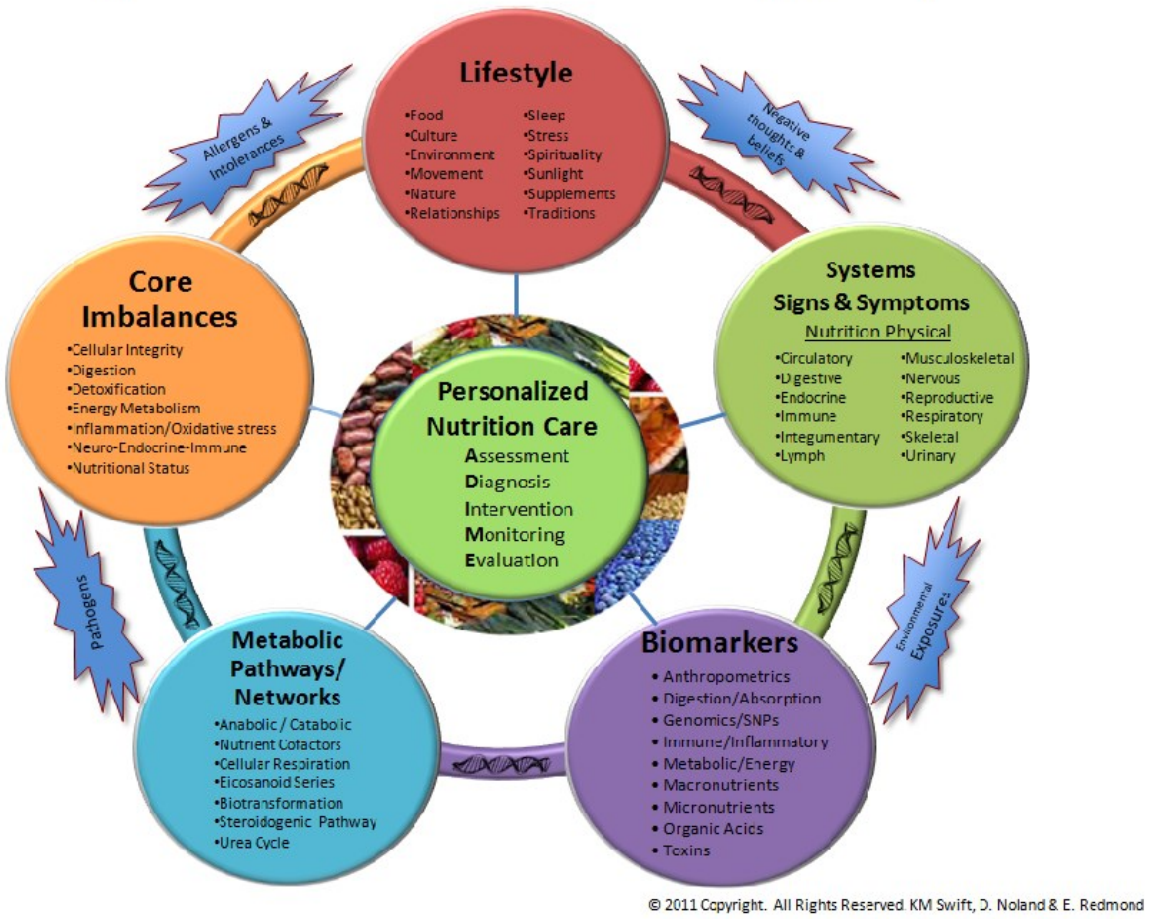
	Never (1)	Sometimes (2)	Every time (3)
IgG Antibody Tests (1)	❍	❍	❍
IgE Antibody Tests (2)	❍	❍	❍
IgA Antibody Tests (3)	❍	❍	❍
Lymphocyte Testing (4)	❍	❍	❍

Q19 How often do you utilize the following treatments when working with clients who have an adverse food reaction?

	Never (1)	Sometimes (2)	Every time (3)
Therapeutic Elimination Diet (1)	❍	❍	❍
Coordination of Care (2)	❍	❍	❍

The image below shows the Integrative and Functional Medical Nutrition Therapy Radial. The Radial's intended purpose is to provide Registered Dietitians who practice Integrative and Functional Nutrition with a tool to assist in the implementation of Integrative and Functional Medical Nutrition Therapy in their practice.

Integrative & Functional Medical Nutrition Therapy (IFMNT) Radial



The following questions are related to the image seen above.

Q20 Have you previously seen the Integrative and Functional Medical Nutrition Therapy Radial?

- ❍ Yes (1)
- ❍ No (2)

If No Is Selected, Then Skip To Indicate your level of agreement rega...

Q21 Have you previously used the Integrative and Functional Medical Nutrition Therapy Radial in your practice?

- ❍ Yes (1)
- ❍ No (2)

If No Is Selected, Then Skip To How is the Radial a useful and effect...

Q22 How often do you utilize the following aspects of the Integrative and Functional Medical Nutrition Therapy Radial when conducting a nutrition assessment?

	Never (1)	Sometimes (2)	Every Time (3)
Lifestyle (1)	❍	❍	❍
Systems Signs and Symptoms (2)	❍	❍	❍
Biomarkers (3)	❍	❍	❍
Metabolic Pathways/Networks (4)	❍	❍	❍
Core Imbalances (5)	❍	❍	❍
Pathogens (6)	❍	❍	❍
Negative Thoughts and Beliefs (7)	❍	❍	❍
Allergens and Intolerances (8)	❍	❍	❍

Q23 Indicate your level of agreement regarding the effectiveness of the Radial in your future practice:

	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
I see the radial as being an effective tool to guide my integrative practice (1)	❍	❍	❍	❍	❍

Q24 Please indicate which aspects of the radial you think will be most useful to you in your practice. Please rank from most useful (1) to least useful (5). To place the items in the order that you wish, you may click on the item and drag it to the desired position.

_____ Lifestyle (1)
_____ Systems Signs and Symptoms (2)
_____ Biomarkers (3)
_____ Metabolic Pathways/Networks (4)
_____ Core Imbalances (5)

Q25 How can the Radial be improved to be a more useful tool to guide your practice?

Q26 What areas of the Radial could you use more education on?

- ❑ Lifestyle (1)
- ❑ Biomarkers (2)
- ❑ Systems Signs and Symptoms (3)
- ❑ Metabolic Pathways/Networks (4)
- ❑ Core Imbalances (5)

Thank you for taking the time to complete this survey! Your response is greatly appreciated and contributes greatly to my research. If you have any questions please contact me at dkohut@syr.edu

Appendix B:

Table 1 Cross-tabulation of IFMNT Radial use/exposure and percentage of professional practice which is dedicated to providing Integrative and Functional Therapies

IFMNT Radial exposure/use	Percentage of Professional Practice that is devoted to providing IFMNT				
	None	1%-25%	26%-50%	51%-75%	76%-100%
Previously seen the Radial					
Yes	14	33	19	13	24
No	20	39	17	15	17
Previously used the IFMNT Radial					
Yes	3	11	10	7	17
No	10	22	9	6	7

Table 2 Cross tabulation of client history assessment methods and percentage of professional practice that is devoted to providing Integrative and Functional therapies.

Client History Assessment	Percentage of Professional Practice that is devoted to providing IFMNT				
	None	1%-25%	26%-50%	51%-75%	76%-100%
Spirituality (note: 1 cell had an expected count less than 5)					
Never	22 (28.6%)	33 (42.9%)	7 (9.1%)	9 (11.7%)	6 (7.8%)
Sometimes	8 (7.8%)	29 (28.4%)	28 (27.5%)	15 (14.7%)	22 (21.6%)
Every time	4 (12.9%)	9 (29%)	1 (3.2%)	4 (12.9%)	13 (41.9%)
Environmental toxin exposure					
Never	22 (36.7%)	29 (48.3%)	4 (6.7%)	2 (3.3%)	3 (5%)
Sometimes	10 (9.1%)	42 (38.2%)	26 (23.6%)	19 (17.3%)	13 (11.8%)
Every time	2 (5%)	1 (2.5%)	6 (15%)	6 (15%)	25 (62.5%)
Sleep (note: 4 cells had an expected count less than 5)					
Never	9 (47.7%)	9 (47.7%)	1 (5.3%)	0 (0.0%)	0 (0.0%)
Sometimes	20 (23.3%)	37 (43%)	16 (18.6%)	7 (8.1%)	6 (7.0%)
Every time	5 (4.7%)	26 (24.5%)	19 (17.9%)	21 (19.8%)	35 (33%)
Stress (note: 5 cells had an expected count less than 5)					
Never	6 (50%)	5 (41.7%)	1 (8.3%)	0 (0.0%)	0 (0.0%)
Sometimes	19 (28.4%)	31 (46.3%)	12 (17.9%)	2 (3%)	3 (4.5%)
Every time	9 (6.8%)	36 (27.3%)	23 (17.4%)	26 (19.7%)	38 (28.8%)
Exposure to sunlight					
Never	16 (27.1%)	30 (50.8%)	5 (8.5%)	4 (6.8%)	4 (6.8%)
Sometimes	16 (16.5%)	32 (33%)	18 (18.6%)	14 (14.4%)	17 (17.5%)
Every time	2 (3.6%)	10 (18.2%)	13 (23.6%)	10 (18.3%)	20 (36.4%)
Digestive wellness (note: 5 cells had an expected count less than 5)					
Never	5 (62.5%)	3 (37.5%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Sometimes	14 (28%)	22 (44%)	7 (14%)	5 (10%)	2 (4%)
Every time	15 (9.8%)	47 (30.7%)	29 (19%)	23 (15%)	39 (25.5%)
Social supports and relationships (note: 5 cells had an expected count less than 5)					
Never	6 (60%)	3 (30%)	0 (0.0%)	0 (0.0%)	1 (10%)
Sometimes	15 (17.4%)	38 (44.2%)	12 (14%)	10 (11.6%)	11 (12.8%)
Every time	13 (11.3%)	31 (27%)	24 (20.9%)	18 (15.7%)	29 (25.2%)

Physical activity levels (note: 6 cells had an expected count less than 5)					
Never	2 (66.7%)	1 (33.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Sometimes	11 (32.4%)	17 (50%)	3 (8.8%)	1 (2.9%)	2 (5.9%)
Every time	21 (12.1%)	54 (31.2%)	32 (18.5%)	27 (15.6%)	39 (22.5%)
Use of supplements (note: 8 cells had an expected count less than 5)					
Never	4 (66.7%)	2 (33.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Sometimes	7 (26.9%)	14 (53.8%)	1 (3.8%)	2 (7.7%)	2 (7.7%)
Every time	23 (12.8%)	56 (31.3%)	35 (19.6%)	26 (14.5%)	39 (21.8%)

Table 3 Cross tabulation of client history assessment methods and previous use of the Radial.

Client History Assessment	Previously used the IFMNT Radial	
	Yes	No
Stress (note: 2 cells had an expected count less than 5)		
Never	0 (0.0%)	2 (100%)
Sometimes	8 (26.7%)	22 (73.3%)
Every time	40 (57.1%)	30 (42.9%)
Exposure to sunlight		
Never	3 (16.7%)	15 (83.3%)
Sometimes	23 (50%)	23 (50%)
Every time	22 (57.9%)	16 (42.1%)
Sleep (note: 2 cells had an expected count less than 5)		
Never	0 (0.0%)	4 (100%)
Sometimes	14 (36.8%)	24 (63.2%)
Every time	34 (56.7%)	26 (43.3%)
Environmental toxin exposure		
Never	7 (29.2%)	17 (70.8%)
Sometimes	23 (45.1%)	28 (54.9%)
Every time	18 (66.7%)	9 (33.3%)

Table 4 Chi square tests for independence showed significant association between percentage of professional practice that is devoted to providing Integrative and Functional Therapies and the above factors.

	n	*df*	*phi*	*Cramer's V*	*p*
Demographics					
Primary dietetic practice area	211	36	0.701	0.351	<0.0001
IFMNT Radial					
Previous use of the IFMNT Radial	102	4	0.335	0.335	0.022
Client History Assessment					
Spirituality	210	8	0.684	0.314	<0.0001
Environmental toxin exposure	210	8	0.684	0.483	<0.0001
Sleep	211	8	0.527	0.373	<0.0001
Stress	211	8	0.508	0.359	<0.0001
Exposure to sunlight	211	8	0.430	0.304	<0.0001
Digestive wellness	211	8	0.408	0.289	<0.0001
Social supports and relationships	211	8	0.362	0.256	0.001
Physical activity levels	210	8	0.348	0.246	0.001
Use of supplements	211	8	0.347	0.246	0.001
Nutrition Focused Physical					
Providing nutrition focused physical exams	210	4	0.269	0.269	0.004
Assessment of skin/nail/hair	70	8	0.541	0.383	0.009
Biochemical Status Assessment					
Assessment of toxins	177	8	0.562	0.397	<0.0001
Assessment of hormonal imbalances	178	8	0.513	0.363	<0.0001
Assessment of genomic information/SNPS	178	8	0.459	0.325	<0.0001
Utilization of static tests	176	8	0.397	0.281	0.001
Utilization of stool sample analysis	178	8	0.382	0.270	0.001
Macronutrient Assessment	178	8	0.308	0.218	0.031
Gut Dysbiosis Assessment	210	16	.639	0.320	<0.0001
Gut Dysbiosis Treatment Methods					
Nutrient Supplementation	140	8	0.434	0.307	0.001
Low carbohydrate diet	139	8	0.364	0.257	0.018
Food Allergy and Intolerance Testing					
IgG Antibody Testing	199	8	0.397	0.281	<0.0001
IgE Antibody Testing	200	8	0.336	0.237	0.004
IgA Antibody Testing	200	8	0.333	0.235	0.005

Table 5 Cross tabulation of nutrition focused physical practices and percentage of professional practice that is devoted to providing Integrative and Functional therapies.

Nutrition Focused Physical Practices	Percentage of Professional Practice that is devoted to providing IFMNT				
	None	1%-25%	26%-50%	51%-75%	76%-100%
Provides Nutrition Focused Physical exams to clients					
Yes	6 (8.7%)	24 (34.8%)	9 (13.0%)	7 (10.1%)	23 (33.3%)
No	28 (19.9%)	48 (34%)	27 (19.1%)	20 (14.2%)	18 (12.8%)
Assessment of Hair/Skin/Nail Health (note: 9 cells had an expected count less than 5)					
Never	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (100%)	0 (0.0%)
Sometimes	4 (16%)	11 (44%)	5 (20%)	3 (12%)	2 (8%)
Every time	2 (4.5%)	13 (29.5%)	4 (9.1%)	4 (9.1%)	21 (47.7%)

Table 6 Chi square tests for independence showed a significant association between previous use of the IFMNT Radial and the assessment of the below factors

	n	*df*	*phi*	*Cramer's V*	*p*
Client History Assessment					
Stress	102	2	0.307	0.307	0.008
Exposure to sunlight	102	2	0.291	0.291	0.013
Sleep	102	2	0.269	0.269	0.025
Environmental toxin exposure	102	2	0.268	0.268	0.026
Nutrition Focused Physical					
Assessment of Hyperkeratosis	42	2	0.472	0.472	0.009
Biochemical Status Assessment					
Assessment of genomic information/SNPS	86	2	0.400	0.400	0.001
Utilization of Nutrigenomic Tests	86	2	0.387	0.387	0.002
Assessment of toxins	85	2	0.349	0.349	0.006
Assessment of hormonal imbalances	86	2	0.364	0.364	0.006
Gut Dysbiosis Treatment Methods					
Low carbohydrate diet	77	2	0.309	0.309	0.025
Food Allergy and Intolerance Treatment					
Coordination of Care	95	2	0.321	0,321	0.008
Therapeutic Elimination Diet	98	2	0.292	0.292	0.015

Table 7 Cross tabulation of assessment/treatment methods of nutrition related diseases and percentage of professional practice that is devoted to providing Integrative and Functional therapies.

Assessment/Treatment of specific nutrition related diseases	Percentage of Professional Practice that is devoted to providing IFMNT				
	None	1%-25%	26%-50%	51%-75%	76%-100%
Assessment of Gut Dysbiosis (note: 6 cells had an expected count less than 5)					
Never	24 (33.8%)	30 (42.3%)	9 (12.7%)	5 (7%)	3 (4.2%)
Rarely	6 (23.1%)	11 (42.3%)	5 (19.2)	2 (7.7%)	2 (7.7%)
Sometimes	3 (6.1%)	22 (44.9%)	10 (20.4%)	8 (16.3%)	6 (12.2%)
Most of the time	1 (2.1%)	8 (16.7%)	10 (20.8%)	9 (18.8%)	20 (41.7%)
Always	0 (0.0%)	0 (0.0%)	2 (12.5%)	4 (25%)	10 (62.5%)
Gut Dysbiosis Treatment Methods					
Nutrient Supplementation (note: 6 cells had an expected count less than 5)					
Never	4 (26.7%)	8 (53.3%)	1 (6.7%)	2 (13.3%)	0 (0.0%)
Sometimes	5 (5.4%)	28 (30.1%)	21 (22.6%)	17 (18.3%)	22 (23.7%)
Every time	1 (3.1%)	6 (18.8%)	5 (15.6%)	4 (12.5%)	16 (50%)
Low carbohydrate diet (note: 4 cells had an expected count less than 5)					
Never	7 (21.2%)	9 (27.3%)	5 (15.2%)	6 (18.2%)	6 (18.2%)
Sometimes	2 (2.5%)	29 (36.3%)	16 (20%)	11 (13.8%)	22 (27.5%)
Every time	1 (3.8%)	4 (15.4%)	5 (19.2%)	6 (23.1%)	10 (38.5%)
Food Allergy and Intolerance Testing					
IgG Antibody Testing (note: 5 cells had an expected count less than 5)					
Never	22 (21.8%)	39 (38.6%)	21 (20.8%)	8 (7.9%)	11 (10.9%)
Sometimes	4 (4.5%)	30 (33.7%)	14 (15.7%)	15 (16.9%)	26 (29.2%)
Every time	0 (0.0%)	2 (22.2%)	0 (0.0%)	3 (33.3%)	4 (44.4%)
IgE Antibody Testing (note: 5 cells had an expected count less than 5)					
Never	22 (21.1%)	41 (39.4%)	17 (16.3%)	9 (8.7%)	15 (14.4%)
Sometimes	4 (4.4%)	28 (31.1%)	19 (21.1%)	16 (17.8%)	23 (25.6%)
Every time	0 (0.0%)	2 (33.3%)	0 (0.0%)	1 (16.7%)	3 (50%)
IgA Antibody Testing (note: 5 cells had an expected count less than 5)					
Never	22 (20%)	44 (40%)	20 (18.2%)	10 (9.1%)	14 (12.7%)
Sometimes	4 (4.7%)	25 (29.1%)	16 (18.6%)	15 (17.4%)	26 (30.2%)
Every time	0 (0.0%)	2 (50%)	0 (0.0%)	1 (25%)	1 (25%)

Table 8 Cross tabulation of assessment/treatment methods of nutrition related diseases and previous use of the IFMNT Radial.

Assessment/Treatment of specific nutrition related diseases	Previously used the IFMNT Radial	
	Yes	No
Gut Dysbiosis Treatment Methods		
Low carbohydrate diet		
Never	3 (21.4%)	11 (78.6%)
Sometimes	30 (62.5%)	18 (37.5%)
Every time	8 (53.5%)	7 (46.7%)
Food Allergy and Intolerance Treatment		
Coordination of Care		
Never	8 (53.3%)	7 (46.7%)
Sometimes	18 (34%)	35 (66%)
Every time	19 (70.4%)	8 (29.6%)
Therapeutic Elimination Diet (note: 1 cell had an expected count less than 5)		
Never	0 (0.0%)	7 (100%)
Sometimes	29 (46%)	34 (54%)
Every time	17 (60.7%)	11 (39.3%)

Vita:

Dana Kohut was born in Bound Brook, New Jersey to her parents Peter Kohut and Gwen Kohut-Brunt. She received her Bachelor of Science degree in Health Sciences from Ithaca College, in 2012. She continued her education at Syracuse University in Syracuse, NY, where she is pursuing a Master of Science degree in Nutrition Science. She is anticipated to graduate in May of 2014. While attending Syracuse University, she worked as a Graduate Assistant in the department of Nutrition Science and Dietetics. Dana was selected as the Nutrition Science and Dietetics graduate Marshal, and as such will be representing her class at Falk College's 2014 Convocation. She has been accepted to Syracuse University's Dietetic Internship for the 2014-2015 academic year, and will continue to pursue the Registered Dietitian credential.