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The Nutrition Care Process in Diabetes Medical Nutrition Therapy

By

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Doctoral Dissertation
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DEDICATION

I dedicate my dissertation first to my husband, John. Without his tireless support and encouragement, none of this would be possible; John is my biggest cheerleader of them all. To Brynn and Cooper, so that they may be inspired to tackle their goals no matter the obstacles they face. To Denali, for being the sister I never had, and helping hold down the fort when I couldn't. Last (but not least) to my brother, Jody, for his unconditional support. I will be forever thankful for the practical advice he has always given me over the years, especially during hard times.

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LIST OF ABBREVIATIONS

Academy	Academy of Nutrition and Dietetics
ADA	American Dietetic Association
ADIME	Assessment, Diagnosis, Intervention, Monitoring & Evaluation
AHP	Allied Health Professions
AMA	American Medical Association
AND	Academy of Nutrition and Dietetics
ANDHII	Academy of Nutrition and Dietetics Health Informatics Infrastructure
ASPEN	American Society for Parenteral and Enteral Nutrition
CCD	Classification and Coding Lists for Dietetics
CDC	Centers for Disease Control and Prevention
CHO	Carbohydrate
CKD	Chronic kidney disease
CMS	Center for Medicare Services
CNIS	Clinical Nutritional Information System
CNIS	Clinical Nutritional Information System
COPD	Chronic obstructive pulmonary disease
CPT	Common Procedural Terms
CVD	Cardiovascular disease
DCCT	Diabetes Control and Complications Trial
DOR	Diabetes Outcomes Registry
DRI	Dietary Reference Intakes
EAL	Evidence Analysis Library
EBNPG	Evidence-based nutrition practice guidelines
EBP	Evidence-based practice
EFAD	European Federation of the Association of Dietitians
EMR	Electronic Medical Record
eNCPT	Electronic Nutrition Care Process Terminology
GDM	Gestational Diabetes Mellitus
HD	Hemodialysis
HOD	The Academy's House of Delegates
HSR	Health Services Research Task Force
I-CVI	Item content validity index
ICD	International Classification of Diseases
ICF	International Classification of Functioning, Disability, and Health
ICF-Dietetics	International Classification of Functioning, Disability, and Health-Dietetics
IDNT	International Dietetics and Nutrition Terminology
IMPECD	Improvement of Education and Competencies in Dietetics
MIS	Malnutrition Inflammation Score
MNT	Medical nutrition therapy
MUST	Malnutrition Universal Screening Tool
NCP	Nutrition Care Process
NCPM	Nutrition Care Process and Model
NCPT	Nutrition Care Process Terminology

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NCPTC	Nutrition Care Process and Terminology Committee
NFPE	Nutrition-Focused Physical Exam
NQI	National Quality Improvement
PD	Peritoneal dialysis
PG-SGA	Patient-Generated Subjective Global Assessment
PI	Principle Investigator
RDN	Registered dietitian nutritionist
RRT	Renal replacement therapy
S-CVI	Scale content validity index
S-CVI-Ave	Scale content validity index average
S-CVI-UA	Scale content validity index universal agreement
SGA	Subjective Global Assessment
SNOMED	Systematized Nomenclature of Medicine
SOP	Standards of Practice
SOPP	Standards of Professional Performance
T1DM	Type 1 Diabetes Mellitus
T2DM	Type 2 Diabetes Mellitus
TPB	Theory of Planned Behavior
TTM	Transtheoretical Model
UK	United Kingdom
US	United States

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GLOSSARY OF TERMS

Registered dietitian nutritionist (RDN): the expert in food and nutrition who has completed a minimum of an accredited bachelor's degree in nutrition science and a supervised dietetic internship

Medical nutrition therapy (MNT): nutrition care designed to target and resolve a Nutrition Diagnosis related to a medical condition using a personalized, evidence-based approach.

Nutrition Care Process (NCP): the system utilized by registered dietitian nutritionists to deliver medical nutrition therapy.

Nutrition Care Process and Model (NCPM): an illustration developed by the Academy of Nutrition and Dietetics demonstrating all the steps of the Nutrition Care Process, along with all the factors which affect delivery and impact of medical nutrition therapy.

International Classification of Diseases (ICD): a standardized system of nomenclature designed to capture health maladies in a way that can be researched.[1]

Common Procedural Terminology (CPT): a coding system designed to standardize medical reporting and billing.[2]

Systematized Nomenclature of Medicine (SNOMED): internationally standardized medical terminology designed specifically for the interchange of electronic information and facilitation of research.[3]

Nutrition Care Process Terminology (NCPT): a standardized system of categorizing medical nutrition therapy terms developed by the Academy of Nutrition and Dietetics used in the Nutrition Care Process in order to capture nutrition care in a way that can be researched in order to "ensure optimal nutrition care."[4]

Electronic Nutrition Care Process Terminology: the subscription-based electronic platform where Nutrition Care Process Terminology references are found.

Classification and Coding Lists for Dietetics: a standardized system of categorizing medical nutrition therapy terms developed by the Dutch Association of Dietitians and the Dutch Institute of Allied Healthcare in order to capture nutrition care in a way that can be researched for the enhancement of dietetics.[5]

International Classification of Functioning, Disability, and Health (ICF): a standardized system of nomenclature designed to capture health maladies in a way that can be

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researched.[5]

International Classification of Functioning, Disability, and Health-Dietetics (ICF-Dietetics): a subset of the International Classification of Functioning, Disability, and Health designed to specifically capture nutrition and dietetics care.[5]

Clinical Nutritional Information System (CNIS): a dietetic-centric informatics platform which allows registered dietitian nutritionists to enter NCP data for later research and outcomes tracking.[6]

Nutrition Indicators: "markers that can be measured and evaluated to determine the effectiveness of the nutrition care."[7]

Nutrition Outcomes: "the results of nutrition care that are directly related to the Nutrition Diagnosis and the goals of the intervention plan."[7]

Goal Progress: "the results of nutrition care that are directly related to the Nutrition Diagnosis and the goals of the intervention plan."[7]

Problem Resolution: the result of fixing a Nutrition Diagnosis through application of the Nutrition Care Process.

Patient Reported Outcome Measures (PROMs): outcomes data collected directly from patients through use a valid and reliable tool.[8]

Patient Reported Experience Measures (PREMs): objective satisfaction data collected from standardized questions regarding specific facets of care.[8]

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ABSTRACT

The purpose of study was to examine documentation quality and outcomes in a sample (n = 564 patient cases) of Diabetes Registry data from ANDHII, and to determine the validity and reliability of a revised NCP quality audit tool. RDNs have struggled to objectively demonstrate the value of MNT, which has limited MNT reimbursement and RDN recognition amongst allied healthcare providers. Development of a standardized process (the NCP), standardized language (the NCPT), and ANDHII have provided a means through which RDNs can improve MNT documentation and capture outcomes data, but gaps in adequate utilization exist. The most common etiology term used in the Nutrition Diagnosis was *food and nutrition related knowledge deficit* (56.65%) despite knowledge-based Nutrition Assessment terms representing less than 3% of all Nutrition Assessment terms used. Nutrition Interventions were mostly derived from the *Nutrition Education* domain (63.88%) with only 4.04% of Nutrition Interventions derived from the *Nutrition Counseling* domain. Only 146 patient cases (26%) had at least one follow-up visit (M = 1.40 visits). Factors most significant for predicting problem resolution included presence of the evidence-diagnosis link (p = .033) and location (p =.001). The revised NCP quality audit tool was found to have high validity (relevance: S-CVI-UA = .958, S-CVI-Ave = .979; clarity: S-CVI-UA = .917, S-CVI-Ave = .958), moderate inter-rater reliability (α = .668), and low to moderate intra-rater reliability (rater CC α = .860, rater MC α = .319). The revised tool exposed disparities in RDN documentation of clear NCP linkages not previously captured from the existing Diet-NCP-Audit tool. Better training for RDNs in the NCP, NCPT, and ANDHII, as well as improvements in NCP application is critical. RDNs must improve NCP and NCP linkages documentation, and capture outcomes through ANDHII in order to elevate the dietetics profession, expand MNT accessibility, and improve global health.

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CHAPTER ONE: LITERATURE REVIEW

The Nutrition Care Process (NCP)

Significance and Benefits of the NCP

The ideas presented in this dissertation will focus on the clinical application aspects of the Nutrition Care Process (NCP). Registered dietitian nutritionists (RDNs) acknowledge the potential of medical nutrition therapy (MNT) in resolving acute and chronic nutrition problems. However, capturing these outcomes in a meaningful, measurable way has often proved difficult, making it a challenge for RDNs to demonstrate the value of MNT in healthcare. This difficulty created the need for RDNs to build a framework through which to standardize the process of delivering MNT to patients, and elevate the profession of dietetics in terms of interdisciplinary healthcare. Proving the connection between MNT provided by the RDN and measurable outcomes amplifies the value of the RDN in patient care, and elevates the profession as a whole. Beyond capturing patient care outcomes, experts agree that the NCP advances the scope of practice for RDNs, and can significantly increase MNT efficiency and quality.[9] Hakel-Smith and Lewis[10] described the importance of the NCP and standardized language when they said, "The need for a standardized language for the clinical dietetics profession can be summarized as follows: If we cannot name it, we cannot control it, finance it, teach it, research it, put it into public policy, or claim reimbursement from it."[10]

Dietetic pioneers who built the foundation of the NCP did so using medical and nursing models as a foundation of thinking. The nursing practice has their own model of practice, which helps to frame the unique, specific way in which nurses impact patient outcomes; so do the physical therapy and occupational therapy disciplines.[11,12] The nursing care process provided a scaffolding upon which RDNs built the NCP built with verbiage identifying the specific function

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of an RDN in MNT.[10] Likewise, Lövestam and colleagues[13] describe some of the key benefits to the NCP as "the provision of support and a framework for critical thinking in nutrition care, improved clarity in communication and clinical documentation, and an increased acknowledgement of dietetics practitioners' unique competence among other health care professionals."[13]

MNT Cost-Effectiveness

Subjectively, RDNs know the value of MNT; and, while, difficult to find objective data supporting this stance, some data has emerged in recent years. As of 2002, stage 3-5 chronic kidney disease (CKD) MNT has been reimbursable through the Center for Medicare Services (CMS).[14] CMS's cost-savings projections considered the role of the RDN in preventing or delaying the need for renal replacement therapy (RRT) in CKD through comprehensive MNT.[14] The estimated annual cost in 2009 for an individual on hemodialysis (HD) was nearly $90K; and, for an individual on peritoneal dialysis (PD) nearly $70K.[14] By 2018, the per-person cost for HD was over $93K, and for PD was nearly $80K.[15] CMS recognized the value of MNT in CKD in terms of patient outcomes, and also in terms of cost savings.[14]

Because RDNs witness the link between MNT and positive patient outcomes every day in their individual practices, the question remains: why is CMS reimbursement of MNT not expanded further? For instance, the Centers for Disease Control and Prevention (CDC), has indicated that nutrition-related lifestyle changes can have a profound reduction in the development of Type 2 Diabetes Mellitus (T2DM), especially for those with prediabetes and/or obesity.[16] Yet, CMS reimbursement for these conditions is limited to specific parameters involved with treatment of Type 1 Diabetes Mellitus (T1DM), T2DM, Gestational Diabetes Mellitus (GDM) and CKD.[17] The Academy said in its 2010 Academy Position Statement, "RDs

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use MNT as a cost-effective means to achieve significant health benefits by preventing or altering the course of diabetes, obesity, hypertension, disorders of lipid metabolism, heart failure, osteoporosis, celiac disease, and chronic kidney disease, among other diseases"[18] MNT from an RDN also has been shown to have a profound impact on improving patient outcomes and reducing healthcare costs in patients found to have malnutrition.[19] In 2019, Hiesmayr and colleagues[20] emphasized the need for public policy initiatives to demonstrate the value of the MNT through the NCP on improving malnutrition outcomes and morbidity.[20] In 2020, Congress introduced the Medical Nutrition Act of 2020 bill in an effort to expand coverage of MNT for chronic conditions including, but not limited to, obesity;[21] at the time of this study, outcomes regarding this legislation are still pending in the United States Congress.

Public Policy

Similarly to Hiesmayr et al,[20] Myers[22] also emphasized the role of NCPT, then called *International Dietetics & Nutrition Terminology* (IDNT), in formulating public policy governing nutrition.[22] She particularly noted the importance of the asserting RDNs as nutrition diagnosticians in healthcare; which, in many ways, removed the hurdle of requiring the physician's consent to initiate a therapeutic intervention.[22] RDNs have universally been regarded as ancillary services, often an afterthought in situations where nutrition intervention has a powerful effect on prevention and treatment of acute and chronic conditions. Yet, the value of the RDN in healthcare is not only a powerfully subjective one with regard to the role of the RDN on the interdisciplinary healthcare team, but also an objective one in terms of insurance reimbursement. Even the concept of RDNs taking the reins on ordering diets has been extremely controversial in healthcare, as diet orders have traditionally been restricted to physicians. Myers[22] makes the point that when a physician places a physical therapy referral, the physical

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therapist has the expertise and clinical judgement to assess and treat the patient appropriately without explicit guidance from the physician; so, dietetics should be no different.[22] Additionally, a 2015 review by Ichimasa[23] noted that use of the NCP increased the likelihood of the physician endorsing the RDN's MNT prescription by 75-90%.[23]

Although the journey is still in progress, the continued efforts of the Academy and its international affiliates gained momentum in raising the profession of dietetics closer than ever before toward being recognized as the nutrition expert in healthcare. What is still needed is a clearly defined link between MNT from the RDN and improvement or resolution of acute and chronic conditions in order to demonstrate exactly what RDNs have been trying to prove all along: the true value of MNT. From the public policy vantage point, proper use of the NCP and NCPT are necessary for RDNs to continuously demonstrate the value of MNT through outcomes-based research, which is discussed in a later section.

History and Evolution of the NCP

In order to understand the NCPM existing today, one must understand the conceptional journey the NCP has made over the years. One of the earliest NCP visionaries, Marian I. Hammond, recognized the barriers imposed for capturing the role of MNT provided by an RDN in patient care and outcomes resolution, and sought to redefine a new nutrition practice structure to fill this need.[24] Hammond, Myers, and Trostler[24] displayed Hammond's hand-drawn, 1970 *Original Hammond Model*, entitled "Nutrition Counseling Cycle," in their 2014 Odyssey paper.[24] The 1970 Hammond Model depicted the cycle of a patient entering the care of the RDN through physician referral, and subsequently the patient then becoming the center of the approach to defining a nutrition problem, developing a nutrition prescription, planning, teaching, and following up with the patient.[24] Hammond continued refining her model of nutrition care,

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developing the 1977 *Nutrition/Dietary Counseling Cycle*; the 1984 *The Nutritional Care Planning Cycle: A Generic Philosophy;* and ultimately the 1986 *A Nutrition Care Process: A Generic Philosophy*.[24]

Shortly after the Hammond Model was last updated, Mary Ann Kight also proposed a nutrition care framework, albeit not as widely recognized by the Academy as the Hammond Model. Kight's method, reportedly was developed in 1985,[25] but first published in 1993, was called the *Nine-Step Nutritional Care Process*.[26] Additionally, Meyer and Gates[27] report that, although no formal model of nutritional care existed then, "Most authors recommend that the nutrition care process include the following kind of steps: data collection, problem identification, goal setting, implementation of activities, and evaluation of the effectiveness of the plan."[27] A 1995 article by Weddle and colleagues[28] also described a structured nutrition care process, which included "an initial Assessment;" "planned outcome(s);" "activities performed by dietitian to accomplish goal;" "complications occurring;" "documentation of outcomes;" and "acceptance of dietitian's recommendations."[28]

The Academy, formerly known then as the *American Dietetic Association* (ADA), recognized the need for consensus agreement for a nationally recognized, formal nutrition care model. In 1998, the American Dietetic Association formed the Health Services Research (HSR) Task Force.[11] In 1999, the HSR developed a draft of the *Nutrition Care Model*, which was later published in 2001 by Splett and Myers.[11] Also in 2001, the Academy officially defined MNT in order to facilitate policy governing CMS reimbursement for MNT.[22] In 2002, the Academy's House of Delegates (HOD) Quality Management Committee launched the Nutrition Care Model Workgroup.[12] In 2003, Lacey and Pritchett[12] published the *Nutrition Care Process and Model*, a graphic representation streamlining the role of MNT from an RDN on patient outcomes[12] The

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Nutrition Care Process and Terminology Committee (NCPTC) was established in 2005 as a stand-alone committee,[29] and is responsible for updating and revising the NCP and NCPT in conjunction with the NCPT Advisory Workgroup.[30] The Nutrition Care Process and Model (NCPM) is revised periodically, and the most recent version has emphasized outcomes/people-centeredness, and re-assessment in the paper by Swan et al.[31]

The NCP in Detail

Once a strategic understanding of NCP is built, a tactical understanding must also be built in order to fully conceptualize the NCP. The modern-day NCP contains four steps: *Assessment, Diagnosis, Intervention, Monitoring & Evaluation*, otherwise known as the acronym *ADIME*.[31] In their 2005 paper, Hakel-Smith and colleagues[32] referred to the NCP as upholding the scientific method in the following quote:

> The commonalities found in the defined nutrition care processes reflect six steps or clinical judgments that are consistent with the scientific problem-solving process. Six steps or clinical judgments include:
> (a) deliberate collection of evidence,
> (b) determine diagnosis,
> (c) determine etiology,
> (d) establish goals,
> (e) determine and implement interventions, and
> (f) measure and evaluate patient outcomes.[32]

Lacey and Pritchett[12] were careful to distinguish the difference between *a standardized process* as compared to *standardized nutrition care*.[12] Standardizing the *process* in which RDNs provide nutrition care organizes the way in which individualized care is provided, not to be confused with standardized nutrition care, which would make the care the exact same for all patients receiving MNT.[12] A significant amount of critical thinking, expertise, and evidence-based clinical judgement is the solid foundation upon which the NCP is built, and allows for tailor-made nutrition care in the setting of a standardized process.

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Before the NCP can be applied, the patient must have been screened for the appropriateness or need for referral for MNT from the RDN. Some third-party payers, such as CMS, actually require the referral be placed by a physician.[33] Some private third-party payers cover MNT regardless of the referral method; the referral process requirements also vary by state licensure laws.[33] Inadequate nutrition screening, especially in the context of malnutrition, negatively impacts patient outcome and healthcare expenses.[34]

Patient screening to determine who would benefit from MNT in terms of nutrition acuity is required within 24 hours of admission as inpatient, which has been required by The Joint Commission since 1995, and agreed upon by The Academy and the American Society for Parenteral and Enteral Nutrition (ASPEN).[34] It is critical for those performing the nutritional risk screen to use a screening tool which has been tested for validity and reliability in that particular patient population.[34] Although MNT through the NCP must be provided by an RDN, virtually anyone can screen patients as long as the screening tool is valid and reliable.[34]

NCP Assessment

Once the patient is screened to be positive for nutritional risk, the patient is then referred to the RDN for assessment. The Nutrition Assessment step should not be confused with screening; rather, the Nutrition Assessment step occurs as a result of a positive screen for nutrition referral. As Field and Hand[34] state, "The Academy defines screening as 'the process of identifying patients, clients, or groups who may have a Nutrition Diagnosis and benefit from Nutrition Assessment and intervention by a registered dietitian.'"[34] Field and Hand[34] also state "The Academy defines Nutrition Assessment as the process 'to obtain, verify, and interpret data needed to identify nutrition-related problems, their causes, and significance.'"[34]

The RDN is the only qualified practitioner to perform the Nutrition Assessment. Upon

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the initial Nutrition Assessment, the RDN is charged with collecting and analyzing all relevant subjective and objective data available concerning the patient's nutritional situation. The RDN then compares the data collected against evidence-based nutrition practice guidelines (EBNPGs). Included in the 2020 eNCPT update is a section for "Comparative Standards," a critical part of an objective Nutrition Assessment which defines how the RDN compared the observed data to evidence-based standards.[35] It is within the Nutrition Assessment step of the NCP where the RDN is charged with applying the unique critical thinking and professional expertise which is the core of MNT. During follow-up visits, the re-assessment entails the RDN comparing the newest data against both EBNPGs and data from the Nutrition Monitoring & Evaluation NCPT from the last visit.[34]

Nutrition Assessment NCPT terms fall into eight different domains: Food/Nutrition-Related History; Anthropometric Measurements; Biochemical Data, Medical Tests, and Procedures; Nutrition Focused Physical Findings; Client History; Assessment, Monitoring & Evaluation Tools; Etiology Category; and Progress Evaluation.[35] Because the findings in the Nutrition Assessment determine the etiology of the Nutrition Diagnosis, the newest 2020 eNCPT update for *Nutrition Assessment and Monitoring & Evaluation Terminology* includes a section for "Etiology Category," which is an important component to help target an appropriate Nutrition Intervention.[35] Subjective and objective Nutrition Assessment data can be obtained from multiple modalities, including the RDN chart review for information from the interdisciplinary team; from team rounds when applicable; from the patient's caregiver and/or family members; and, of utmost importance, from the patient interview. The Nutrition Assessment step requires the RDN to critically think and apply evidence-based expertise to determine what the nutrition problem is, and what steps are going to be most appropriate to correct the nutrition problem using MNT.

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NCP Diagnosis

After the Assessment step in the NCP comes the Nutrition Diagnosis step. Many argue that the centerpiece of MNT, around which the NCP revolves, is the Nutrition Diagnosis.[36] Susan Ramsey said, "The second step forces us to make a one-line statement. It brings the whole assessment into one clear vision."[37] In the 2008 NCPM update, the Academy highlighted that the NCP does not limit the RDN to only one Nutrition Diagnosis if the individualized situation warrants two or more.[31] However, if more than one Nutrition Diagnosis is chosen, care must be taken to list those that will impart the greatest impact toward problem resolution.[38] Outcomes research focused on determining how MNT produces problem resolution requires an expertly crafted Nutrition Diagnosis.

The Diagnosis NCPT terms fall into three different domains: Intake, Clinical, and Behaviorial-Environmental.[39] The Diagnosis step uses the acronym PES, which stands for "Problem," [as evidenced by] "Etiology" [related to] "Signs and Symptoms." The PES is the collective representation of the Nutrition Diagnosis, and is formed from the RDN's clinical and critical-thinking skills synthesizing all relevant Assessment data into a coherent nutrition problem capable of change through Nutrition Intervention, which is the next step in the NCP. The problem indicates the "what?" of the nutrition problem; in other words, the problem is the outcome which is contributing to a disease or condition. The etiology is the "why?" of the nutrition problem; it is the most likely reason the problem is occurring. The etiology could also be considered the "cause," and the problem the "effect." Finally, the signs and symptoms are the "how do you know?" or the indications that have led you to the conclusion that this is the problem and what is causing it. The *Signs & Symptoms* portion of the PES statement should contain the nutrition care *indicators*, defined as "markers that can be measured and evaluated to

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determine the effectiveness of the nutrition care,"[40] which stem directly from the Nutrition Assessment. The nutrition care indicators should also be included in the Nutrition Monitoring & Evaluation step (discussed later), and should be re-assessed upon the patient or client's return for follow-up visits to evaluate progress toward problem resolution.

NCP Intervention

After Nutrition Assessment and Diagnosis in the NCP comes the Nutrition Intervention step. The role of Nutrition Intervention in the NCP is to target the etiology of the Nutrition Diagnosis in order to formulate a plan to overcome or manage the etiology and lead toward problem resolution. Evidence-based guidelines should be utilized for the Nutrition Intervention.[36] The Nutrition Intervention should be formulated in collaboration between the RDN and the patient. Swan et al[41] described the Nutrition Intervention as, "…a planned set of specific behaviors or actions performed, delegated, coordinated, or recommended by a professional that move a client toward a desired outcome."[41]

The Nutrition Intervention NCPT terms fall into five different domains: Food and/or Nutrient Delivery; Nutrition Education; Nutrition Counseling; Coordination of Nutrition Care; and Population Based Nutrition Action.[42] The Nutrition Intervention is where the Nutrition Prescription and goals are clearly defined and target the problem defined in the Nutrition Diagnosis step using the Nutrition Assessment findings. A diverse array of Nutrition Intervention strategies from multiple domains should be considered while still individualizing care in order to empower the patient to implement lasting change.

NCP Monitoring & Evaluation

The final step in the NCP is the Nutrition Monitoring & Evaluation step. The real magic in research concerning the NCP happens within the Nutrition Monitoring & Evaluation step

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since the concepts chosen by the RDN to monitor and evaluate can be compared over the course of time, ultimately creating the data for outcomes-based research. The Nutrition Monitoring & Evaluation is a means of measuring the effectiveness of the chosen intervention on the Nutrition Diagnosis in the context and relevance of the Assessment. All of the previous steps—Nutrition Assessment, Diagnosis, Intervention—mold the Nutrition Monitoring & Evaluation step through defining what exactly the target outcomes are so that, within the Nutrition Monitoring & Evaluation step, we can determine how we will track these outcomes. Nutrition care outcomes are defined as "the results of nutrition care that are directly related to the Nutrition Diagnosis and the goals of the intervention plan. Anticipated short- and long-term outcomes can be defined."[40] Nutrition care outcomes should be differentiated from overall health care outcomes, although health care outcomes can be positively impacted by nutrition care outcomes.[40] Nutrition care outcomes involve improvement or resolution of the *nutrition* diagnosis through MNT and the NCP. Overall health care outcomes involve improvement or resolution of the *medical* diagnosis through interdisciplinary care, including the RDN.

The Nutrition Monitoring & Evaluation NCPT terms fall into seven different domains**:** Food/Nutrition-Related History Outcomes; Anthropometric Measurement Outcomes; Biochemical Data, Medical Tests, and Procedure Outcomes; Nutrition-Focused Physical Finding Outcomes; Assessment, Monitoring, and Evaluation Tools; Etiology Category; and Progress Evaluation.[40] The 2020 update to the eNCPT *Nutrition Assessment and Monitoring & Evaluation Terminology* includes a new section for "Progress Evaluation," which standardizes the evaluation for goal and nutrition statuses.[43] This revision better defines goal progress and problem resolution for the RDN to contribute toward outcomes research. The goals of the Nutrition Intervention are assessed in the follow-up visit as "new goal identified," "goal achieved," "goal

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discontinued," and "goal not achieved."[35] The Nutrition Diagnosis status is assessed as "new Nutrition Diagnosis," "active Nutrition Diagnosis," "resolved Nutrition Diagnosis," and "discontinued Nutrition Diagnosis."[35]

Standardized Language within the NCP

At the same time the Academy rolled out the NCPM in 2003, the Standardized Language Task Force of the ADA also came together.[9] Leaders realized that, with a newly standardized NCPM, consistent verbiage must also ensue, and therefore created the IDNT.[9] Without standardized language in the way the RDN documents MNT, we are unable to compare data to determine any appreciable outcomes coming from MNT. Plans for international implementation of the NCP and IDNT commenced in 2005 with a meeting with dietetic leaders from seven countries, and key subject-matter experts from the creation of ICD and Systematized Nomenclature of Medicine (SNOMED).[9] In order to underscore the connection with NCP, the nomenclature from IDNT changed to *Nutrition Care Process Terminology* (NCPT) in 2014.[41]

The NCPT standardizes the way RDNs communicate with the interdisciplinary team regarding patient care, and standardized language defining outcomes is paramount for MNT insurance reimbursement.[10] The practice of MNT by RDNs seemed inadequately captured by the existing nomenclature used within the medical field, particularly International Classification of Diseases (ICD) and Current Procedural Terminology (CPT) coding.[44] The dietetics field made progress in 2001 when legislation passed to include reimbursement for MNT under Medicare Part B,[11,12,22,45] and the American Medical Association (AMA) added MNT to the CPT.[11,26]

RDN Value

Standardized, professional, comprehensive medical nutrition therapy language underscores the value of the RDN in the medical model. At the same time the NCPM was

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developed, so was the IDNT.[44] In 2006, only 62 Nutrition Diagnosis terms existed within the IDNT.[41] Now, after many revisions over several years, 166 Nutrition Diagnosis terms exist.[41] The International Confederation of Dietetic Associations endorsed global use of the IDNT.[9] Swan and colleagues[41] provide a summary of the transition from IDNT to NCPT; development of the print versions one, two, three, and four of NCPT; eventual conversion of the NCPT to the completely electronic NCPT (eNCPT) in 2014; and a detailed description of the specific changes within the NCP revisions.[41] Some of the major changes from the 2008 update to the 2015 update include the addition of criteria for the Nutrition-Focused Physical Exam (NFPE), malnutrition term updates, revisions which streamline each step, and the inclusion of the Academy of Nutrition and Dietetics Health Informatics Infrastructure (ANDHII) to collect data which facilitates research.[41] The NCPT Advisory Workgroup published the newest update to the eNCPT in 2020.[7] Major changes in the 2020 eNCPT include the addition of "Etiology Matrix Category" and "Progress Evaluation" domains to the *Nutrition Assessment and Monitoring & Evaluation Terminology* reference sheets; updated terms in the "Beliefs and Attitudes" section of the *Nutrition Assessment and Monitoring & Evaluation Terminology;* language differentiating "planning" versus "implementation" within the Nutrition Intervention step; and the addition of a clearly defined goal progress section within the *Nutrition Intervention Terminology* reference sheet.[7]

Standardized language provides a uniform method for RDNs to link MNT with outcomes. Especially with regard to the transformation of documentation from paper records to the electronic medical record (EMR), a uniform method of tracking RDN input within the NCPM became possible; and, conversely, the NCPT facilitated documentation structure when building the MNT charting templates in the EMR. In fact, when RDNs are surveyed for factors

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which have influenced their implementation of the NCP, one of the most common factors positively associated with successful implementation of NCP by RDNs is the availability of the EMR.[46–50]

International Translation

Implementation of standardization language through NCPT internationally required translating the terms into other languages. One barrier of translation is the differences in vernacular across cultures, in which case there may not be a direct translation of a word or phrase. Japan was the first country to translate the NCPT.[41] Later, McGreevy and Orrevall[51] provided great detail in their 2017 paper on the process of translation of NCPT from English to Swedish.[51] Subsequently multiple countries followed suit; as of 2020, the NCPT is available in eleven different languages: Chinese, Danish, British English, French (Canada), German, Italian, Japanese, Korean, Spanish (Mexico), and Swedish.[52] Additionally the eNCPT has been translated into several different languages: Spanish (Mexico), Swedish, German (Switzerland), French (Canada), Norwegian, Danish, Simplified Chinese (China), Traditional Chinese (Taiwan), and soon Portuguese (Brazil).[52]

Gabler et al[5] describes the importance of "interoperability" concerning internationally standardized language, "concept harmonization," and "term harmonization," in order to ensure MNT practice documented anywhere in the world means the same thing in one country as it does in another.[5] Gabler and colleagues[5] compared the NCPT to the International Classification of Functioning, Disability, and Health-Dietetics (ICF-Dietetics) in order to determine overlap and linkages through mapping; they found direct or similar connection between 86.5% of the NCPT vs the ICF-Dietetics.[5] Similarly the Academy's Standardized Language Committee continued exploring international NCPT development in conjunction with the Norwegian Expert

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Workgroup as described in the 2019 paper by Lorenzen and colleagues.[53] The Norwegian Expert Workgroup mapped the NCPT with their existing medical coding system, the Norwegian Classification of Medical Procedures (NCMP), along with the ICD-10.[53] Authors provide a detailed description of the methods used to map the ICD, NCMP, and NCPT; ultimately, a direct or similar connection between the ICD-10 and NCPT existed in only 6% of terms.[53] When the NCPT was compared to both the ICD-10 and NCMP, no direct nor similar connection existed in 49% of nutrition diagnostic terms and 98% of intervention terms.[53] These findings underscore the importance of having nutrition-specific standardized language, as many of the overarching medical classification systems are simply unable to capture the depth and breadth that is MNT.

The modern day advent of virtual MNT from RDNs, especially concerning international practice with "cross-border communication,"[5] further underscores the inherent need for standardized language in the dietetics practice. Both the NCPT and the Classification and Coding Lists for Dietetics (CCD), particularly the ICF-Dietetics, are utilized for dietetics-specific standardized language in Europe.[5] In a 2012 report from Yuill through the European Federation of the Association of Dietitians (EFAD)[54] found that IDNT was the most widely utilized standardized language among RDNs in Austria, France, Germany, Greece, Holland, Italy, Norway, Sweden, Switzerland, and Turkey, despite access to ICF, ICF-Dietetics, and Polish Society of Sciences and Polish National Food & Nutrition Institute Standardized Language.[54]

ANDHII

Although the need for a standardized language seemed to be filled by the NCPT, researchers still found a gap in the ability to extract NCPT and outcomes data; that is, until 2014, when ANDHII was created.[55] ANDHII is a web-based program which allows RDNs to enter real, automatically de-identified patient data into the Dietetics Outcomes Registry (DOR) to allow for

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extrapolation of outcomes data with the potential to demonstrate the link between MNT and positive patient outcomes. Multiple subset registries exist within the DOR, which further categorize the data the RDN is entering for later analysis by researchers. One key benefit of ANDHII is RDNs whose facilities have not transitioned to the EMR can still have a means to electronically capture their NCP data, thus removing the EMR as a barrier to entry of outcomes-data.[8] Furthermore, the strategic flow of dietetics practice is completed with the functionality of ANDHII: the Evidence Analysis Library (EAL) fuels the NCP, which provides data entered into ANDHII; the outcomes data aggregated from ANDHII fuel evidence-based practice (EBP); and the cycle continues.[55] Studies in ANDHII have been, and continue to be, very helpful to identify gaps in ANDHII, and to identify specific improvements needed.

In 2018, Kuo et al[6] tested another informatics modality based on NCP in Taiwan, called the Clinical Nutritional Information System (CNIS).[6] CNIS is similar to ANDHII in many ways, such as creating a streamlined, electronic approach to documenting the NCP using pre-populated NCPT and facilitating the connection between steps.[6] Differences between CNIS and ANDHII include the integration of CNIS with validated screening tools such as the Subjective Global Assessment (SGA), the Patient-Generated Subjective Global Assessment (PG-SGA), and the Malnutrition Universal Screening Tool (MUST), and the ability for CNIS to generate the patient's estimated energy needs from manually entered subjective and objective information.[6] Authors found a significant improvement in NCP documentation efficiency and satisfaction among the RDNs who transitioned to CNIS from paper charting.[6] On a similar scale, Chen et al[56] introduced the idea of a NCP-based smartphone application designed to improve the RDN-patient connection and outcomes gathering through a digitized NCP framework. Authors indicate that if it is more convenient for the patient, both compliance and outcomes are likely to improve.

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NCP Chain Links

In their 2015 paper, Thompson and colleagues[57] further explored the idea of the NCP step linkage, or chains, first mentioned by Hakel-Smith et al[32] in 2005, and their role in closing the gap between MNT and proof of effectiveness.[57] Authors explained the importance of NCP chains in the context of how these clear linkages give life to the thought process of the RDN in establishing and attempting to resolve a nutrition problem within the setting of the NCP.[57] Authors also describe NCP chains as a critical component of establishing EBNPGs when combined with outcomes research, as a clear delineation of how that outcome was achieved in that particular condition through the NCP chain.[57] Just like Murphy and colleagues[55] indicated with the rollout of ANDHII, Thompson and colleagues[57] reiterate the fact that ANDHII enhances the strategic flow of dietetics practice: the EAL fuels the NCP, which provides data to be entered into ANDHII; the outcomes data aggregated from ANDHII fuels EBP; and the cycle continues.[55,57]

In 2018, Murphy and colleagues[58] put this theory of ANDHII's usability to the test, with special emphasis on NCP chains and RDN views of use.[58] The RDNs participating in the study were trained on how to use ANDHII.[58] One of the most common themes concerning NCP documentation gaps, which is the absence of complete linkage amongst all the steps in the NCP, and within PES statement itself, surfaced within this study.[58] Authors also note that, despite the perception amongst RDNs regarding the length of time required to enter ANDHII entries being high, findings indicated that practice makes the time concern nearly obsolete.[58] Findings of this study also indicate that exposure to and practice with ANDHII are key aspects of positively altering the RDN experience, and increasing likelihood of future or continued use.[58]

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Murphy et al[58] further contributed to the idea of NCP chain linkages by defining criteria for examining each of the chain links individually as part of the entire complete NCP chain. First, authors describe the "evidence-diagnosis link" as:

> "…the evidence-diagnosis link was present or absent by examining the recorded assessment terms and signs and symptoms listed in the PES statement. If at least one selection from signs and symptoms matched a reported assessment term, and the finding was evaluated and considered by the participant RDN as abnormal (eg, above normal blood pressure), the evidence-diagnosis link was present."[58]

Next, the "diagnosis-etiology link" was complete if "at least one etiology was assigned to the diagnosis."[58] Authors explain that "a complete etiology-intervention link included at least one Nutrition Intervention that was entered and assigned to the reported etiology."[58] Each intervention must have a goal assigned to it for the "intervention-goal link" to be complete.[58] Finally, authors considered the "diagnosis-outcomes link" complete "if at least one monitoring parameter was selected for the diagnosis."[58]

In a groundbreaking 2020 study, Lewis and colleagues[59] examined the impact of NCP chain linkages on problem resolution in a sample of Veterans Health Administration patients.[59] Authors' major findings included a greater than 50% increased likelihood of problem resolution when the etiology-intervention link was present, and a nearly 20% increased likelihood of problem resolution when the evidence-diagnosis link was present.[59] Authors utilized the Diet-NCP-Audit tool to score the quality of documentation, and found a significant impact on problem resolution as the quality score increased.[59] These findings provide evidence of the power of completed NCP chain linkages and quality of NCP documentation on problem resolution, which is a key element of proving the link between MNT and outcomes.

NCP Audit

Although the NCPM has been in its most current existence since 2008, gaps still exist

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within the practicing international dietetics community where the NCP is not widely embraced. Even within the populations in which the NCP has been adopted, discrepancies in the way it is documented are known to exist.[32,60] As of March, 2009, accredited didactic dietetic program instruction officially required inclusion of education on the NCPM.[31] Therefore, RDNs who received their didactic program education after 2009 were likely educated on the NCP and NCPT. However, RDNs in practice prior to the implementation of NCP and NCPT have had to change the way they practice, and especially regarding how they document MNT. The Academy outlined the requirement for use of the NCP in the 2017 Scope of Practice for the Registered Dietitian Nutritionist (RDN).[61]

The Academy has multiple papers defining the Standards of Practice (SOP) and Standards of Professional Performance (SOPP) for various RDN settings. The most general standards encompassing the general practice as an RDN is found in The Academy Quality Management Committee's Revised 2017 SOP and SOPP for the RDN.[62] Although each area of dietetics practice has some defining differences regarding what determines the RDN "competent, proficient, and expert," every Academy SOP and SOPP has the NCP at its core, including the SOP and SOPP for RDNs in Mental Health and Addictions;[63] Nutrition Support;[64] Public Health and Community Nutrition;[65] Diabetes Care;[66] Adult Weight Management;[67] Pediatric Nutrition;[68] Integrative and Functional Medicine;[69] Post-Acute and Long-Term Care Nutrition;[70] Sports Nutrition and Dietetics;[71] Personalized Nutrition;[72] and Food Insecurity.[73]

NCP Implementation Experiences

Gardner-Cardani et al[74] describe how using pilot or "test" groups to implement the NCP in a facility can ease the minds of the team by allowing room to make mistakes and learn from them before fully transitioning as a team.[74] Like the study from Mathieu and colleagues,[37] this

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study found some of the largest enablers of NCP implementation to be the use of pilot RDNs/groups of RDNs; ongoing support and education, and an extensive preparation period before transitioning to be the keys to success with the transition to full NCP usage.[37,74] Authors also surveyed RDNs and found that many viewed the NCP would add time to their documentation and workload,[74] but other studies have actually found the contrary, especially after RDNs had adequate time for practicing NCP.[23,75,76] A 2017 study by Vivanti and colleagues[75] and another, nearly identical, study in 2018[77] of the long-term outcomes regarding NCP implementation found leadership support to be key in successful NCP implementation; other key findings included improvement in NCP documentation ease and duration with continued practice.[75,77]

The Virginia Hospital Center in Arlington and the Veterans Affairs Medical Center in San Diego, CA, were among the first institutions to implement the NCP.[37] Leaders at these facilities provided extensive education and ramp-up for their roll-out of NCP as the new expectation for documentation, and audited a large portion of chart notes in the beginning using the Hakel-Smith Coding Instrument.[32,37] The audits facilitated constructive feedback as the transition occurred; and leaders mention a notable improvement amongst the beginning audits compared to later audits, indicating increased proficiency and comfortability amongst the RDNs in the pilot group.[37] Authors credit significant preparation and education prior to transitioning, ongoing team collaboration, including documentation practice workshops, for the successful transition to NCP at their facilities.[37] Of note, the Academy now has a plethora of tools available to assist RDNs and facilities with the implementation to NCP, including (but not limited to) presentation slides with a comprehensive overview of each step in the NCP.[78] Experiences were quite similar when described by Van Heukelom et al[79] in their 2011 NCP rollout in Canada.

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Obtaining buy-in from RDNs on effective, consistent implementation of the NCP requires a clear idea of the rationale behind the NCP, especially its propensity to elevate the role of MNT from the RDN in healthcare and its function within outcomes-based research.[36] Orienting the RDN to the NCP allows the RDN to have the opportunity to fully understand what the NCP is, why the NCP is important, and how to incorporate NCP documentation into practice. For instance, in 2005, Hakel-Smith and colleagues[32] compared the NCP documentation amongst two different groups of RDNs. Group A had extensive NCP education initially and recurring; Group B had no NCP education beyond their baseline of nutrition care expectations established by The Joint Commission.[32] Group A documented complete NCP step linkages more often than Group B ($p < .001$).[32] McCarthy[80] emphasizes in her 2015 commentary that, for research on the linkage between MNT and patient outcomes to be effective, RDNs must keep the integrity of the NCP and NCPT within their documentation.[80]

In 2017, Lövestam and colleagues,[50] surveyed RDNs in Sweden on their views of NCP, and found resources, support (both peer and leadership), and adequate time to have the most positive influence on the transition to NCP.[50] In 2018 O'Sullivan and colleagues[81] surveyed RDNs in Australia, Singapore, and New Zealand on their views of NCP.[81] Authors found that lack of training and support, lack of understanding the rationale or benefits of NCP in patient care, and lack of motivation to change were among the biggest barriers to success with RDNs implementing the NCP into their practice.[81] Carpenter et al[76] also found adequate training to be the quintessential aspect of successful NCP implementation when they surveyed pediatric RDNs in Canada in 2019.[76] Memmer[82] highlighted the rationale for renal RDNs to get excited about NCP in practice, and also identified that a large barrier to implementation is simply the difficulties many RDNs have embracing change.[82]

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Also in 2017, Lövestam and colleagues[83] administered a survey with ten different countries to examine their approaches toward implementing NCP.[83] Authors explain that, while most of the countries surveyed were knowledgeable about NCP, Australia, New Zealand, and the United States had the highest rates of RDNs using NCP.[83] Authors also introduce the notion that the NCPT may not be sufficient for the needs of all areas and geographic locations of dietetics practice, and the inpatient setting seems to utilize the NCP the most.[83] In 2019, Lövestam and colleagues[84] published a secondary analysis on the data from their 2017 10-country survey results, in order to determine the "barriers and enablers experienced by nutrition and dietetic professionals of NCP…"[84] Major findings included the least barriers and most enablers were found in the countries with the most NCP use; national guidelines were a significant enabler; and many RDNs reported they viewed the NCP as too time-consuming.[84]

Later, in 2019, Lövestam and colleagues[13] used their previous findings on the international implementation of NCP to test the validity and reliability of a new survey tool in order to better apply a standardized way of exploring the difficulties and successes with NCP amongst different countries in the hope of improving global NCP quality as well as improving patient outcomes.[13] The *International NCP/NCPT Implementation Survey* tool was found to be both valid and reliable for use in evaluating NCP use globally.[13]

In their 2020 study, Alkhaldy and colleagues[85] surveyed a cross-section RDNs in Saudi Arabia to determine barriers and enablers with implementing the NCP.[85] Results indicated a very high level of awareness and understanding of the NCP, while a relatively low number of RDNs reported having been formally taught the NCP.[85] Among the highest barriers to implementation, struggles with applying ADIME documentation was the top barrier, along with lack of familiarity, difficulties applying the NCP with regard to established facility policy, and

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inadequate staffing.[85] Kim and colleagues[86] also surveyed a cross-section of RDNs in Korea, and findings can be summarized as a need for initial and ongoing training on the NCP for RDNs to have success with incorporating it into regular practice.[86]

Inconsistent Documentation

In their 2016 publication, Enrione and colleagues[87] describe some of the discrepancies in NCP documentation, especially the lack of uniform interpretation within the Nutrition Diagnosis step of the NCP.[87] Authors state, "A clinically reliable and valid Nutrition Diagnosis is one that RDNs predicatively and consistently choose when interpreting the same Assessment data that occur in practice."[87] This reliability amongst RDNs in the documentation of NCP is critical in building trust in the dietetics profession among our allied healthcare colleagues. Results of the Enrione[87] study highlight some aspects of the NCP that must be addressed in future revisions if the dietetics profession is to truly provide standardized care. Matthews, Palmer, and Capra[88] examined if the use of NCP and NCPT among RDNs was accurately standardized and reliable across the dietetics practice, globally.[88] Findings indicated an undesirable variance among the NCPT selected, and authors suggest that inadequate training may be to blame.[88]

In 2014, Lövestam et al[60] tested the validity and reliability of the *Diet-NCP-Audit* tool, a version of which was previously introduced by Hakel-Smith et al,[32] for evaluating NCP charting quality.[60] The Diet-NCP-Audit tool contains 14 questions with a choice of 0, 1, or 2 points for each question (except questions 13-14 are scored 0, 0.5, or 1) based on a specific quality-level rubric manual totaling a maximum of 26 points.[60] Authors found the Diet-NCP-Audit tool to have high validity and reliability, albeit in a small sample of RDNs and patient charts.[60] The tool was further validated in a retrospective review of Swedish RDN NCP documentation.[89] A key aspect from much of the analyzed NCP charting was the absence of a clear linkage of all the

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steps in the NCP, and inclusion of information not completely relevant to the identified problem.[89] The Diet-NCP-Audit tool is currently the only available validated NCP audit tool, although researchers are considering revised options. In 2015, Field and colleagues[34] provided a detailed description of how to test validity and reliability of a prospective evaluation tool.[34]

Data Aggregation

Despite the significant progress in the international NCP revolution since 2003, and the transition to the EMR in nearly all healthcare facilities, the missing piece of the puzzle in MNT outcomes is finding a way to pool together NCP documentation for various conditions in order to analyze patient outcomes for a chosen condition. Enter ANDHII, the missing piece of the puzzle. When RDNs enter NCPT for each step of the NCP into ANDHII, researchers are then able to extract the data and analyze the associations between MNT, nutrition problem improvement or resolution, and patient outcomes as a whole. Because of the nature of standardized language within the NCPT, ANDHII facilitates obtaining statistics capturing how each of the steps of the NCP influence outcomes, independently or when grouped in chains.

In 2012, prior to the development of ANDHII, Hand and colleagues[90] developed a computerized algorithm to assist RDNs in decision-making and NCP documentation for CKD patients on HD.[90] Findings of this pilot study indicated a new tool streamlined the application of the NCP for RDNs and provided a means of data collection.[90] However, authors also observed a "wide variation" in terms used, which would indicate a concern for the reliability of the NCPT among MNT for HD, and an area for future research.[90]

In 2019, Chui and colleagues[8] catapulted the dietetics profession forward with their pivotal work with combining NCP outcomes data, ANDHII, and the DOR's National Quality Improvement (NQI) dataset.[8] The NQI project allowed researchers to utilize the Diet-NCP-Audit

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tool against the NQI dataset, problem resolution, patient-reported outcome measures (PROMs), and patient-reported experience measures (PREMs) to determine how NCP chains and quality affect outcomes.[8] Findings from this study have set the stage for refining the NCP and NCPT, and ultimately improving how RDNs are utilizing these key tools for practice standardization. This study stemmed directly from the work done in the NQI project by Chui and colleagues;[8] therefore, this project applied very similar aspects of their methodology to the DOR's Diabetes Registry.

Other countries are also making efforts to connect MNT with outcomes. A 2010 review from Atkins and colleagues[91] concluded that the NCP and standardized terminology are paramount in proving outcomes from MNT in Canada.[91] In their 2018 paper, Vanherle et al[92] described results from the Improvement of Education and Competencies in Dietetics (IMPECD) project through the European Union.[92] Authors reviewed different nutrition care settings in Belgium, Netherlands, Austria, and Germany, in the context of dietetic indicators and outcomes data.[92] Major findings included that problem resolution was not guaranteed from a "good intervention" without the connection to goals and distinct outcome monitoring through use of standardized language, and vice-versa.[92] In 2019, The Allied Health Professions (AHP) Outcome Measures United Kingdom (UK) Working Group published a checklist to facilitate the capture of outcomes data in order to objectively assess the effectiveness of interventions.[93] The AHP Outcome Measures UK Working Group is multidisciplinary amongst healthcare professions, including the Royal College of Speech and Language Therapists, the British Dietetic Association, the Chartered Society of Physiotherapy, the College of Podiatry, the Institute of Osteopathy, and the Royal College of Occupational Therapists.[93] The AHP checklist was developed as tool for clinicians to utilize to assist in selecting quantifiable outcomes that are

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reproducible and effective in capturing effectiveness of discipline-specific healthcare interventions.[93]

In 2020, the EFAD Professional Practice Committee published a policy paper summarizing the existing support for standardized methods of quantifying outcomes associated with Nutrition Interventions, and recommend widespread adoption of standardized language in dietetics practice.[54] Further, authors stressed inclusion of standardized language in academic curricula, as well as the importance of globally accessible "data pooling" to support more extensive dietetics outcomes research.[54] Authors also recommend RDNs utilize quality documentation, including NCP chain linkages, PROMs, and PREMS, to support dietetics outcomes research and policy efforts to fund MNT.[54] These collective findings accentuate the importance of using standardized language in documentation; they also underscore the importance of connecting interventions, goals, and monitoring of outcomes.

NCP Outcomes

Understanding the connection between outcomes and MNT is a key factor in demonstrating the role of the RDN and the NCP in healthcare. The following sections detail the existing evidence concerning the clinical application of NCP in chronic health conditions.

CVD

Although cardiovascular disease (CVD) remains one of the leading causes of death globally, and existing evidence supports the role of nutrition as a key element in preventing and treating CVD,[94] CVD MNT is not currently reimbursable through CMS. A likely barrier for MNT reimbursement is the lack of evidence supporting a *direct* linkage between CVD prevention programs, weight management programs, and/or CVD MNT with measurable, positive outcomes. Kang and colleagues[94] demonstrated improvements in CVD-related outcomes

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when performance standards were defined for CVD MNT in accordance with the NCP.[94] Myers and colleagues[95] found that use of EBNPGs resulted in improved serum cholesterol levels when compared against "usual care" as defined in India at that time.[95] A 2018 systematic review and meta-analysis from Sikand and colleagues[96] found a significant positive impact of MNT on body mass index biochemical markers associated with dyslipidemia.[96]

Malnutrition in Cancer and CKD

Kuo and colleagues[6] mention the positive impact nutrition care can have on cancer and malnutrition.[6] Steiber[38] reviewed that evidence for the positive impact of combining the NCP with validated tools such as the SGA or the Malnutrition Inflammation Score (MIS) in MNT for CKD is underscored by linking the indirect role of MNT in resolving the underlying morbidities for CKD, such as obesity or malnutrition, uncontrolled T2DM, micronutrient imbalances, macronutrient imbalances, and overall energy intake.[38] The Academy's 2010 Position Statement on the MNT with pharmacotherapy emphasized the improvement in patient outcomes when these interventions are used in concert with one another.[18]

Campbell et al[97] observed a significant improvement in SGA scores for malnutrition in patients with CKD who received MNT.[97] Ruperto and colleagues[98] magnified the role of MNT in the evolution of CKD, stating, "[protein-energy wasting] PEW/cachexia is a predictable event in many HD patients, readily diagnosed by Assessment of body weight, change in appetite, low albumin and a concomitant increase in bioinflammatory markers," and that MNT is a critical piece of the treatment plan for patients with CKD.[98] In 2014, Beto, Ramirez, and Bansal[14] described the existing evidence in support of MNT targeting the biochemical and anthropometric risk factors associated with the progression of CKD, including a 19% reduced mortality rate in dialysis patients.[14]

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In a 2014 case study in Korea, Lee and Lee[99] examined the impact of MNT on outcomes associated with malnutrition and cancer.[99] Although authors describe the patient as already malnourished upon presenting for MNT, and despite chemotherapy-related barriers to adequate energy intake, MNT positively impacted the patient's energy intake. Authors also note that this patient was medically diagnosed with malnutrition on multiple previous occasions without ever being referred to an RDN,[99] a situation which has, unfortunately, become all too common in healthcare. Sherry, Sauer, and Thrush[100] echoed Lee and Lee's observations regarding malnutrition in their 2017 study.[100] Authors tested a "web-based tool" designed to collect data for analysis regarding NCP practices concerning malnutrition.[100] Findings included that many patients who were identified at risk for malnutrition were not diagnosed, and malnutrition screening was inadequate.[100] Authors stated, "a web-based quality improvement tool could be used to capture the nutrition care practice at an institution level to provide directed approaches for addressing hospital malnutrition and improving care of patients at risk for malnutrition,"[100] which is exactly what ANDHII is designed to capture.

COPD

Hanson et al[101] reported the Academy's EBNPG for chronic obstructive pulmonary disease (COPD) based on EAL findings.[101] These extensive COPD EBNPGs review fourteen categories of nutrition care which relate to COPD outcomes, and are well summarized by this statement concluded from the authors, "MNT can be an integral component of lifestyle treatment targeted at maintaining and improving outcomes, such as lung function, mortality, [quality of life] QOL, and the myriad of comorbidities associated with the disease."[101]

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Diabetes and Medical Nutrition Therapy (MNT)

Background of T1DM, T2DM, and GDM

The CDC estimates that T1DM affects approximately "5-10% of people with diabetes."[102] Unlike prediabetes and T2DM, T1DM is thought to be an autoimmune condition, which makes it unpreventable through lifestyle modifications.[102] T1DM was previously called "juvenile diabetes," as the onset often occurs in childhood or adolescence; the term was later modified due to the discovery that T1DM can occur at any age.[102] Because the hallmark of T1DM is the inability for the pancreas to produce any or enough insulin, T1DM treatment requires insulin therapy. Diabetes self-management, including MNT, is a critical piece of a successful treatment plan for T1DM.[102] Unlike T1DM, development of T2DM is influenced by lifestyle, and has a continuously increasing prevalence in the United States (US). According to the 2020 CDC National Diabetes Statistics report, nearly 11% of people of all ages living in the US have T2DM, and more than 20% of people are undiagnosed.[103] The most significant factors associated with preventing, prolonging, or treating T2DM have long been known to be proper diet and exercise. Like T2DM, prevention and treatment of GDM largely includes education on a healthy diet and exercise. According to the CDC, GDM affects up to approximately 1 in 10 women.[104] A systematic review from the Academy's EAL concluded that all women found to have impaired glucose tolerance (with or without diagnosis of GDM) should be referred to the RDN for MNT.[105] The EAL also mentions that screening for glucose tolerance and GDM typically occurs near the end of the second trimester, and MNT should begin within a week of diagnosis of either condition.[105]

Because of the impact lifestyle has on the development and progression of T2DM, the CDC emphasizes lifestyle changes in the prevention and management of T2DM[106] In 1997, Congress allowed CMS coverage for certain programs which provide T2DM "self-management

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training."[45] In 2002, Congress recognized the specific role of MNT in the management of diabetes, when they made MNT for T1DM, T2DM, and GDM a CMS reimbursable service.[45] However, as of 2021, no updates have been made to the CMS MNT legislation since the original signing.

Diabetes MNT Guidelines

In 1993, Meyer and Gates[27] described the benefits of a structured form of nutrition care for patients with T2DM, ten years before the NCP was published.[27] Since then, and since the implementation and revisions of the NCP, further research has been done on the effectiveness of MNT within the NCP on T1DM and T2DM. Most recently, the Academy's EAL has systematically determined the EBNPGs for the management of T1DM and T2DM based on the evidence surrounding specific questions concerning MNT, which are summarized in Table 1.[107]

Table 1: EAL Findings on EBNPG for T1DM and T2DM[107]

Effectiveness of MNT on:	Strength of Evidence
Glycosylated hemoglobin measurements	Grade I/Strong
Risk factors for CVD	Grade II/Fair
Weight management efforts	Grade II/Fair
Medication use	Grade I/Strong
Improving the Patient's Quality of Life	Grade I/Strong

Guidelines from the EAL also examined the strength of evidence for the specific application of MNT, which also included screening for T2DM before applying the NCP.[107] These findings are summarized in Table 2. More explicit guidelines for macronutrient and micronutrient needs are required for individuals with T1DM and T2DM and comorbidities such as CKD;[14] these will not be discussed here.

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Table 2: EAL Findings on for T2DM Screening and T1DM and T2DM MNT Application[107]

Effectiveness of:	Strength of Evidence
Routine T2DM screening for people who are classified as overweight or obese	Fair, Imperative
Routine referral of all patients with T1DM or T2DM to the RDN for individualized MNT	Strong, Imperative
A minimum of 3 or more one-on-one MNT sessions within 6 months for patients referred to the RDN	Strong, Imperative
Regular follow-up MNT visits of at least once annually for patients with T1DM or T2DM	Strong, Imperative
Inclusion of biochemical data, medical tests, medication use, nutrition-focused physical findings, and client history, food and nutrition-related history, and experiences with food as part of the NCP Assessment	Fair, Imperative
The RDN monitoring and evaluating the same data (previously mentioned) gathered in the Assessment	Fair, Imperative
Creation of a patient-centered nutrition prescription through MNT	Fair, Imperative

More specifically, the Academy has found the following T1DM and T2DM MNT guidelines to be at least "fair" to "strong" evidence according to the EAL:

- a reduced energy (for those who are overweight or obese), patient-centered, healthful diet;
- carbohydrate (CHO) counting, especially for those on insulin-to-carbohydrate ratio regimens;
- the "plate method," reduced portions, and "simplified meal plan;"
- inclusion of approximately 25-35 grams of dietary fiber from whole-food sources;
- consideration on total calorie content of foods/beverages using non-nutritive sweeteners;
- a personalized protein intake of 0.7-2.0 grams per kilogram;
- a decrease in saturated fat and increase in unsaturated fat;
- a general goal of <2300 milligrams of sodium per day;

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- advice against routine herbal, micronutrient, or antioxidant supplements unless clinically indicated;
- moderation in alcohol intake;
- at least 150 minutes of exercise throughout at least 3 days per week (use caution with insulin and insulin secretagogues);
- blood glucose self-monitoring; and
- interdisciplinary, family, RDN, and patient involvement in management.[107]

The EAL last updated EBNPGs for GDM in 2016.[105] The major findings regarding effectiveness and strength of evidence on the recommendations can be found in Table 3. The Academy has found the following GDM MNT guidelines to be at least "consensus" to "fair" evidence according to the EAL unless otherwise noted:

- a patient-centered, healthful diet with caloric goals designed with both fetal and maternal outcomes in mind;
- Macronutrient distribution according to the Dietary Reference Intakes (DRI) for pregnancy, which includes "a minimum of 175g carbohydrate (CHO), a minimum of 71g protein (or 1.1g per kg per day protein) and 28g fiber;"
- Individualized CHO intake with emphasis on nutrient-rich, low-glycemic CHO with special attention focused on the breakfast meal;
- Individualized meal pattern consisting of small meals and snacks, with 3 meals and 2+ snacks suggested;
- Inclusion of nutrient-rich foods along with prenatal vitamin or mineral supplements to reach adequate intake of vitamins and minerals;
- Moderate, conditional use of "high-intensity sweeteners" generally recognized as safe (GRAS) by the US Food and Drug Administration;
- Complete abstinence from alcohol intake;
- General encouragement for at least 30 minutes of moderate exercise most days (STRONG, CONDITIONAL);

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Table 3: EAL Findings on for GDM MNT Application[105]

Effectiveness of:	Strength of Evidence
Routine referral of all patients with GDM to the RDN for individualized MNT	Strong, Imperative
Inclusion of food, beverage, medication, supplement, and substance intake, as well as environmental and behavioral factors as part of the NCP Assessment	Consensus, Imperative
Assessment of height, BMI, and pregnancy weight changes	Consensus, Imperative
Inclusion of biochemical data and fetal/maternal medical tests as part of the NCP Assessment	Consensus, Imperative
Inclusion of nutrition-focused physical findings and client history as part of the NCP Assessment	Consensus, Imperative
Individualized MNT from an RDN for all women diagnosed with GDM	Strong, Imperative
At least 3 MNT sessions, including one 60-90 minute session and at least 2 follow-up visits within the first month of GDM diagnosis	Consensus, Imperative
Monitoring and evaluation of all factors found in the NCP Assessment	Consensus, Imperative

Davidson, Ross, and Castor[66] describe the SOP and SOPP for RDNs treating patients with diabetes.[66] Authors explain that the "competent" RDN in diabetes care applies the EBNPG within the NCP; the "proficient" RDN also has been practicing for at least three years, has above-average skills, and likely has advanced diabetes-related credentials; the "expert" RD also has significantly advanced skills, diabetes-related credentials, and is sought after as the authority on MNT for diabetes.[66] The 2021 Standards of Medical Care in Diabetes[108] from the American Diabetes Association recommend referral of all patients with diabetes for MNT by the RDN, and that the RDN be included on the interdisciplinary, patient-centered care team.[108]

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Diabetes MNT Outcomes

In the EBNPGs on T1DM and T2DM published by the Franz and colleagues[107] in 2017, the variables of highest interest in terms of MNT-related diabetes outcomes were glycosylated hemoglobin, fasting blood glucose, total cholesterol, low-density lipoprotein (LDL) cholesterol, high-density lipoprotein (HDL) cholesterol, triglycerides, blood pressure, weight, BMI, QOL, and medication use.[107] In a study mentioned earlier with regard to CVD outcomes, Myers and colleagues[95] also found that use of EBNPGs resulted in significant improvements in patient glycosylated hemoglobin when compared against "usual care" as defined in India at that time.[95] Notably, a 2017 study from Møller et al[109] compared MNT from an RDN versus nutrition education from non-RDN healthcare staff (nurses, doctors, etc.) and found a "greater effect" on weight and diabetes-related biochemical data (glycosylated hemoglobin, LDL cholesterol) when MNT came from the RDN.[109] A 2017 study from Marincic et al[110] found through a retrospective chart review that significant improvements in weight, body mass index, glycosylated hemoglobin, and triglycerides were found when patients were provided diabetes self-management education and MNT from an RDN.[110] Authors note their aim for this study was to determine a method for capturing outcomes associated with diabetes and MNT in the context of the fight for reimbursement and access to care through public policy.[110] Marincic and colleagues[111] performed another retrospective chart review in 2019, again finding significant improvements in weight, body mass index, glycosylated hemoglobin, total cholesterol, LDL cholesterol, HDL cholesterol, triglycerides, and triglycerides-to-HDL ratio from diabetes self-management education and MNT.[111]

A 2016 systematic review from the EAL[105] found improvements in GDM outcomes (maternal blood glucose; neonatal birth weight; maternal insulin intervention; maternal blood

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pressure; maternal hospitalizations) and adverse neonatal outcomes resulting directly from inclusion of MNT in the care plan.[105] In a 2019 systematic review and meta-analysis, Razaz and colleagues[112] examined the impact of MNT on diabetes outcomes, and found significant improvements in diabetes-related biochemical data (fasting blood glucose, glycosylated hemoglobin, total cholesterol, and systolic blood pressure) and anthropometric data (weight, body mass index, and waist circumference) on patients who were provided with MNT.[112]

Without ANDHII, capturing MNT for diabetes outcomes can be difficult, even with the availability of the EMR in most major medical facilities. Without capturing what are the most commonly measured Nutrition Monitoring & Evaluation terms used by RDNs, we have no way of knowing if current MNT practice amongst RDNs actually reflects the most current diabetes practice guidelines. ANDHII provides a platform in which RDNs can enter their real patient data, track their specific patient outcomes, and enter their data into the Academy's DOR for disease/condition-specific outcomes tracking.

Conclusion

Although researchers and visionaries have made great strides forward in the creation of (and revisions of) the NCPM, the NCPT, and ANDHII, the existing literature[46,87,88] still suggests a gap between intended use and actual use by RDNs. Inconsistent documentation and lack of NCP chains make proving the associations between MNT and outcomes difficult. Further research must address the possibility that increased NCP documentation quality, including the presence of clear NCP chains, may be positively associated with improved patient outcomes. The purpose of this doctoral research project was to examine the association between patient outcomes and NCP documentation quality, and to determine the validity and reliability of a revised NCP audit tool on a diabetes-specific population.

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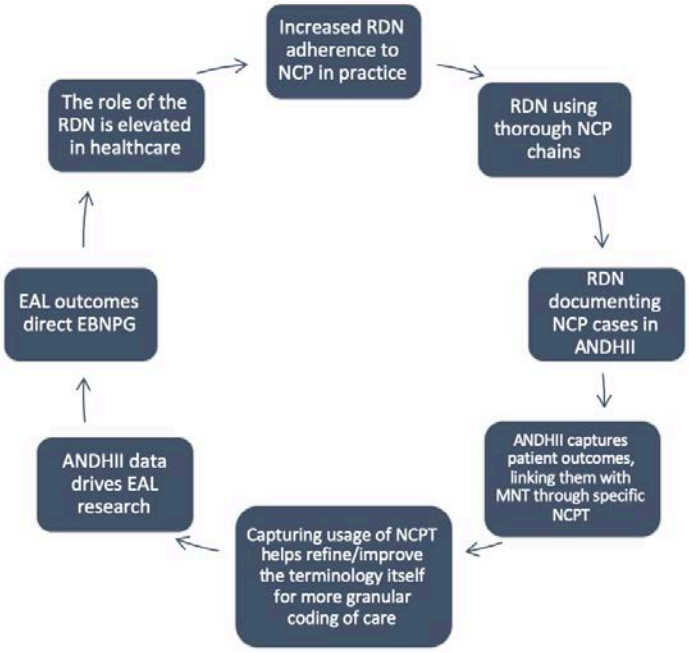
CHAPTER TWO: THEORY

Theoretical Models Relating to the NCP

The idea of how theory is intertwined within the NCPM is threefold: the way in which NCP is implemented by RDNs; the NCPM itself; and the way in which it is utilized. A substantial factor in the ability to research NCP outcomes lies within the RDN effectively documenting the complete NCP with clear linkages among the steps. Ultimately, the theoretical framework which underpins this project must support the overarching concept of RDN adherence in the integrity of the NCP in order to achieve measurable outcomes in the field of diabetes nutrition, as illustrated in Figure 1.

Figure 1: Concept Map



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Theory Regarding NCP Implementation: Theory of Planned Behavior

The theory of planned behavior (TPB) is often a central underpinning of nutrition research, especially qualitative or observational research. The TPB is useful because it helps the researcher to determine why a person or population practices a particular nutrition behavior, and can often pave the way for interventional research. The major constructs within the TPB center around describing what motivates a person to change or implement a behavior: "attitudes, behavioral intention, subjective norms, social norms, perceived power," and "perceived behavioral control."[113]

The TPB through the lens of the NCP is bifurcated regarding whether we are examining patient adherence to MNT or the RDN's adoption of the NCP in practice. The factors which influence patient behavior change will not be discussed in the context of this study. However, the principles within the TPB can be applied to what influences RDNs and/or entire nutrition departments to embrace the rationale and function of the NCP in practice. Desroches and colleagues[114] utilized the TPB framework in this manner, to determine barriers and enablers to NCP implementation in Canada.[114] Authors determined that making RDNs aware of the NCP use and importance is not enough to motivate RDNs to use it in practice.[114] Proper training and normalizing use in practice is key in successful NCP implementation.[114] While useful when researching the patterns concerning why and how facilities have transitioned to full acceptance and utilization of the NCP, factors which are barriers or enablers to NCP implementation is not the major focus of research on the clinical application of NCP.

Theory within the NCPM: Complexity Theory

The complexity theory has a framework through which the NCP could be situated idealistically. Thompson and colleagues[115] describe the complexity theory as "the interactions between components of a system are important for studying a system."[115] The existing

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indications that highlight the multidirectional nature of the NCP steps, which demonstrate that the way in which the outcomes stemming from the NCP are greater than the sum of each step individually. The overarching principles within complexity theory are what happens within each independent step affects the holistic function of the system,[115] which is true with regard to the NCP. If the RDN implements the NCP using expertly crafted NCPT, which interweaves the entire ADIME process together around a Nutrition Diagnosis (which, in itself, is clearly linked), the NCP chain is created.

Although the complexity theory seems to encompass the NCPM within itself, it ultimately fails to support the NCP in one critical way. The complexity theory argues "interactions between agents are not controlled by a central control."[115] However the entire NCPM centers around the patient at its core; patient-centered care influences every step in the NCP, as well as the holistic effect of the NCP on that patient's outcomes.

Theory Related to NCP Utilization: Systems Theory

The general systems theory was originally developed by Ludwig von Bertalanffy in 1949, and has been modified in many different ways thereafter.[116] The general systems theory was taken in many different idealistic directions, one of which was the *social* systems theory.[116] Although many scholars contributed to aspects of the social systems theory, Talcot Parson's approach dealt specifically with the "structure-function" piece of social systems theory.[116] Parson's structure-function version of the social systems theory could be viewed "in terms of four functions: adaptation, goal attainment, integration, and latency."[116]

The constructs within the structure-function social systems theory specific to RDN utilization of the NCP and subsequent nutrition outcomes research align in some key ways. The function of "adaptation" speaks to the aspect of the RDN learning the NCP, adopting the NCP

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into standard practice, and becoming proficient with the documentation of NCP chains in both their facility EMR as well as documenting within ANDHII. Within the context of this study, the function of "goal attainment" supports the Academy's goal of the RDN fully adhering to, embracing and understanding the NCP in practice, and utilizing the data collected to shape nutrition outcomes research. The construct of "integration" in the context of NCP supports the emergence of a clearly defined relationship between MNT from the RDN through the NCP through outcomes research based on data from ANDHII converging with the EAL and EBNPG. Lastly, the function of "latency" supports the period of time required to collect, synthesize, and globally broadcast the RDN's role in healthcare, forging a pathway toward a more substantial doctrine elevating the RDN, MNT, and the NCP.

When examining the major constructs of this study, the fundamental structure-function social systems theory principles provide a nearly direct overlay concerning the examination of NCP quality. Therefore, the theoretical framework which underpins the overarching concept of RDN adherence in the integrity of the NCP (NCP quality) in order to achieve measurable outcomes in the field of diabetes nutrition is the systems theory.

NCP Theory Application

The NCPM itself demonstrates the practical application of the systems theory within the context of this study, as illustrated in Figure 2. Table 4 compares and categorizes the constructs of each.

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Table 4: NCPM and Systems Theory Relationship

	NCPM	Systems Theory
Middle Ring	Collaboration	Adaptation
	Skills & Competencies	
	Communication	
	Evidence-based Practice	
	Critical Thinking	
	Documentation	
	Code of Ethics	
	Nutrition & Dietetics Knowledge	
Outer Edge	Outcomes Management System	Goal attainment
Main Inner Circle	Assessment	Integration
	Diagnosis	
	Intervention	
	Monitoring & Evaluation	
Outermost Ring	Practice Settings	Latency
	Health Care Systems	
	Social Systems	
	Economics	

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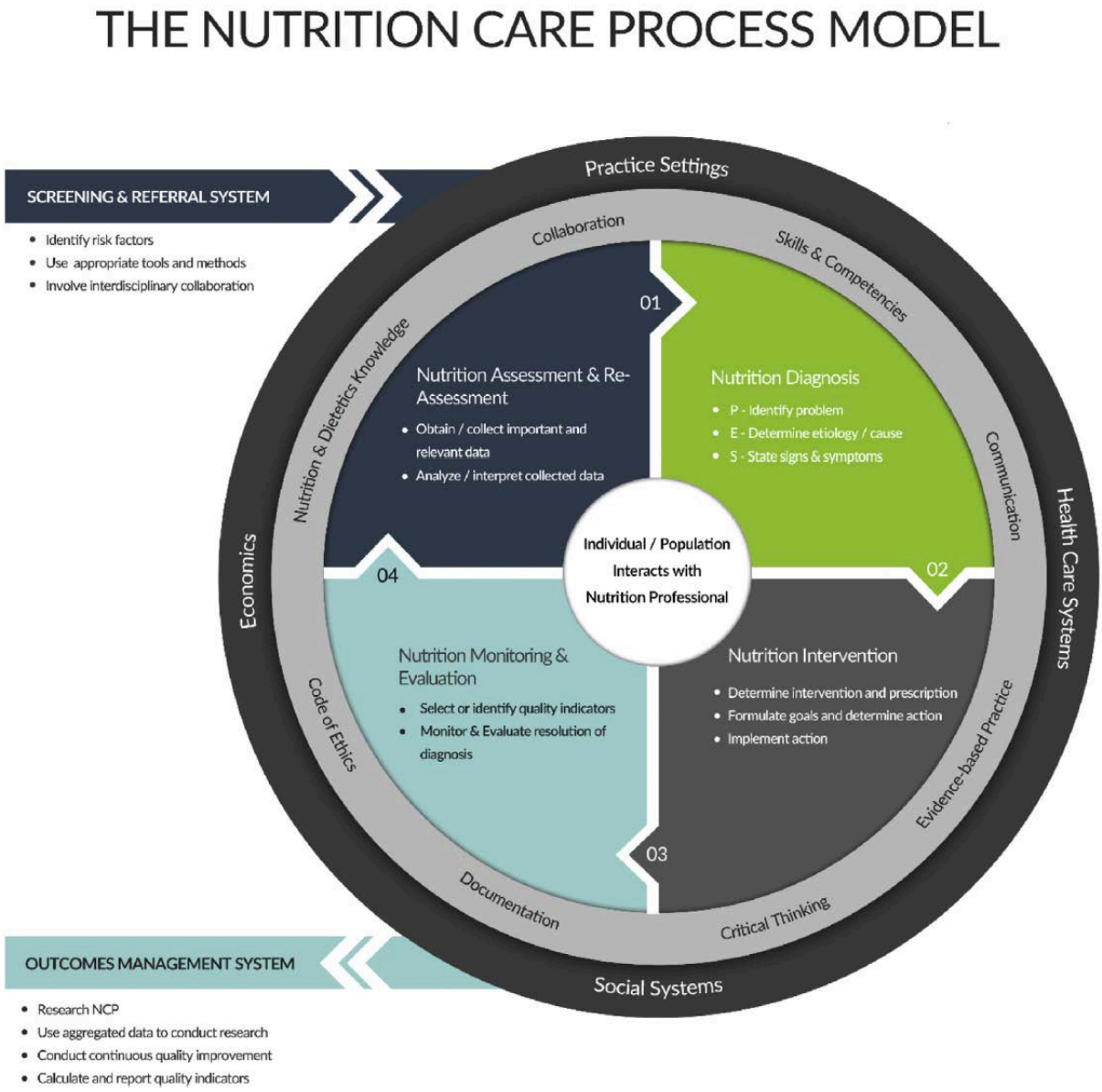
Figure 2: The NCPM. *NCP Model taken from the publication: electronic Nutrition Care Process Terminology (eNCPT), published by the Academy of Nutrition and Dietetics*



NCP Theory Operationalization

Table 5 summarizes the operationalization of the key constructs in this study as they relate to the constructs of the systems theory. A key component of the systems theory "adaptation" construct exists within this study regarding complete NCP chain links. Some literature suggests improved nutrition outcomes when clear chain links are documented.[8,59] In

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order for improved NCP documentation, including the presence of NCP chain links, RDNs must obtain the skills and competencies to refine their documentation through improved critical thinking in MNT application. The inclusion of complete NCP chain links is a crucial aspect of high-quality NCP care and documentation, which would indicate the RDN fully adapting to the NCPM as designed. As described by Murphy et al,[58] a complete NCP chain is closed when all linkages—evidence-diagnosis, diagnosis-intervention, diagnosis-etiology, etiology-intervention, and diagnosis-outcomes—are explicitly evident within the NCP documentation while using standardized language from the NCPT. A more detailed description of NCP chain links can be found in Chapter One.

Although *goal progress* and *problem resolution* were key variables examined in this study, the systems theory construct of "goal attainment" is approached from a different angle. In the context of this study, the "goal attainment" construct supports the process of RDNs capturing usable data (through "adaptation"), ultimately providing the fuel for nutrition outcomes research. Once high-quality NCP documentation including clear chain links is entered into ANDHII, researchers can extract this data, and aggregate nutrition outcomes. The process of obtaining usable data through RDNs capturing NCP documentation through ANDHII would satisfy fulfillment of the "goal attainment" construct of the systems theory, since nutrition outcomes research is needed to achieve the goal of demonstrating the value of MNT from the RDN. Notably, a factor in this study affecting goal attainment was the total number of visits; only 146 cases (26% of all patient cases) had at least one follow-up visit. Therefore, total number of visits should be a focal point in efforts contained in the "adaptation" phase, where RDNs apply patient-centered care in a manner that fosters the patient returning for subsequent visits.

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Conceptually, the NCP quality audit results in this study align with the "integration" phase of the system theory, as it speaks to the degree to which the RDN has fully honored the integrity of the NCP. The NCP quality audit provides a quantifiable measure of NCP documentation quality, and provides a medium for linking all elements of the NCP and MNT with nutrition outcomes. In other words, the NCP quality audit scores represent the field of dietetics integrating standardized language through the NCPT and linking all elements of the NCP into a completed chain within NCP documentation. With the NCP quality audit scores, we have the potential to connect high-quality documentation with high-quality MNT; subsequently, this high-quality MNT can be connected with goal progress and problem resolution. The systems theory "integration" construct within the NCPM frame upholds the idea of improved interdisciplinary collaboration through a more clearly defined value of MNT in overall health outcomes.

The "latency" function of the system theory in this study lies within the "behind the scenes" analysis of results and synthesis of the discussion on how RDNs can utilize data from real-world NCP quality audit scores and ANDHII data to link MNT with nutrition outcomes, and ultimately health outcomes, in future research.

Table 5: NCPM Study Operationalization within the Systems Theory

Construct within this Study	**Systems Theory Constructs**
NCP documentation quality, and inclusion of chain links	Adaptation
NCPT use frequency	Adaptation
Nutrition outcomes prediction from NCP quality score	Goal attainment

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Construct within this Study	Systems Theory Constructs
NCP quality audit scores	Integration
NCP data synthesis	Latency

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CHAPTER THREE: METHODS

Purpose

RDNs providing MNT play a critical role in the management of diabetes mellitus. However, determining how well the EBNPGs and NCPT can facilitate the improvement in health outcomes is unknown. Uncovering associations which exist between RDN adherence to the NCP and diabetes outcomes will provide valuable insight into future NCP, NCPT, and EBNPG revisions. The purpose of this research was to examine the association between patient outcomes and NCP documentation quality, and to test the validity and reliability of a revised NCP audit tool on a diabetes-specific population.

Aims

Aim #1: Determine if diabetes-related outcomes can be predicted by NCP documentation quality

Aim #2: Evaluate the validity and reliability of a revised NCP quality audit tool on a diabetes-specific population.

Objectives

1. Identify the most commonly used NCP terms within each ADIME domain in diabetes MNT (Aim #1)
2. Examine the relationship between the etiology-intervention link present and problem resolution (Aim #1)
3. Examine the relationship between the etiology-intervention link present and goal progress (Aim #1)
4. Examine the relationship between the NCP quality audit score category and total number of visits (Aim #1)
5. Examine the relationship between the NCP quality audit score category and problem resolution (Aim #1)
6. Examine the relationship between the number of visits and problem resolution (Aim #1)
7. Determine which indicators are being tracked (Aim #1)
8. Determine which indicators showed improvement with MNT (Aim #1)

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9. Determine which NCP Etiology Matrix category has the highest problem resolution rate in diabetes MNT (Aim #1)
10. Determine which NCP Interventions have the highest problem resolution rate in diabetes MNT (Aim #1)
11. Identify the most commonly tracked outcomes (Monitoring & Evaluation NCPT) (Aim #1)
12. Determine significant predictors for problem resolution (Aim #1)
13. Determine validity and reliability of a revised NCP quality audit tool on the diabetes population (Aim #2)

Null Hypotheses

1. H_0: There is no relationship between the etiology-intervention link presence and problem resolution
2. H_0: There is no relationship between the etiology-intervention link presence and goal progress
3. H_0: There is no relationship between the NCP quality audit score category and number of visits
4. H_0: There is no relationship between the NCP quality audit score category and problem resolution
5. H_0: There is no relationship between the number of visits and problem resolution
6. H_0: There is equal distribution of problem resolution rates among NCP Etiology Matrix categories
7. H_0: There is equal distribution of problem resolution rates among NCP Interventions
8. H_0: There are no significant predictors for problem resolution
9. H_0: The revised tool is not valid nor reliable on the diabetes population.

Design

This study was a quantitative, observational study as a secondary analysis of ANDHII Diabetes Registry data. The ANDHII Diabetes Registry dataset is part of the DOR of ANDHII, and this study was funded by the Diabetes Practice Group of the Academy.

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Participants

The original data collection included RDNs from Michigan, Ohio, Florida, and Washington DC who were recruited to enter patient cases into ANDHII.[117] All patient data cases entered into ANDHII within the context of the Diabetes Registry were included in this secondary analysis. For patients with more than one PES statement, only the first PES was included. If the PES contained multiple etiologies, only the first etiology was included. Also, only the five NCPT terms for Nutrition Assessment, Intervention, and Monitoring & Evaluation were included.

Data Collection: Aim #1

Table 6 summarizes the variables of interest with regard to the study objectives and their corresponding data type.

Table 6: Variables of Interest and Corresponding Data Type

Variable	Data Type
Location	Categorical
Diet-NCP-Audit score category (A/B/C)	
NCP terms for Assessment	
NCP terms for Problem	
NCP Etiology Matrix category	
Indicators (NCP terms for Signs & Symptoms)	
ADIME step linkages present (yes/no)	
Indicator progress (yes/no)	
NCP terms for Monitoring & Evaluation	
Problem resolution (yes/no)	
Revised NCP audit tool score category (A/B/C)	
Revised NCP audit tool clarity (scale 1-4)	
Number of visits	Discrete
Revised NCP audit tool I-CVI	Continuous
Revised NCP audit tool S-CVI-Ave	
Revised NCP audit tool S-CVI-UA	
Revised NCP audit tool inter-rater reliability	
Revised NCP audit tool intra-rater reliability	

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The raw data for this secondary analysis was originally collected through the ANDHII Diabetes Registry from May 2017 through June 2019.[117] It is important to note that, because the newest updates to the eNCPT were published after the data was collected in the Diabetes Registry, the NCPT used in this dataset refer to the 2015 version of the eNCPT, although the eNCP has been updated since then. The timeline for reorganization and data analysis occurred as outlined in Table 7.

Table 7: Data Analysis Timeline

Phase	**Tasks**
Phase 1	First and second reorganizations of baseline and post-education data completed **and** NCP quality audit performed on baseline and post-education data using Diet-NCP-Audit tool by 30 September 2020
Phase 2	Statistical results for Aim #1 compiled by 30 December 2020
Phase 3	NCP quality audit performed using the revised tool on a subset of Diabetes Registry data by 30 January 2021
Phase 4	Second NCP quality audit using the revised tool completed by 28 February 2021
Phase 5	Statistical results for Aim #2 compiled by 15 March 2021
Phase 6	Study completed no later than 16 April 2021

At the time of this study, the way in which the ANDHII software downloaded the raw data left the researcher to have to reorganize the data points manually. The first reorganization of data entailed the PI taking the raw data from all patient cases in column format into all patient cases in row format. The first reorganization resulted in all follow-up visits for each patient contained in the same continuous row of data with data from each ADIME step contained in one cell within that row. This first reorganization was paramount to having the data arranged in a way that allowed the NCP documentation quality audit to commence. The second reorganization of data entailed the data being arranged with only one data point per cell in order to allow for

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statistical analysis. Both the first and second data reorganizations utilized Microsoft Excel (version 16.16.22). The data from the second reorganization was uploaded into IBM SPSS Statistics version 26, which is where all statistical analyses occurred.

Aim #1 required use of the Diet-NCP-Audit tool from Lövestam and colleagues[60] in order to determine our data for NCP quality audit score category. As described in Chapter One, the Diet-NCP-Audit tool was developed by Lövestam et al.[60] in 2014 in Sweden. These researchers tested the validity and reliability of their tool, a version of which was previously introduced by Hakel-Smith and colleagues,[32] for evaluating NCP charting quality. The Diet-NCP-Audit tool contains 14 questions with a maximum of 26 points. The PI conducted the first audit using the Diet-NCP-Audit tool, with a second RDN performing the same audit using a subset of the data. Each RDN performed the audit independently and blindly from the other. Upon completion of each independent audit, the PI and second RDN collaborated to perform a pairwise comparison of scoring in order to discuss differences existing between the two scores for one patient encounter. The PI and second RDN evaluated clinical judgement utilized to formulate each scoring choice within the Diet-NCP-Audit tool. When a difference existed, the PI and second RDN were able to confer and reconsider a mutually agreeable score for that patient encounter. If a mutually agreed upon score could not be reached, the PI and second RDN had planned to bring that particular patient case to the Academy and University of North Florida Collaboration committee. Fortunately, no such cases regarded intervention beyond the PI and second RDN.

Regarding NCP linkages, the PI utilized guidelines developed by Murphy and colleagues (Table 8).[58] At the time data was collected for this study, the ANDHII data entry platform did not clearly delineate a field within the Nutrition Intervention for the RDN to enter “goal(s)” or “goal

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progress." Therefore, in the data analysis for this study, goals had to be determined by first attempting to identify the goal from the Nutrition Intervention documentation, then examining the Nutrition Monitoring & Evaluation documentation for further indications of the RDN including any specific goals for the intervention(s). For the sake of the Diet-NCP-Audit, the PI and collaborating RDN agreed to consider a specific, measurable Nutrition Monitoring & Evaluation NCPT as a "goal."

Although the terms "indicators" and "outcomes" are sometimes used interchangeably, they are distinguishable terms in this study. Determining which "outcomes" are monitored in diabetes MNT came directly from the Nutrition Monitoring & Evaluation step, and the *Signs and Symptoms* piece of the NCP Diagnosis as a PES statement was utilized to extract indicators. In other words, the indicators *were* the Signs and Symptoms of the NCP Diagnosis PES statement as documented in ANDHII. Positive goal progress (annotated in the dataset as "yes") was considered when a) the indicator remained the same, or b) improved (i.e. any reduction in a previously clinically glycosylated hemoglobin measurement). Positive problem resolution (annotated in the dataset as "yes") was considered when the problem resolution documented in ANDHII was listed as "resolved" for that patient case.

At the time data was collected for this study, the ANDHII data entry platform did not clearly delineate a field within the Nutrition Diagnosis PES statement for the RDN to enter the Etiology Matrix category. Therefore, the PI and collaborating RDN employed clinical judgement to classify all etiologies into an appropriate Etiology Matrix. When a difference existed, the PI and second RDN were able to confer and reconsider a mutually agreeable Etiology Matrix for that particular etiology. Also, at the time data was collected for this study, the ANDHII data entry platform did not clearly delineate a field within the Nutrition Intervention for the RDN to

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enter a Nutrition Prescription. The PI and second RDN considered inclusion of specific diet NCPT and/or relevant Nutrition Interventions with quantifiable action (i.e. 45 grams CHO per meal or 30 minutes of physical activity three times weekly) to satisfy the requirement for a Nutrition Prescription.

Table 8: Criteria for Determining Presence of Chain Links in NCP Documentation

Chain Link	**Criteria for Linkage Presence in NCP Documentation**[58]
Evidence-Diagnosis	At least one NCPT term used in the Nutrition Assessment is used in the Signs and Symptoms (S) portion of the PES statement in the Nutrition Diagnosis, and is determined to be an abnormal finding
Diagnosis-Etiology	The Nutrition Diagnosis contains at least one etiology (E) for the problem (P) in the PES statement
Etiology-Intervention	Each etiology (E) included in the PES statement of the Nutrition Diagnosis is assigned a relevant Nutrition Intervention
Intervention-Goal	Every Nutrition Intervention has a specific goal assigned and documented
Diagnosis-Outcomes	At least one outcome listed in the Nutrition Monitoring & Evaluation NCPT is directly related to the Nutrition Diagnosis

Data Collection: Aim #2

Aim #2 included validation of a form of the NCP audit tool originally developed by Hakel-Smith et al[32] and later revised by the Academy of Nutrition and Dietetics Data Science Center in collaboration with a national advancing dietetics practice workgroup within the Department of Veterans Affairs (VA). The Academy Data Science Center revised the NCP quality audit tool all-around because it was felt that there was need for additional clarity. The revised tool reflects the NCP chains as a whole, and the linkages as isolated questions. Also, the NCP is assessed completely in the tool. Before, it really only focused on the initial visit; but now it explicitly addresses the reassessment.

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Validity

The second NCP quality audit for Aim #2 utilized a revised NCP quality audit tool in order to test the validity (relevance and clarity) of this tool on patients with diabetes by using a ten-percent subset of the Diabetes Registry data. Several outcomes were assessed with regard to the revised tool. First, the PI conducted the audit using the revised tool, with a second RDN performing the same audit, during the same timeframe, using the same subset of data.

The revised NCP quality audit tool validity was tested by the PI and collaborating RDN using similar methodology of that used by Lövestam and colleagues[60] in the evaluation of their Diet-NCP-Audit tool in 2013.[60] The two RDNs each first rated each of the 24 questions of the revised tool relevance on a scale of 1 to 4, where 1 meant "not relevant," 2 meant "item need[s] some revision," 3 meant "relevant but need[s] minor revision," and 4 meant "very relevant."[118] Each RDN then rated each of the 24 questions of the revised tool clarity on a scale of 1 to 4, where 1 meant "not clear," 2 meant "item need[s] some revision," 3 meant "clear but need[s] some minor revision," and 4 meant "very clear."[118] The Item Content Validity Index (I-CVI) was calculated by counting the total number of ratings of 3 or 4 for that item, divided by 2 for the number of raters in this evaluation. The Scale Content Validity Index Universal Agreement (S-CVI-UA) for relevance was calculated by the total questions rated 3 or 4 by both raters, divided by the total number of questions (24). The same S-CVI-UA calculation was applied to the scores for clarity. The Scale Content Validity Index Average (S-CVI-Ave) for relevance was calculated as the average proportion of questions rated as 3 or 4 across both raters. The same S-CVI-Ave calculation was applied to the scores for clarity.

Reliability

Within the 146 patient cases with follow-up visits, the PI randomly chose a 10% sample of every 9 patient cases for a total of 15 patient cases. These 15 patient cases were scored on

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their initial visit and one follow-up visit. If the patient case included more than one follow-up visit in the original dataset, only the first follow-up visit was scored as the "reassessment" in questions. Inter-rater reliability of the revised NCP quality audit tool was calculated using a Krippendorff's α pairwise comparison of the actual revised tool audit score per RDN, per item, against the total number of items. Intra-rater reliability entailed an initial scoring of the Diabetes Registry data subset by the PI and also by the collaborating RDN. Then, the same subset was re-scored by each RDN four weeks later. Each RDN's scores were compared to the same subset's previous scores from the same RDN using a Krippendorff's α pairwise comparison, per item, of the revised tool audit score per RDN in order to determine intra-rater reliability of scores using the revised tool. Percentage agreement was determined by the number of total scores per item judged the same between the two raters.

Data Analysis

Both Microsoft Excel (version 16.16.22) and IBM SPSS Statistics version 26 were used to conduct the statistical analyses. Missing categorical values were expected, as the first 5 NCP terms were included; but, some cases had less than 5 NCP terms in some of the NCP steps. Therefore, missing categorical values were replaced with a "-99" imputation to streamline the identification of these missing value locations. Missing discrete and continuous variables were not possible given the structure of this dataset. The only discrete variable was the number of patient visits; and continuous variables included the various CVI values, all of which are calculated by the PI. All patient cases had either zero, one, or more than one follow-up; thus, missing data was not possible for the *total number of visits* variable. Likewise, all of the CVI variables were calculated by the PI, therefore missing values were not possible. Statistical methods for each set of variables within each objective are described in Table 9.

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Table 9: Statistical Methods for Each Measurable Objective

Variable	Variable Type	Statistical Analysis Method
Identify the most commonly used NCP terms within each ADIME domain in diabetes MNT		
Assessment NCPT	Categorical	Descriptive statistics
Diagnosis NCPT		
Intervention NCPT		
Monitoring & Evaluation NCPT		
Examine relationship between etiology-intervention link present and problem resolution		
Etiology-intervention linkage presence	Categorical	Pearson chi-square
Problem resolution	Categorical	
Examine relationship between etiology-intervention link present and goal progress		
Etiology-intervention linkage presence	Categorical	Fisher's exact
Goal progress	Categorical	
Examine the relationship between the NCP quality audit score category and number of visits		
Number of visits (independent)	Discrete	Logistic regression
NCP quality audit score category (dependent)	Categorical	
Examine the relationship between the NCP quality audit score category and problem resolution		
NCP quality audit score category (independent)	Categorical	Logistic regression
Problem resolution (dependent)	Categorical	
Examine the relationship between the number of visits and problem resolution		
Number of visits (independent)	Discrete	Logistic regression
Problem resolution (dependent)	Categorical	
Determine which indicators are being tracked		
Indicator (from PES)	Categorical	Descriptive Statistics
Determine which indicators showed improvement with MNT		
Indicator (from PES)	Categorical	Descriptive Statistics
Goal progress	Categorical	
Determine which NCP Etiology Matrix category has the highest problem resolution rate in diabetes MNT		
NCP Etiology Category	Categorical	Descriptive Statistics
Problem resolution	Categorical	
Determine which NCP Interventions have the highest problem resolution rate in diabetes MNT		
Intervention NCPT	Categorical	Descriptive Statistics
Problem resolution	Categorical	
Identify the most commonly tracked outcomes (Monitoring & Evaluation NCPT)		
Monitoring & Evaluation NCPT	Categorical	Descriptive statistics
Determine significant predictors for problem resolution		
Evidence-Diagnosis Link, Diagnosis-Etiology Link, Etiology-Intervention Link, Intervention-Goal Link, and Problem-Outcome Link, Location, and Total Number of Visits (independent)	Categorical and Discrete	Stepwise backward elimination logistic regression
Problem resolution (dependent)	Categorical	
Determine validity and reliability of the new NCP quality audit tool on the diabetes population		
Revised NCP audit tool clarity (scale 1-4)	Categorical	Descriptive statistics
Revised NCP audit tool I-CVI	Continuous	Descriptive statistics
Revised NCP audit tool S-CVI-UA	Continuous	Descriptive statistics
Revised NCP audit tool S-CVI-Ave	Continuous	Descriptive statistics
Revised NCP audit tool inter-rater reliability	Continuous	Krippendorff's α
Revised NCP audit tool intra-rater reliability	Continuous	Krippendorff's α

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CHAPTER FOUR: RESULTS

Descriptive Statistics

Sample Size

The sample size for this study was predetermined by the very nature of the secondary analysis, as the sample size was defined by the available raw data from the ANDHII Diabetes Registry. The raw dataset contained data on 790 total patient visits, which included 564 patient cases. Of the 564 patient visits, 418 had only one single visit without follow-up, leaving 146 patient cases (with a total of 372 encounters including all follow-up visits) to use for outcomes analysis. Frequencies for the total number of visits for all patient cases are found in Table 10 and illustrated in Figure 3. Frequencies for total number of visits for only those patients with follow-up visits are found in Table 11. For the 146 patient cases with follow-up visits, the number of follow-up visits varied amongst the patient cases, the breakdown of which is indicated in Table 11.

Table 10: Frequencies (%) for Total Number of Visits for All Patient Cases

Total Number of Visits	n = 564 patient cases, M = 1.40
1 visit	418 (74.11%)
2 visits	104 (18.43%)
3 visits	18 (3.19%)
4 visits	16 (2.83%)
5 visits	5 (0.89%)
6 visits	1 (0.18%)
7 visits	1 (0.18%)
8 visits	1 (0.18%)

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Figure 3: Frequencies (%) for Total Number of Visits for All Patient Cases

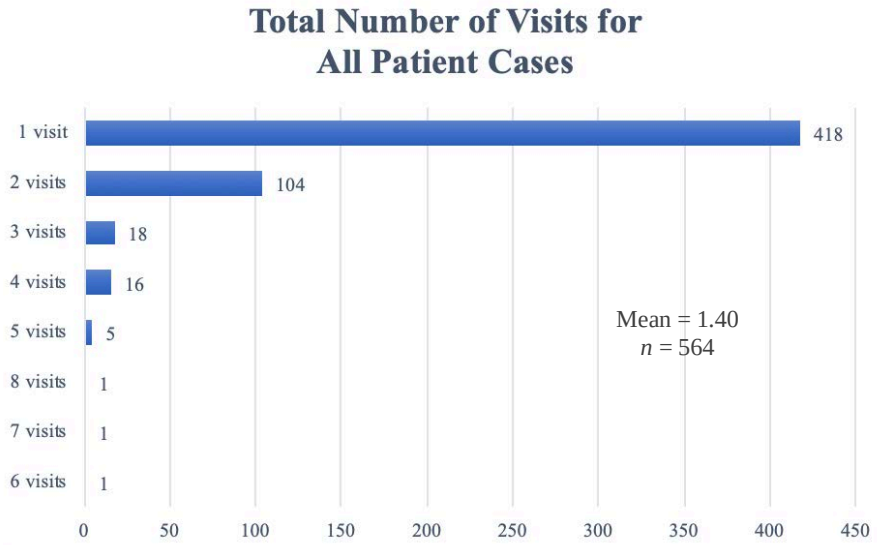

Table 11: Frequencies (Total Collective Number of Visits) for Total Number of Visits for Patients with Follow-Up

Total Number of Visits for Patients with Follow-up	*n* = 146 patient cases
2 visits	104 (208)
3 visits	18 (36)
4 visits	16 (64)
5 visits	5 (25)
6 visits	1 (6)
7 visits	1 (7)
8 visits	1 (8)

Problem Resolution

Positive problem resolution (annotated in the dataset as "yes") was considered when the problem resolution documented in ANDHII was listed as "resolved" for that patient case. Because more than one visit was required in order to assess problem resolution status, only the 146 patient cases with follow-up visits could be evaluated for this outcome. The majority of

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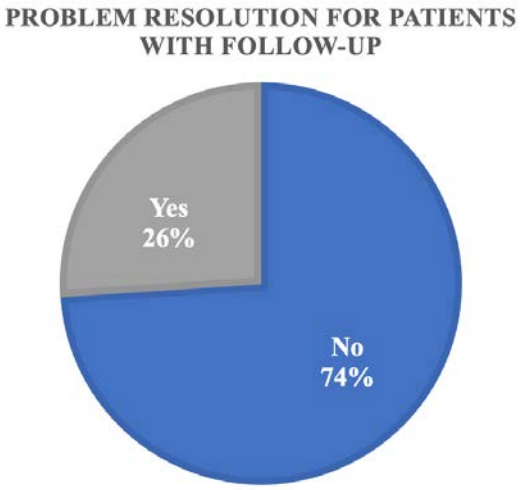
patient cases did not have a problem resolved (74%) as indicated in Table 12 and illustrated in Figure 4.

Table 12: Frequencies (%) for Problem Resolution for Cases with Follow-up Visits

Problem Resolution for Patients with Follow-up	*n* = 146 patient cases
Yes	38 (26%)
No	108 (74%)

Figure 4: Frequencies (%) for Problem Resolution for Cases with Follow-up Visits



Indicators

The indicator terms were directly extracted from the Signs and Symptoms of the Nutrition Diagnosis PES statement as documented in ANDHII, and were assessed for goal progress. Frequencies for indicator NCP terms documented for all patient cases are shown in Table 13. In order to manage the data for statistical analysis in SPSS, the individual terms had to be categorized by NCP Domain using Nutrition Assessment and Monitoring & Evaluation

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Terminology. Frequencies for indicator NCP domains documented for all patient cases are shown in Table 14. Frequencies for indicator NCP terms documented and indicator NCP domains for only patient cases with follow-up visits are shown in Table 15 and Table 16, respectively. A visual representation of the indicator NCP term domains documented for all patient visits versus only those patient cases with follow-up visits is illustrated in Figure 5.

Table 13: Frequencies (%) for Indicator NCP Terms Documented for All Patient Cases

Indicator NCP **Terms** Documented for All Patient Cases	*n* = 1187 term documentations
glycosylated hemoglobin measurement	219 (18.45%)
glucose, fasting	112 (9.44%)
total carbohydrate intake	77 (6.49%)
weight	76 (6.40%)
body mass index	58 (4.89%)
glucose, casual	57 (4.80%)
area(s) and level of nutrition knowledge/skill	41 (3.45%)
triglycerides, serum	41 (3.45%)
knowledge/skill level - control food portions	39 (3.29%)
type of carbohydrate needed	35 (2.95%)
weight change	35 (2.95%)
total energy intake	33 (2.78%)
total carbohydrate estimated intake in 24 h	31 (2.61%)
knowledge/skill level - food label	25 (2.11%)
total energy measured intake in 24 h	23 (1.94%)
total carbohydrate estimated needs	20 (1.68%)
total energy estimated needs	16 (1.35%)
none documented	15 (1.26%)
oral fluid intake - soda, regular	13 (1.10%)
diagnosis specific or global nutrition-related knowledge score	12 (1.01%)
glucose tolerance test	9 (0.76%)
nutrition related self management as agreed upon	8 (0.67%)
cholesterol, serum	6 (0.51%)
meal or snack pattern - number of meals	6 (0.51%)

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Indicator NCP **Terms** Documented for All Patient Cases	*n* = 1187 term documentations
oral fluid intake - juice	6 (0.51%)
saturated fat intake	6 (0.51%)
total fiber intake	6 (0.51%)
finding of obesity	5 (0.42%)
food intake - amount	5 (0.42%)
food intake amount - concentrated sweets	5 (0.42%)
saturated fat estimated intake in 24 h	5 (0.42%)
weight gain	5 (0.42%)
duration of physical activity	4 (0.34%)
knowledge/skill level - disease condition	4 (0.34%)
knowledge/skill level - nutrition recommendations	4 (0.34%)
oral fluid intake	4 (0.34%)
preprandial capillary plasma glucose	4 (0.34%)
consistency of physical activity	3 (0.25%)
food-derived fluid intake	3 (0.25%)
frequency of alcohol intake	3 (0.25%)
frequency of physical activity	3 (0.25%)
other sedentary activity	3 (0.25%)
total carbohydrate from diet	3 (0.25%)
binge eating behavior	2 (0.17%)
body compartment estimates	2 (0.17%)
empty energy servings estimated in 24 h	2 (0.17%)
finding of constipation	2 (0.17%)
food intake amount - fats and oils	2 (0.17%)
food intake amount - fruits and vegetables	2 (0.17%)
food intake amount - grains	2 (0.17%)
food variety	2 (0.17%)
intensity of physical activity	2 (0.17%)
knowledge/skill level - food/nutrient requirement	2 (0.17%)
knowledge/skill level - health knowledge gap	2 (0.17%)
knowledge/skill level - laboratory results compared to desirable	2 (0.17%)
knowledge/skill level - self-management parameters	2 (0.17%)
meal or snack pattern	2 (0.17%)
number of meals estimated in 24 h	2 (0.17%)
nutrition related avoidance behavior	2 (0.17%)
physical activity history	2 (0.17%)

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Indicator NCP **Terms** Documented for All Patient Cases	*n* = 1187 term documentations
prescription medication - insulin or insulin secretagogues	2 (0.17%)
readiness to change nutrition-related behaviors	2 (0.17%)
simple carbohydrate estimated intake in 24 h	2 (0.17%)
sodium intake	2 (0.17%)
total fiber estimated intake in 24 h	2 (0.17%)
total fluid estimated needs	2 (0.17%)
total protein intake	2 (0.17%)
type of carbohydrate	2 (0.17%)
type of food or meal - convenience frozen meals	2 (0.17%)
type of food or meal - ready-to-eat food selections	2 (0.17%)
types of food/meals	2 (0.17%)
alcohol intake: drink size or volume	1 (0.08%)
avoidance - specific foods	1 (0.08%)
calcium needs	1 (0.08%)
caregiver, companion in eating environment	1 (0.08%)
cholesterol, HDL	1 (0.08%)
digestive system - abdominal distension, bloating, cramping, pain	1 (0.08%)
eats alone	1 (0.08%)
eligibility for community food and nutrition programs	1 (0.08%)
finding of dizziness	1 (0.08%)
finding of excess subcutaneous fat	1 (0.08%)
finding of increased appetite	1 (0.08%)
food intake amount - meat, poultry, fish, eggs, beans, nut product	1 (0.08%)
food intake amount - vegetables	1 (0.08%)
growth pattern indices, percentile ranks	1 (0.08%)
knowledge/skill level - food preparation/cooking	1 (0.08%)
knowledge/skill level - select healthful foods/meals	1 (0.08%)
liquid meal replacement or supplement intake	1 (0.08%)
location of eating environment	1 (0.08%)
motivation, nutrition related beliefs and attitudes	1 (0.08%)
number of snacks estimated in 24 h	1 (0.08%)
nutrition knowledge of individual client	1 (0.08%)
nutrition-related avoidance behavior	1 (0.08%)
oral fluid intake - milk	1 (0.08%)
oral fluid intake - water	1 (0.08%)

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Indicator NCP **Terms** Documented for All Patient Cases	*n* = 1187 term documentations
oral fluid intake measured in 24 h	1 (0.08%)
peak postprandial capillary plasma glucose	1 (0.08%)
prescription medication - alter glucose levels	1 (0.08%)
prescription medication nutrient/food-medication interaction	1 (0.08%)
prescription medication use	1 (0.08%)
self-efficacy	1 (0.08%)
self-selected diets followed	1 (0.08%)
simple sugar carbohydrate intake	1 (0.08%)
strength, physical activity	1 (0.08%)
total carbohydrate estimated needs in 24 hours	1 (0.08%)
toxicology report, including alcohol	1 (0.08%)
type of fat needed	1 (0.08%)
type of fiber needed	1 (0.08%)
type of food or meal	1 (0.08%)
type of food or meal - self-prepared foods/snacks	1 (0.08%)
type of physical activity	1 (0.08%)
types of carbohydrate needed	1 (0.08%)
unscientific nutrition related beliefs, attitudes	1 (0.08%)
vitamin K intake	1 (0.08%)

Table 14: Frequencies (%) for Indicator NCP Term Domains Documented for All Patient Cases

Indicator NCP **Domains** Documented for All Patient Cases	*n* = 1187 domain documentations
Biochemical Data, Medical Tests, and Procedures	531 (44.73%)
Food/Nutrition-Related History	453 (38.16%)
Anthropometric Measurements	177 (14.91%)
None documented	15 (1.26%)
Nutrition-Focused Physical Findings	10 (0.84%)
Client History	1 (0.08%)

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Table 15: Frequencies (%) for Indicator NCP Terms Documented for Cases with Follow-up Visits

Indicator NCP **Terms** Documented for Cases with Follow-up Visits	*n* = 287 term documentations
glycosylated hemoglobin measurement	52 (18.12%)
total carbohydrate intake	27 (9.41%)
glucose, fasting	23 (8.01%)
weight	15 (5.23%)
body mass index	14 (4.88%
total energy intake	13 (4.53%)
triglycerides, serum	13 (4.53%)
glucose, casual	12 (4.18%)
total carbohydrate estimated intake in 24 h	9 (3.14%)
weight change	9 (3.14%)
area(s) and level of nutrition knowledge/skill	7 (2.44%)
knowledge/skill level - control food portions	5 (1.74%)
none documented	5 (1.74%)
nutrition related self management as agreed upon	5 (1.74%)
total energy measured intake in 24 h	5 (1.74%)
type of carbohydrate needed	5 (1.74%)
diagnosis specific or global nutrition-related knowledge score	4 (1.39%)
total energy estimated needs	4 (1.39%)
saturated fat intake	3 (1.05%)
total carbohydrate estimated needs	3 (1.05%)
finding of obesity	2 (0.70%
food intake amount - concentrated sweets	2 (0.70%
food-derived fluid intake	2 (0.70%
knowledge/skill level - disease condition	2 (0.70%
knowledge/skill level - food label	2 (0.70%
knowledge/skill level - laboratory results compared to desirable	2 (0.70%
oral fluid intake - juice	2 (0.70%
simple carbohydrate estimated intake in 24 h	2 (0.70%
sodium intake	2 (0.70%
types of food/meals	2 (0.70%
weight gain	2 (0.70%
binge eating behavior	1 (0.35%)
body compartment estimates	1 (0.35%)

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Indicator NCP **Terms** Documented for Cases with Follow-up Visits	*n* = 287 term documentations
caregiver, companion in eating environment	1 (0.35%)
cholesterol, serum	1 (0.35%)
eligibility for community food and nutrition programs	1 (0.35%)
empty energy servings estimated in 24 h	1 (0.35%)
food intake - amount	1 (0.35%)
food intake amount - fats and oils	1 (0.35%)
food intake amount - fruits and vegetables	1 (0.35%)
food variety	1 (0.35%)
frequency of alcohol intake	1 (0.35%)
knowledge/skill level - food preparation/cooking	1 (0.35%)
knowledge/skill level - food/nutrient requirement	1 (0.35%)
knowledge/skill level - nutrition recommendations	1 (0.35%)
knowledge/skill level - select healthful foods/meals	1 (0.35%)
meal or snack pattern - number of meals	1 (0.35%)
number of meals estimated in 24 h	1 (0.35%)
nutrition related avoidance behavior	1 (0.35%)
oral fluid intake	1 (0.35%)
oral fluid intake - soda, regular	1 (0.35%)
oral fluid intake measured in 24 h	1 (0.35%)
physical activity history	1 (0.35%)
preprandial capillary plasma glucose	1 (0.35%)
prescription medication - alter glucose levels	1 (0.35%)
prescription medication - insulin or insulin secretagogues	1 (0.35%)
prescription medication nutrient/food-medication interaction	1 (0.35%)
prescription medication use	1 (0.35%)
self-selected diets followed	1 (0.35%)
strength, physical activity	1 (0.35%)
total carbohydrate from diet	1 (0.35%)
total fiber intake	1 (0.35%)
type of physical activity	1 (0.35%)

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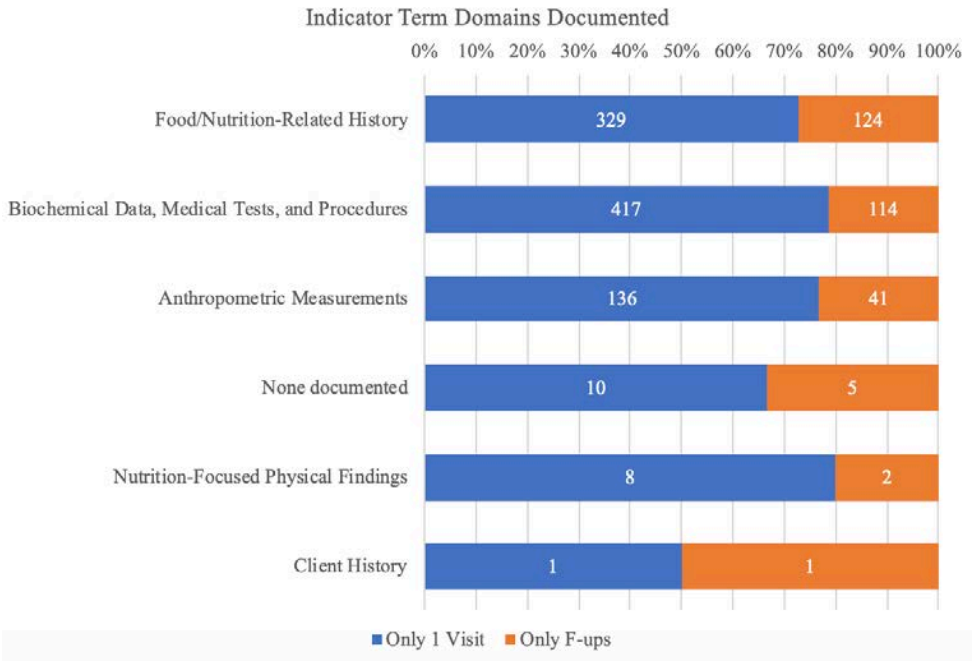
Table 16: Frequencies (%) of Indicator NCP Term Domains Documented for Cases with Follow-up Visits

Indicator NCP **Domains** Documented for Cases with Follow-up Visits	*n* = 287 domain documentations
Food/Nutrition-Related History	124 (43.21%)
Biochemical Data, Medical Tests, and Procedures	114 (39.72%)
Anthropometric Measurements	41 (14.29%)
None documented	5 (1.74%)
Nutrition-Focused Physical Findings	2 (0.70%)
Client History	1 (0.35%)

Figure 5: Frequencies (%) for Indicator NCP Term Domains Documented: Only 1 Visit and Follow-up



Goal Progress

Indicators were assessed for goal progress in patient cases who had at least one follow-up visit. Positive goal progress (annotated in the dataset as "yes") was considered when a) the

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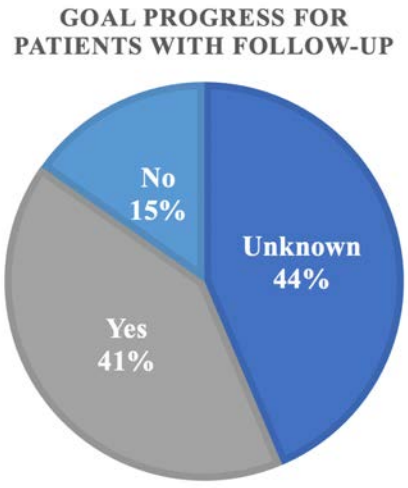
indicator remained the same, or b) improved (i.e. any reduction in a previously clinically glycosylated hemoglobin measurement). Frequencies for goal progress for patient cases with follow-up visits are shown in Table 17 and illustrated in Figure 6. In some cases, the indicators being tracked actually changed between the initial and follow-up visits, therefore goal progress was unknown.

Table 17: Frequencies (%) for Goal Progress for Cases with Follow-up Visits

Goal Progress for Patients with Follow-up	*n* = 282 goals*
Yes	123 (43.62%)
Unknown	116 (41.13%)
No	43 (15.25%)

* 5 goals were "N/A" for goal progress due to an indicator of "none documented"

Figure 6: Frequencies (%) for Goal Progress for Cases with Follow-up Visits



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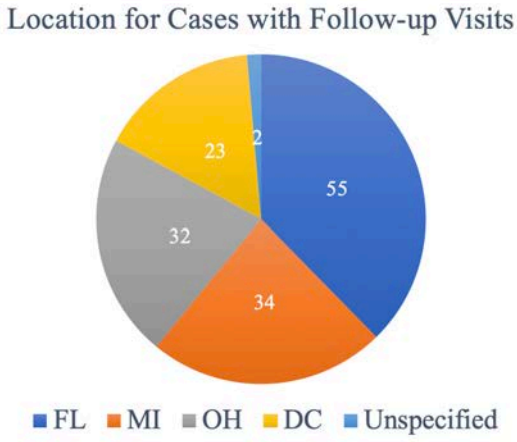
Location

The original data collection included RDNs from Michigan, Ohio, Florida, and Washington DC who were recruited to enter patient cases into ANDHII.[117] Frequencies for location for patient cases who had at least one or more follow-up visit are shown in Table 18 and illustrated in Figure 7.

Table 18: Frequencies (%) for Location for Cases with Follow-up Visits

Location for Patients with Follow-up	*n* = 146 patient cases
FL	55 (37.67%)
MI	34 (23.29%)
OH	32 (21.92%)
DC	23 (15.75%)
Unspecified	2 (1.37%)

Figure 7: Frequencies (%) for Location for Cases with Follow-up Visits



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NCP Chain Linkages

All patient cases were assessed for chain links between each NCP step using criteria defined by Murphy et al.[58] Frequencies for the presence of linkage for each step of the NCP including all patient cases are shown in Table 19 and illustrated in Figure 8.

Table 19: Frequencies (%) for Presence of NCP Linkage for All Patient Cases

Presence of NCP Linkage		*n* = 564 patient cases for each linkage
Evidence-Diagnosis Linkage	Yes	370 (65.60%)
	No	194 (34.40%)
Diagnosis-Etiology Linkage	Yes	542 (96.10%)
	No	22 (3.90%)
Etiology-Intervention Linkage	Yes	550 (97.52%)
	No	14 (2.48%)
Intervention-Goal Linkage	Yes	538 (95.39%)
	No	26 (4.61%)
Problem-Outcome Linkage	Yes	515 (91.31%)
	No	49 (8.69%)

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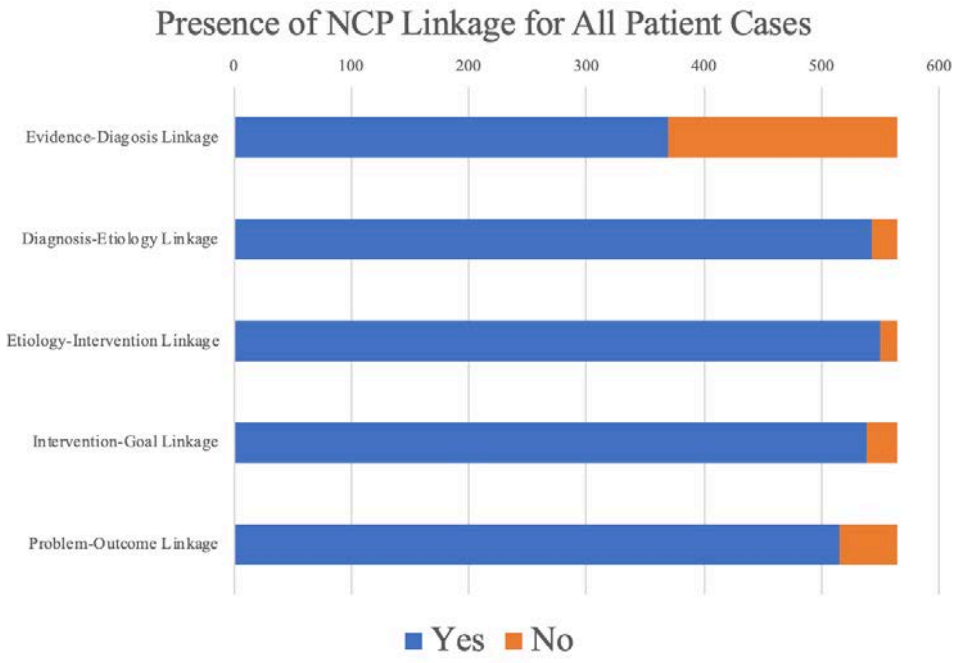
Figure 8: Frequencies (%) for Presence of NCP Linkage for All Patient Cases



NCP Quality Audits

Obtaining the NCP quality audit score for Aim #1 required use of the Diet-NCP-Audit tool from Lövestam and colleagues.[60] Determining the NCP quality audit score category (A, B, or C) also followed criteria defined by Lövestam and colleagues.[60] The distribution of scores from all 790 total patient encounters (initial visit and follow-ups for the all patient cases) for each question of the Diet-NCP-Audit tool is shown in Table 20 and illustrated in Figure 9. A score of 0-13 points was categorized as "C," a score of 13.5—19.5 points was a "B," and 20—26 points was an "A." [60] The average NCP quality audit score (points) was calculated for patient cases with one or more follow-up in order to determine the NCP quality audit score category for that patient. Frequencies for NCP quality audit score category for all patient cases is shown in Table 21 and illustrated in Figure 9. Frequencies for NCP quality audit score category for only those patient cases with follow-up visits are shown in Table 22 and illustrated in Figure 10.

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Table 20: Diet-NCP-Audit Raw Score Distribution by Question (n = 790)

Raw Diet-NCP-Audit Scores by Question	n = 790 total patient visits			
	Score	n	%	M (SD)
Question 1: One or more nutrition problems have been identified and prioritized				
	0	1	0.1	
	1	0	0	2 (±0.071)
	2	789	99.9	
Question 2: Possible etiology related to one or more nutrition problems is documented				
	0	9	1.1	
	1	1	0.1	1.98 (±0.215)
	2	780	98.7	
Question 3: The documentation refers to signs (objective) and/or symptoms (subjective) related to one or more nutrition problems				
	0	23	2.9	
	1	0	0	1.94 (±0.336)
	2	767	97.1	
Question 4: The documentation expresses a relationship between problem, etiology and signs/symptoms				
	0	2	0.3	
	1	42	5.3	1.94 (±0.245)
	2	746	94.4	
Question 5: The documentation includes a nutrition prescription				
	0	14	1.8	
	1	45	5.7	1.91 (±0.346)
	2	731	92.5	
Question 6: The documentation includes interventions implemented or planned, alternatively a comment explaining why no intervention was undertaken				
	0	13	1.6	1.96 (±0.259)
	1	2	0.3	

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Raw Diet-NCP-Audit Scores by Question	*n* = 790 total patient visits			
	Score	*n*	%	M (SD)
	2	775	98.1	
Question 7: The documentation includes evidence for the choice of interventions that are implemented or planned, or alternatively the decision to not undertake any interventions				
	0	13	1.6	
	1	16	2	1.95 (±0.289)
	2	761	96.3	
Question 8: The documentation includes one or more goals for the intervention				
	0	7	0.9	
	1	23	2.9	1.95 (±0.25)
	2	760	96.2	
Question 9: he documentation includes information about whether a follow-up appointment is planned, or alternatively whether the patient is discharged				
	0	7	0.9	
	1	758	95.9	1.02 (±0.2)
	2	25	3.2	
Question 10: The documentation includes a plan for how to perform the monitoring and evaluation, or alternatively an explanation of why no monitoring and evaluation are planned				
	0	15	1.9	
	1	22	2.8	1.93 (±0.316)
	2	753	95.3	
Question 11: The structure of the note follows the ADIME format of the Nutrition Care Process				
	0	0	0	1.96 (±0.194)
	1	31	3.9	

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Raw Diet-NCP-Audit Scores by Question		*n* = 790 total patient visits		
	Score	*n*	%	M (SD)
	2	759	96.1	
Question 12: The language in the documentation is clear and cannot lead to misunderstanding				
	0	1	0.1	
	1	32	4.1	1.96 (±0.209)
	2	757	95.8	
Question 13a: All the information documented is relevant to understanding the patient's nutritional status, problem and situation				
	0	0	0	
	0.5	85	10.8	0.946(±0.155)
	1	705	89.2	
Question 13b: All relevant information documented in the assessment part is addressed in the intervention part				
	0	14	1.8	
	0.5	16	2	0.972(±0.148)
	1	760	96.2	
	Total	790		24.42(±1.813)

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Figure 9: Distribution of Scores for Each Question of the Diet-NCP-Audit tool for All Patient Encounters (*n* = 790)

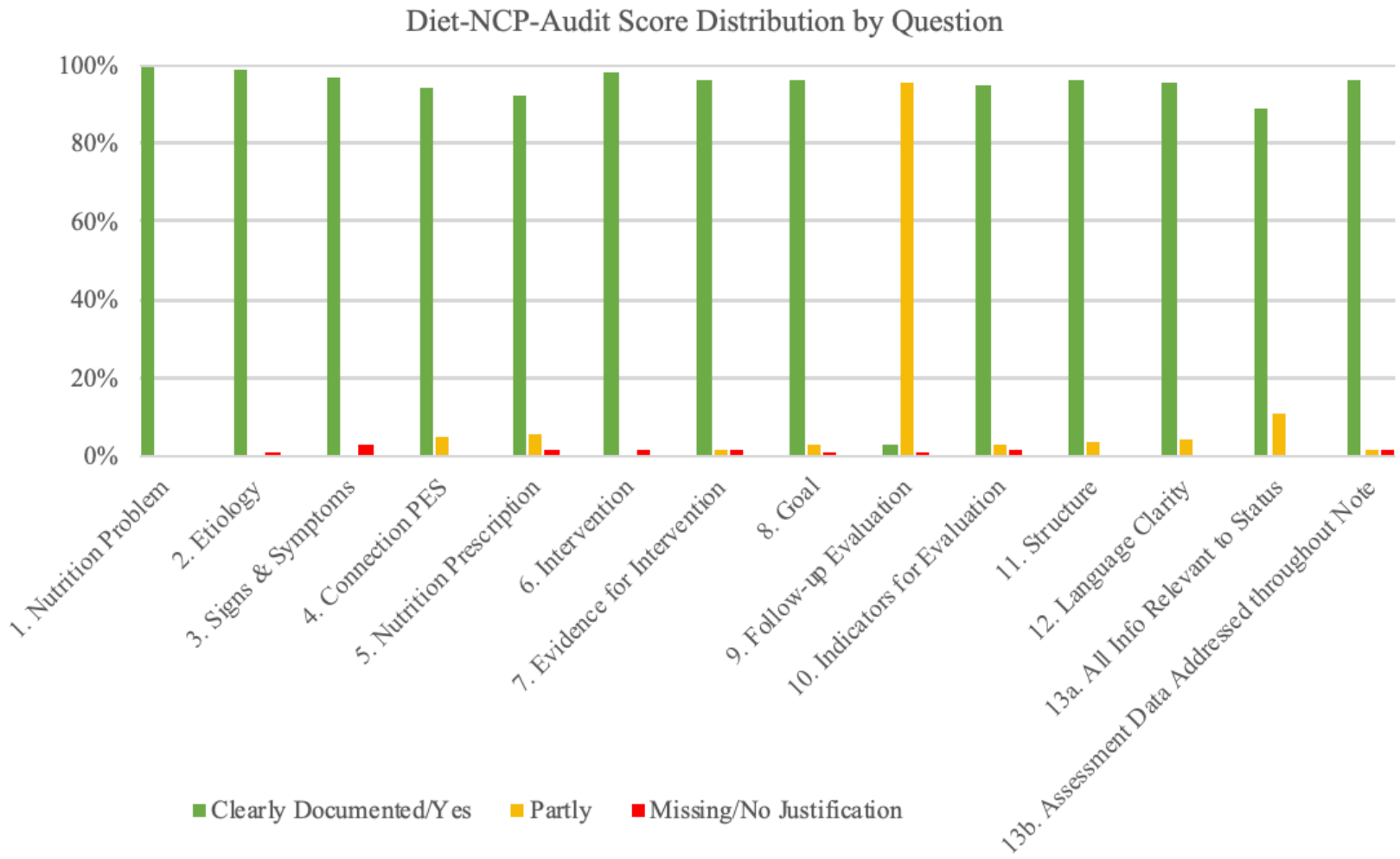

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Table 21: Frequencies (%) for Average NCP Quality Audit Score Category for All Patient Cases

Average NCP Quality Audit Score Category	*n* = 564 patient cases
A (20-26)	554 (98.23%)
B (13.5-19.5)	7 (1.24%)
C (0-13)	3 (0.53%)

Figure 10: Frequencies (%) for Average NCP Quality Audit Score Category for All Patient Cases

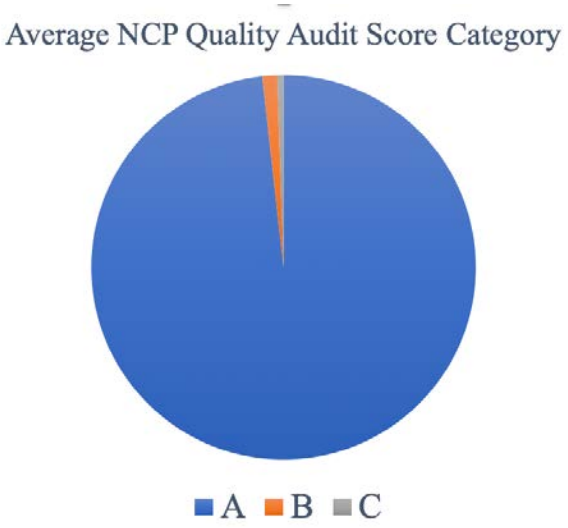

Table 22: Frequencies (%) for Average NCP Quality Audit Score Category for Patients with Follow-Up

Average NCP Quality Audit Score Category	*n* = 146 patient cases
A (20-26)	142 (97.3%)
B (13.5-19.5)	2 (1.4%)
C (0-13)	2 (1.4%)

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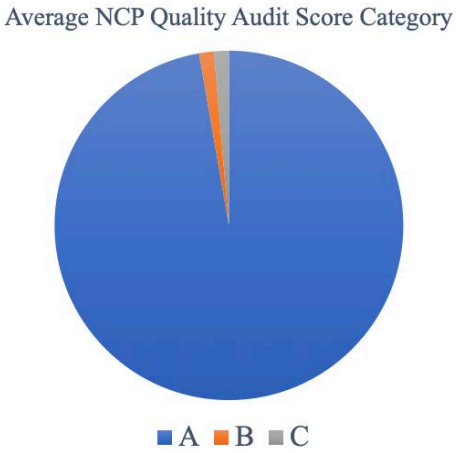
Figure 11: Frequencies (%) for Average NCP Quality Audit Score Category for Patients with Follow-Up



Obtaining the second NCP Quality Audit for Aim #2 required use of a revised NCP quality audit tool (Appendix B). Scoring was applied to a subset of the Diabetes Registry data. Within the 146 patients cases with follow-up visits, the PI randomly choose a sample of every 9 patient cases for a total of 15 patient cases. These 15 patient cases were scored on their initial visit and one follow-up visit. If the patient case included more than one follow-up visit in the original dataset, only the first follow-up visit was scored as the "reassessment" in questions "NE" 1-6. The revised tool contained 24 questions, each with a score of either "0" or "1." Questions "NA" 1-4 refer to the Nutrition Assessment piece of the NCP; questions "ND" 1-4 refer to the Nutrition Diagnosis; questions "NI" 1-6 refer to the Nutrition Intervention; questions "NM" 1-2 refer to the Nutrition Monitoring & Evaluation; questions "NE" 1-6 refer to the re-assessment during the follow-up visit; and questions "OQ" 1-2 refer to the overall documentation quality. All questions except for the "NE" questions are scored during the initial visit. The "NE" questions are the only questions scored during the follow-up visit. The distribution of scores is indicated in Table 23 and illustrated in Figure 12.

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Table 23: Revised NCP Quality Audit Raw Score Distribution by Question (n = 15)

Raw Revised NCP Quality Audit Scores by Question			n = 15 cases		
Question	Rater	Score	*n*	%	M (SD)
NA 1	CC	0	10	66.7	.33 (±0.488)
		1	5	33.3	
	MC	0	1	6.7	.93 (±0.258)
		1	14	93.3	
NA 2	CC	0	15	100	0 (±0.000)
		1	0	0	
	MC	0	15	100	0 (±0.000)
		1	0	0	
NA 3	CC	0	5	33.3	.67 (±0.488)
		1	10	66.7	
	MC	0	1	6.7	.93 (±0.258)
		1	14	93.3	
NA 4	CC	0	0	0	1 (±0.000)
		1	15	100	
	MC	0	4	26.7	.73 (±0.458)
		1	11	73.3	
ND 1	CC	0	0	0	1 (±0.000)
		1	15	100	
	MC	0	0	0	1 (±0.000)
		1	15	100	
ND 2	CC	0	1	6.7	.93 (±0.258)
		1	14	93.3	
	MC	0	1	6.7	.93 (±0.258)
		1	14	93.3	
ND 3	CC	0	15	100	0 (±0.000)
		1	0	0	
	MC	0	15	100	0 (±0.000)
		1	0	0	
ND 4	CC	0	5	33.3	.67 (±0.488)
		1	10	66.7	
	MC	0	1	6.7	.93 (±0.258)
		1	14	93.3	
NI 1	CC	0	5	33.3	.67 (±0.488)
		1	10	66.7	
	MC	0	1	6.7	.93 (±0.258)
		1	14	93.3	
NI 2	CC	0	5	33.3	.67 (±0.488)
		1	10	66.7	
	MC	0	1	6.7	.93 (±0.258)
		1	14	93.3	
NI 3	CC	0	2	13.3	.87 (±0.352)
		1	13	86.7	

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Raw Revised NCP Quality Audit Scores by Question			*n* = 15 cases		
Question	Rater	Score	*n*	%	M (SD)
	MC	0	1	6.7	.93 (±0.258)
		1	14	93.3	
NI 4	CC	0	3	20	.80 (±0.414)
		1	12	80	
	MC	0	1	6.7	.93 (±0.258)
		1	14	93.3	
NI 5	CC	0	1	6.7	.93 (±0.258)
		1	14	93.3	
	MC	0	1	6.7	.93 (±0.258)
		1	14	93.3	
NI 6	CC	0	15	100	0 (±0.000)
		1	0	0	
	MC	0	15	100	0 (±0.000)
		1	0	0	
NM 1	CC	0	3	20	.80 (±0.414)
		1	12	80	
	MC	0	2	13.3	.87 (±0.352)
		1	13	86.7	
NM 2	CC	0	15	100	0 (±0.000)
		1	0	0	
	MC	0	15	100	0 (±0.000)
		1	0	0	
NE 1	CC	0	1	6.7	.93 (±0.258)
		1	14	93.3	
	MC	0	0	0	1 (±0.000)
		1	15	100	
NE 2	CC	0	15	100	0 (±0.000)
		1	0	0	
	MC	0	15	100	0 (±0.000)
		1	0	0	
NE 3	CC	0	0	0	1 (±0.000)
		1	15	100	
	MC	0	0	0	1 (±0.000)
		1	15	100	
NE 4	CC	0	10	66.7	.33 (±0.488)
		1	5	33.3	
	MC	0	2	13.3	.87 (±0.352)
		1	13	86.7	
NE 5	CC	0	14	93.3	.07 (±0.258)
		1	1	6.7	
	MC	0	15	100	0 (±0.000)
		1	0	0	
NE 6	CC	0	3	20	.80 (±0.414)
		1	12	80	

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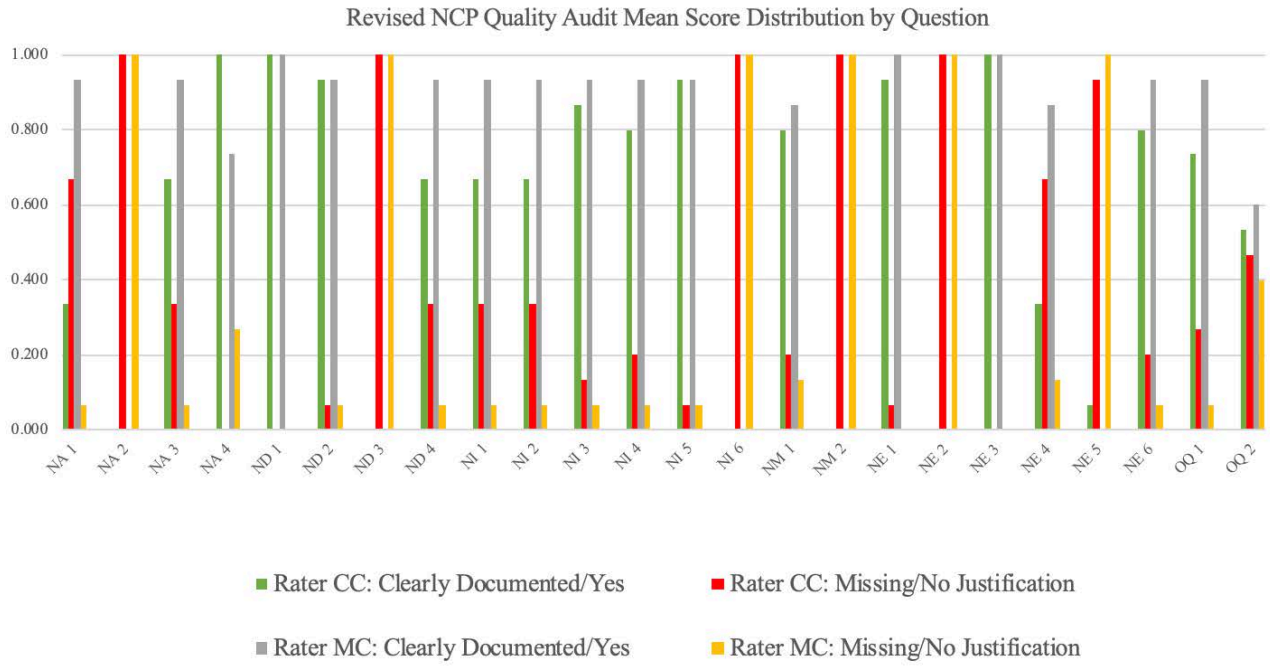
Raw Revised NCP Quality Audit Scores by Question			*n* = 15 cases		
Question	Rater	Score	*n*	%	M (SD)
	MC	0 1	1 14	6.7 93.3	.93 (±0.258)
OQ 1	CC	0 1	4 11	26.7 73.3	.73 (±0.458)
	MC	0 1	1 14	6.7 93.3	.93 (±0.258)
OQ 2	CC	0 1	7 8	46.7 53.3	.53 (±0.516)
	MC	0 1	6 9	40 60	.60 (±0.507)
Total score	CC		15		13.73(±3.173)
	MC		15		16.33(±3.352)

Figure 12: Revised NCP Quality Audit Mean Score Distribution by Question (*n* = 15)



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A dependent samples t-test was performed to test if a significant difference existed between the mean score from the Diet-NCP-Audit tool, and the mean score from the revised NCP quality audit tool. Because the revised NCP quality audit tool was used to score a subset of the data, Assumptions for the dependent samples t-test were met: the data was measured at least at the interval level and was normally distributed. On average, the Diet-NCP-Audit score (M = 23.21, SE = 0.92) was significantly higher than the revised NCP quality audit tool score (M = 14.62, SE = 0.73), t (14) = 12.52, $p < .000$, $r = .67$.

NCP Term Utilization

In order to organize the raw data into a usable form for statistical analysis, the decision was made to include only the first five NCP terms documented within each NCP step were included. In some cases, less than five NCP terms were found in the raw data within an NCP step; therefore, all terms were included. In other cases, more than five terms were found in the raw data, and only the first five included. For patients with more than one PES statement, only the first was included. If the PES contained multiple etiologies, only the first was included. Frequencies for the first five NCPT terms for Nutrition Assessment and for Nutrition Diagnosis are indicated in Tables 24-25 and Tables 26-27, respectively. Frequencies for Etiology and Etiology Matrix are indicated in Tables 28-31. Figure 13 illustrates a comparison between the Etiology Matrix categories documented for all patient cases versus only those cases who had follow-up visits.

Table 24: Frequencies (%) for Assessment NCP Terms Documented for All Patient Cases

Assessment NCP **Terms** Documented for All Patient Cases	n = 1756 term documentations
glycosylated hemoglobin measurement	296 (16.86%)
body mass index	104 (5.92%)

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Assessment NCP **Terms** Documented for All Patient Cases	*n* = 1756 term documentations
glucose, fasting	73 (4.16%)
knowledge/skill level - disease/condition	59 (3.36%)
total carbohydrate intake	55 (3.13%)
knowledge/skill level - food label	48 (2.73%)
weight	48 (2.73%)
knowledge/skill level - control food portions	45 (2.56%)
total energy intake	34 (1.94%)
glucose, casual	32 (1.82%)
meal or snack pattern - number of meals	32 (1.82%)
measured weight	32 (1.82%)
blood pressure	30 (1.71%)
finding of obesity	29 (1.65%)
food intake amount - fruits and vegetables	28 (1.59%)
oral fluid intake - soda, regular	27 (1.54%)
simple sugar carbohydrate intake	27 (1.54%)
physical activity history	26 (1.48%)
food intake amount - vegetables	24 (1.37%)
frequency of physical activity	23 (1.31%)
cholesterol, serum	22 (1.25%)
knowledge/skill level - nutrition recommendations	21 (1.20%)
knowledge/skill level - laboratory results compared to desirable	20 (1.14%)
prescription medication - insulin or insulin secretagogues	19 (1.08%)
food intake amount - concentrated sweets	18 (1.03%)
food intake amount - fruits	18 (1.03%)
meal or snack pattern	18 (1.03%)
triglycerides, serum	18 (1.03%)
cholesterol, LDL	17 (0.97%)
knowledge/skill level - select healthful foods/meals	15 (0.85%)
total carbohydrate estimated intake in 24 h	15 (0.85%)
oral fluid intake - juice	14 (0.80%)
glucose tolerance test	13 (0.74%)
number of meals estimated in 24 h	13 (0.74%)
cholesterol, HDL	12 (0.68%)
consistency of physical activity	12 (0.68%)
oral fluid intake - water	12 (0.68%)
sodium intake	12 (0.68%)
total carbohydrate from diet	12 (0.68%)

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Assessment NCP **Terms** Documented for All Patient Cases	*n* = 1756 term documentations
patient, client, family endocrine, metabolism history	11 (0.63%)
complex carbohydrate intake	10 (0.57%)
preprandial capillary plasma glucose	10 (0.57%)
total fiber intake	10 (0.57%)
food intake amount - fats and oils	8 (0.46%)
prescription medication - alter glucose levels	8 (0.46%)
readiness to change nutrition-related behaviors	8 (0.46%)
total energy measured intake in 24 h	8 (0.46%)
complex carbohydrate estimated intake in 24 h	7 (0.40%)
knowledge/skill level - food/nutrient requirement	7 (0.40%)
knowledge/skill level - self-monitor	7 (0.40%)
daily stress level	6 (0.34%)
food intake - amount	6 (0.34%)
food intake amount - grains	6 (0.34%)
knowledge/skill level - consequences of food behavior	6 (0.34%)
knowledge/skill level - plan meals/snacks	6 (0.34%)
previous diet/nutrition education/counseling	6 (0.34%)
type of food or meal	6 (0.34%)
weight loss	6 (0.34%)
area(s) and level of nutrition knowledge/skill	5 (0.28%)
empty energy servings estimated in 24 h	5 (0.28%)
motivation, nutrition related beliefs and attitudes	5 (0.28%)
number of snacks estimated in 24 h	5 (0.28%)
peak postprandial capillary plasma glucose	5 (0.28%)
saturated fat estimated intake in 24 h	5 (0.28%)
total fat intake	5 (0.28%)
type of food or meal - convenience frozen meals	5 (0.28%)
type of food or meal - ready to eat food selection	5 (0.28%)
fruit servings estimated in 24 h	4 (0.23%)
knowledge/skill level - food preparation/cooking	4 (0.23%)
knowledge/skill level - health knowledge gap	4 (0.23%)
knowledge/skill level - level of physical conditioning	4 (0.23%)
nutrition knowledge of individual client	4 (0.23%)
patient, client chief nutrition complaint	4 (0.23%)
prescription medication use	4 (0.23%)
recommended body mass index	4 (0.23%)
BMI-for-age percentile	3 (0.17%)

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Assessment NCP **Terms** Documented for All Patient Cases	*n* = 1756 term documentations
body fat percentage	3 (0.17%)
digestive system - appetite	3 (0.17%)
ethnicity	3 (0.17%)
fat servings estimated in 24 h	3 (0.17%)
food variety	3 (0.17%)
knowledge/skill level - goal-setting technique	3 (0.17%)
liquid meal replacement or supplement intake	3 (0.17%)
oral fluid intake	3 (0.17%)
oral fluid intake - soda, artificially sweetened	3 (0.17%)
patient, client, family cardiovascular history	3 (0.17%)
physical ability to complete tasks for meal preparation	3 (0.17%)
saturated fat intake	3 (0.17%)
simple carbohydrate estimated intake in 24 h	3 (0.17%)
stated weight	3 (0.17%)
total protein intake	3 (0.17%)
type of physical activity	3 (0.17%)
weight change	3 (0.17%)
binge eating behavior	2 (0.11%)
finding of ankle edema	2 (0.11%)
finding of depressed mood	2 (0.11%)
finding of edema of calf	2 (0.11%)
finding of excessive appetite	2 (0.11%)
finding of impaired wound healing	2 (0.11%)
food intake amount - meat, poultry, fish, eggs, beans, nut produc	2 (0.11%)
frequency of alcohol intake	2 (0.11%)
glomerular filtration rate	2 (0.11%)
grain servings estimated in 24 h	2 (0.11%)
insulin-to-carbohydrate ratio	2 (0.11%)
intensity of physical activity	2 (0.11%)
knowledge/skill level - self-management parameters	2 (0.11%)
living, housing situation	2 (0.11%)
none documented	2 (0.11%)
participation in government food and nutrition programs	2 (0.11%)
prescription medication	2 (0.11%)
prescription medication - nutrient/food-medication interactions	2 (0.11%)
sodium estimated intake in 24 h	2 (0.11%)
total carbohydrate estimated needs	2 (0.11%)

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Assessment NCP **Terms** Documented for All Patient Cases	*n* = 1756 term documentations
total energy estimated intake in 24 h	2 (0.11%)
total fat estimated intake in 24 h	2 (0.11%)
type of food or meal - self-prepared foods/snacks	2 (0.11%)
vegetable servings estimated in 24 h	2 (0.11%)
weight gain	2 (0.11%)
ability to build and utilize nutrition related social network	1 (0.06%)
access to assistive food preparation devices	1 (0.06%)
alcohol intake; drink size or volume	1 (0.06%)
avoidance - specific foods	1 (0.06%)
calcium intake	1 (0.06%)
cholesterol, non-HDL	1 (0.06%)
cognitive ability to complete tasks for meal preparation	1 (0.06%)
dietary cholesterol intake	1 (0.06%)
digestive system - mastication, altered	1 (0.06%)
duration of physical activity	1 (0.06%)
eats alone	1 (0.06%)
emotions affecting nutrition related beliefs and attitudes	1 (0.06%)
enteral nutrition - composition	1 (0.06%)
finding of constipation	1 (0.06%)
finding of decreased range of hip movement	1 (0.06%)
finding of dizziness	1 (0.06%)
finding of edentulousness	1 (0.06%)
finding of impaired dentition	1 (0.06%)
finding of nausea	1 (0.06%)
food allergies	1 (0.06%)
food intake amount - carbohydrate	1 (0.06%)
food intake amount - milk/milk products	1 (0.06%)
food intake amount - percent total meal eaten	1 (0.06%)
food intake amount- concentrated sweets	1 (0.06%)
food intake amount - fruits and vegetables	1 (0.06%)
food intolerance	1 (0.06%)
height, length	1 (0.06%)
height, length	1 (0.06%)
knowledge/skill - disease/condition	1 (0.06%)
knowledge/skill level	1 (0.06%)
knowledge/skill level - health care literacy	1 (0.06%)
knowledge/skill level - healthcare literacy	1 (0.06%)

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Assessment NCP **Terms** Documented for All Patient Cases	*n* = 1756 term documentations
location of eating environment	1 (0.06%)
medical treatment therapy	1 (0.06%)
oral fluid intake - coffee and tea	1 (0.06%)
patient, client, family psychological history	1 (0.06%)
patient, client, family respiratory history	1 (0.06%)
pattern of alcohol consumption	1 (0.06%)
physical disability	1 (0.06%)
potassium estimated intake in 24 h	1 (0.06%)
prescription medication- insulin or insulin secretagogues	1 (0.06%)
saturated fat estimated intake	1 (0.06%)
self-efficacy - eating	1 (0.06%)
socioeconomic factors	1 (0.06%)
strength, physical activity	1 (0.06%)
surgical treatment	1 (0.06%)
total caffeine intake	1 (0.06%)
total caffeine intake	1 (0.06%)
total carbohydrate intake from diet	1 (0.06%)
total energy estimated needs	1 (0.06%)
total fiber estimated intake in 24 h	1 (0.06%)
total protein estimated intake in 24 h	1 (0.06%)
type of food or meal - fortified/enriched foods	1 (0.06%)
types of food/meals	1 (0.06%)
urine acylglycines/creatinine	1 (0.06%)
usual state body weight	1 (0.06%)
vitamin K intake	1 (0.06%)
waist circumference	1 (0.06%)
weight change intent	1 (0.06%)
weight change percentage	1 (0.06%)

Table 25: Frequencies (%) of Assessment NCP Terms Documented for Cases with Follow-up Visits

Assessment NCP **Terms** Documented for Cases with Follow-up Visits	*n* = 778 term documentations

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Assessment NCP **Terms** Documented for Cases with Follow-up Visits	*n* = 778 term documentations
glycosylated hemoglobin measurement	183 (23.52%)
glucose, fasting	55 (7.07%)
weight	49 (6.30%)
total carbohydrate intake	39 (5.01%)
body mass index	33 (4.24%)
glucose, casual	28 (3.60%)
total energy intake	25 (3.21%)
triglycerides, serum	20 (2.57%)
finding of obesity	15 (1.93%)
total carbohydrate estimated intake in 24 h	15 (1.93%)
cholesterol, serum	13 (1.67%)
sodium intake	13 (1.67%)
total energy measured intake in 24 h	12 (1.54%)
food intake amount - concentrated sweets	10 (1.29%)
simple sugar carbohydrate intake	10 (1.29%)
food intake amount - vegetables	8 (1.03%)
physical activity history	8 (1.03%)
recommended body mass index	8 (1.03%)
food intake - amount	7 (0.90%)
food intake amount - fruits and vegetables	7 (0.90%)
meal or snack pattern - number of meals	7 (0.90%)
knowledge/skill level - disease/condition	6 (0.77%)
measured weight	6 (0.77%)
total carbohydrate from diet	6 (0.77%)
weight gain	6 (0.77%)
cholesterol, LDL	5 (0.64%)
frequency of physical activity	5 (0.64%)
knowledge/skill level - laboratory results compared to desirable	5 (0.64%)
meal or snack pattern	5 (0.64%)
saturated fat estimated intake in 24 h	5 (0.64%)
complex carbohydrate intake	4 (0.51%)
daily stress level	4 (0.51%)
food-derived fluid intake	4 (0.51%)
knowledge/skill level - control food portions	4 (0.51%)
knowledge/skill level - plan meals/snacks	4 (0.51%)
nutrition related self management as agreed upon	4 (0.51%)
prescription medication - insulin or insulin secretagogues	4 (0.51%)

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Assessment NCP **Terms** Documented for Cases with Follow-up Visits	*n* = 778 term documentations
simple carbohydrate estimated intake in 24 h	4 (0.51%)
sodium estimated intake in 24 h	4 (0.51%)
total fiber intake	4 (0.51%)
area(s) and level of nutrition knowledge/skill	3 (0.39%)
body fat percentage	3 (0.39%)
cholesterol, HDL	3 (0.39%)
consistency of physical activity	3 (0.39%)
food intake amount - fruits	3 (0.39%)
food intake amount - grains	3 (0.39%)
food variety	3 (0.39%)
glucose tolerance test	3 (0.39%)
knowledge/skill level - food label	3 (0.39%)
peak postprandial capillary plasma glucose	3 (0.39%)
preprandial capillary plasma glucose	3 (0.39%)
readiness to change nutrition-related behaviors	3 (0.39%)
saturated fat intake	3 (0.39%)
strength, physical activity	3 (0.39%)
total carbohydrate estimated needs	3 (0.39%)
type of physical activity	3 (0.39%)
vegetable servings estimated in 24 h	3 (0.39%)
binge eating behavior	2 (0.26%)
blood pressure	2 (0.26%)
caregiver, companion in eating environment	2 (0.26%)
eligibility for community food and nutrition programs	2 (0.26%)
food intake amount - fats and oils	2 (0.26%)
intensity of physical activity	2 (0.26%)
knowledge/skill level - food preparation/cooking	2 (0.26%)
knowledge/skill level - nutrition recommendations	2 (0.26%)
liquid meal replacement or supplement intake	2 (0.26%)
number of meals estimated in 24 h	2 (0.26%)
oral fluid intake	2 (0.26%)
oral fluid intake - juice	2 (0.26%)
oral fluid intake - soda, regular	2 (0.26%)
prescription medication - alter glucose levels	2 (0.26%)
total energy estimated needs	2 (0.26%)
total fat intake	2 (0.26%)
type of food or meal	2 (0.26%)

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Assessment NCP **Terms** Documented for Cases with Follow-up Visits	*n* = 778 term documentations
ability to build and utilize nutrition related social network	1 (0.13%)
access to food and nutrition-related supplies	1 (0.13%)
binge eating disorder	1 (0.13%)
BMI-for-age percentile	1 (0.13%)
complex carbohydrate estimated intake in 24 h	1 (0.13%)
digestive system - appetite	1 (0.13%)
digestive system - mastication, altered	1 (0.13%)
digestive system - nausea	1 (0.13%)
duration of physical activity	1 (0.13%)
emotions affecting nutrition related beliefs and attitudes	1 (0.13%)
fat servings estimated in 24 h	1 (0.13%)
finding of dizziness	1 (0.13%)
food intake amount - carbohydrate	1 (0.13%)
glomerular filtration rate	1 (0.13%)
knowledge/skill level - goal-setting technique	1 (0.13%)
knowledge/skill level - health knowledge gap	1 (0.13%)
knowledge/skill level - nutrition recommendations	1 (0.13%)
knowledge/skill level - self-monitor	1 (0.13%)
meal or snack pattern - number of snacks	1 (0.13%)
number of snacks estimated in 24 h	1 (0.13%)
nutrition-related avoidance behavior	1 (0.13%)
oral fluid intake - coffee and tea	1 (0.13%)
oral fluid intake - soda, artificially sweetened	1 (0.13%)
oral fluid intake - water	1 (0.13%)
oral fluid measured intake in 24 h	1 (0.13%)
participation in government food and nutrition programs	1 (0.13%)
patient, client, family cardiovascular history	1 (0.13%)
patient, client, family endocrine, metabolism history	1 (0.13%)
patient, client, family respiratory history	1 (0.13%)
prescription medication - nutrient/food-medication interactions	1 (0.13%)
previous diet/nutrition education/counseling	1 (0.13%)
self-efficacy - weight loss	1 (0.13%)
socioeconomic factors	1 (0.13%)
soluble fiber intake	1 (0.13%)
total caffeine intake	1 (0.13%)
total protein intake	1 (0.13%)
type of carbohydrate needed	1 (0.13%)

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Assessment NCP **Terms** Documented for Cases with Follow-up Visits	*n* = 778 term documentations
type of food or meal - ready to eat food selections	1 (0.13%)
types of food/meals	1 (0.13%)

Table 26: Frequencies (%) for Diagnosis NCP Terms Documented for All Patient Cases

Diagnosis NCP **Terms** Documented for All Patient Cases	*n* = 773 term documentations
excessive carbohydrate intake	284 (36.74%)
food and nutrition related knowledge deficit	86 (11.13%)
excessive energy intake	80 (10.35%)
inconsistent carbohydrate intake	51 (6.60%)
altered nutrition-related laboratory values	42 (5.43%)
undesirable food choices	33 (4.27%)
overweight/obesity	21 (2.72%)
less than optimal intake of types of carbohydrate	19 (2.46%)
excessive fat intake	15 (1.94%)
excessive oral intake	14 (1.81%)
excessive fluid intake	12 (1.55%)
inadequate oral intake	10 (1.29%)
inadequate energy intake	9 (1.16%)
obese, class III	9 (1.16%)
inadequate carbohydrate intake	8 (1.03%)
physical inactivity	8 (1.03%)
disordered eating pattern	7 (0.91%)
obese, class II	7 (0.91%)
food-medication interaction	6 (0.78%)
intake of types of carbohydrate inconsistent with needs	6 (0.78%)
inadequate fiber intake	5 (0.65%)
predicted excessive energy intake	5 (0.65%)
excessive sodium intake	4 (0.52%)
imbalance of nutrients	4 (0.52%)
obese, class I	4 (0.52%)
inadequate protein-energy intake	3 (0.39%)

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Diagnosis NCP **Terms** Documented for All Patient Cases	*n* = 773 term documentations
inadequate fluid intake	2 (0.26%)
not ready for diet/lifestyle change	2 (0.26%)
enteral nutrition composition inconsistent with needs	1 (0.13%)
excessive alcohol intake	1 (0.13%)
impaired nutrient utilization	1 (0.13%)
inadequate calcium intake	1 (0.13%)
increased energy expenditure	1 (0.13%)
intake of types of fats inconsistent with needs	1 (0.13%)
less than optimal intake of types of fat	1 (0.13%)
limited access to food	1 (0.13%)
limited adherence to nutrition related recommendations	1 (0.13%)
none documented	1 (0.13%)
overweight	1 (0.13%)
overweight, adult or pediatric	1 (0.13%)
predicted excessive intake	1 (0.13%)
predicted suboptimal energy intake	1 (0.13%)
suboptimal bioactive substance intake	1 (0.13%)
underweight	1 (0.13%)
unsupported beliefs/attitudes	1 (0.13%)

Table 27: Frequencies (%) of Diagnosis NCP Terms Documented for Cases with Follow-up Visits

Diagnosis NCP **Terms** Documented for Cases with Follow-up Visits	*n* = 330 term documentations
excessive carbohydrate intake	140 (42.42%)
food and nutrition related knowledge deficit	32 (9.70%)
inconsistent carbohydrate intake	26 (7.88%)
undesirable food choices	24 (7.27%)
excessive energy intake	12 (3.64%)
less than optimal intake of types of carbohydrate	11 (3.33%)
excessive fluid intake	10 (3.33%)
excessive oral intake	8 (2.42%)

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Diagnosis NCP **Terms** Documented for Cases with Follow-up Visits	*n* = 330 term documentations
excessive fat intake	7 (2.12%)
inadequate oral intake	7 (2.12%)
altered nutrition-related laboratory values	5 (1.52%)
disordered eating pattern	5 (1.52%)
food-medication interaction	5 (1.52%)
inadequate carbohydrate intake	5 (1.52%)
obese, class III	5 (1.52%)
overweight/obesity	5 (1.52%)
excessive sodium intake	4 (1.21%)
physical inactivity	4 (1.21%)
inadequate energy intake	3 (0.91%)
inadequate protein-energy intake	3 (0.91%)
obese, class I	3 (0.91%)
obese, class II	3 (0.91%)
none documented	1 (0.30%)
predicted excessive energy intake	1 (0.30%)
predicted excessive intake	1 (0.30%)

Table 28: Frequencies (%) for Etiology NCP Terms Documented for All Patient Cases

Etiology NCP **Terms** Documented for All Patient Cases	*n* = 789 term documentations
food and nutrition related knowledge deficit	447 (56.65%)
disordered eating pattern	87 (11.03%)
excessive energy intake	28 (3.55%)
uncertainty how to apply nutrition knowledge	25 (3.17%)
lack of prior nutrition related education	16 (2.03%)
unsupported beliefs/attitudes about food or nutrition-related topics	13 (1.65%)
excessive oral intake	11 (1.39%)
none documented	10 (1.27%)
not ready for diet/lifestyle change	10 (1.27%)
excessive carbohydrate intake	8 (1.01%)

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Etiology NCP **Terms** Documented for All Patient Cases	*n* = 789 term documentations
no prior education regarding carbohydrate-consistent diet for gestational diabetes management	7 (0.89%)
gestational diabetes	6 (0.76%)
limited access to food or water	6 (0.76%)
newly diagnosed type 2 diabetes	6 (0.76%)
no previous diabetes education	6 (0.76%)
biting/chewing (masticatory) difficulty	5 (0.63%)
lack of physical activity	5 (0.63%)
hyperglycemia	4 (0.51%)
inadequately managed type II diabetes	4 (0.51%)
lack of previous MNT	4 (0.51%)
newly diagnosed diabetes	4 (0.51%)
remote history of education in the past	4 (0.51%)
increased nutrient needs	3 (0.38%)
lack of exposure to information	3 (0.38%)
limited adherence to nutrition related recommendations	3 (0.38%)
no prior education on diabetes meal plan	3 (0.38%)
overweight/obesity	3 (0.38%)
type II diabetes	3 (0.38%)
unmanaged type 2 diabetes	3 (0.38%)
excessive fat intake	2 (0.25%)
food-medication interaction	2 (0.25%)
inadequate energy intake	2 (0.25%)
lack of exposure to previous nutrition education	2 (0.25%)
newly diagnosed pre-diabetes	2 (0.25%)
obese, class I	2 (0.25%)
physical inactivity	2 (0.25%)
poor dentition	2 (0.25%)
prescribed medication	2 (0.25%)
altered nutrition-related laboratory val	1 (0.13%)
deconditioning	1 (0.13%)
depressed	1 (0.13%)
excessive enteral nutrition infusion	1 (0.13%)
excessive fluid intake	1 (0.13%)

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Etiology NCP **Terms** Documented for All Patient Cases	*n* = 789 term documentations
excessive vitamin K intake	1 (0.13%)
exposure to inaccurate nutrition-related	1 (0.13%)
finances	1 (0.13%)
food and nutrition related knowedge deficit	1 (0.13%)
food insecurity	1 (0.13%)
food preferences	1 (0.13%)
glycosylated hemoglobin measurement	1 (0.13%)
hunger	1 (0.13%)
inadequate physical activity	1 (0.13%)
inadequately managed type I diabetes	1 (0.13%)
intake of types of carbohydrate inconsistent with needs	1 (0.13%)
Italian ethnicity	1 (0.13%)
lack of prior access to RDN	1 (0.13%)
limited access to food	1 (0.13%)
multiple diet restrictions	1 (0.13%)
new basal/bolus insulin regiment and restricting carbs to control glucose	1 (0.13%)
new prednisone usage	1 (0.13%)
no prior education on nutrition management	1 (0.13%)
no prior nutrition education	1 (0.13%)
nutrition self monitoring deficit	1 (0.13%)
obesity	1 (0.13%)
poorly controlled T2DM	1 (0.13%)
predicted excessive energy intake	1 (0.13%)
predicted excessive intake	1 (0.13%)
predicted food-medication interaction	1 (0.13%)
reduced SNAP benefits	1 (0.13%)
uncertainty how to apply information	1 (0.13%)
uncertainty of how to incorporate nutrition into daily intake	1 (0.13%)
undesirable food choices	1 (0.13%)

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Table 29: Frequencies (%) for Etiology Matrix Category Documented for All Patient Cases

Etiology Matrix Category Documented for All Patient Cases	*n* = 789 etiology matrix documentations
Knowledge	524 (66.41%)
Psychological	88 (11.15%)
Behavior	73 (9.25%)
Physiologic-Metabolic	43 (5.45%)
Beliefs-Attitudes	28 (3.55%)
Access	10 (1.27%)
N/A*	10 (1.27%)
Treatment	7 (0.89%)
Physical Function	5 (0.63%)
Cultural	1 (0.13%)

*n/a due to no etiology documented

Table 30: Frequencies (%) for Etiology NCP Terms Documented for Cases with Follow-up Visits

Etiology NCP **Terms** Documented for Cases with Follow-up Visits	*n* = 372 term documentations
food and nutrition related knowledge deficit	223 (59.95%)
disordered eating pattern	44 (11.83%)
excessive energy intake	17 (4.57%)
excessive oral intake	9 (2.42%)
lack of prior nutrition related education	9 (2.42%)
uncertainty how to apply nutrition knowledge	9 (2.42%)
none documented	7 (1.88%)
excessive carbohydrate intake	5 (1.34%)
not ready for diet/lifestyle change	5 (1.34%)
biting/chewing (masticatory) difficulty	4 (1.08%)
hyperglycemia	4 (1.08%)
limited access to food or water	4 (1.08%)
remote history of education in the past	4 (1.08%)
unsupported beliefs/attitudes about food	4 (1.08%)

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Etiology NCP **Terms** Documented for Cases with Follow-up Visits	*n* = 372 term documentations
increased nutrient needs	3 (0.81%)
lack of physical activity	3 (0.81%)
limited adherence to nutrition related recommendations	2 (0.54%)
no prior education regarding carbohydrates	2 (0.54%)
obese, class I	2 (0.54%)
overweight/obesity	2 (0.54%)
physical inactivity	2 (0.54%)
poor dentition	2 (0.54%)
predicted excessive energy intake	2 (0.54%)
prescribed medication	2 (0.54%)
depressed	1 (0.27%)
excessive fat intake	1 (0.27%)

Table 31: Frequencies (%) for Etiology Matrix Category Documented for Cases with Follow-up Visits

Etiology Matrix Category Documented for Cases with Follow-up Visits	*n* = 372 etiology matrix documentations
knowledge	247 (66.40%)
psychological	45 (12.10%)
behavior	39 (10.48%)
physiologic-metabolic	13 (3.49%)
beliefs-attitudes	11 (2.96%)
N/A*	7 (1.88%)
access	4 (1.08%)
physical function	4 (1.08%)
treatment	2 (0.54%)

*N/A due to no etiology documented

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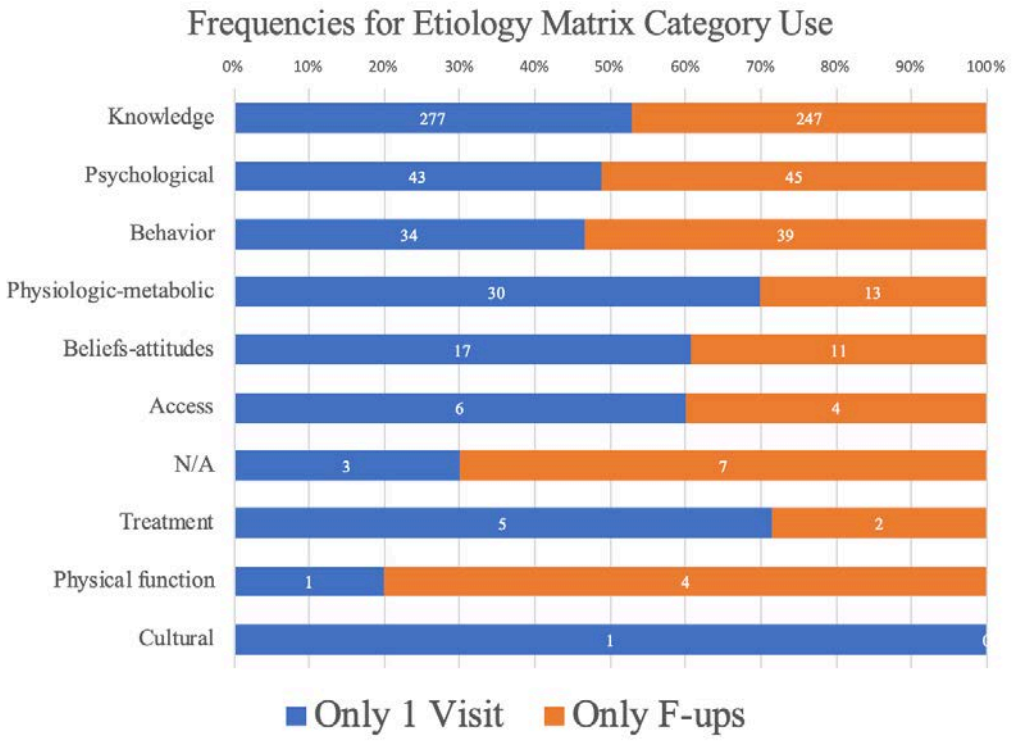
Figure 13: Frequencies (%) for Etiology Matrix Category Documented: Total and Follow-up



Frequencies for NCP Intervention terms documented for all patient cases are shown in Table 32. Frequencies for NCP Intervention domain for all patient cases are shown in Table 33. Frequencies for NCP Intervention for only patient cases who had follow-up visits are shown in Table 34. Frequencies for NCP Intervention domain for patient cases with follow-up visits are shown in Table 35. Figure 14 illustrates a comparison between the NCP Intervention domains documented for all patient cases versus only those cases with follow-up visits.

Table 32: Frequencies (%) for Intervention NCP Terms Documented for All Patient Cases

Intervention NCP **Terms** Documented for All Patient Cases	*n* = 2525 term documentations
nutrition relationship to health/disease	296 (11.70%)
other nutrition education	262 (10.36%)
recommended nutrition modifications	255 (10.08%)

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Intervention NCP **Terms** Documented for All Patient Cases	*n* = 2525 term documentations
priority modifications, nutrition education	155 (6.13%)
other application of nutrition education	137 (5.43%)
modify composition of meals/snacks	132 (5.23%)
general/healthful diet	131 (5.19%)
physical activity guidance	122 (4.83%)
other or related nutrition education topics	121 (4.79%)
nutrition influence on health education	113 (4.48%)
purpose of the nutrition education	103 (4.08%)
nutrition related skill education	87 (3.45%)
skill development, nutrition education	81 (3.21%)
consistent carbohydrate diet	73 (2.89%)
survival information, nutrition education	39 (1.54%)
nutrition counseling based on goal setting strategy	37 (1.47%)
nutrition related laboratory result interpretation	34 (1.35%)
result interpretation, nutrition education	23 (0.91%)
decreased energy diet	22 (0.87%)
technical nutrition education	21 (0.83%)
energy modified diet	17 (0.67%)
decreased simple carbohydrate diet	15 (0.59%)
increased complex carbohydrate diet	15 (0.59%)
carbohydrate modified diet	14 (0.55%)
nutrition counseling based on motivational interviewing strategy	12 (0.48%)
management of nutrition-related prescription medication	12 (0.48%)
none documented	12 (0.48%)
consistent carbohydrate intake	9 (0.36%)
increased fiber diet	9 (0.36%)
increased protein diet	9 (0.36%)
nutrition counseling based on cognitive restructuring	9 (0.36%)
nutrition counseling based on cognitive-behavioral theoretical approach	9 (0.36%)
nutrition counseling based on health belief model	8 (0.32%)
nutrition counseling based on stress management	8 (0.32%)
referral by a nutrition professional to community agencies or programs	7 (0.28%)
increased energy diet	6 (0.24%)
increased fiber diet	6 (0.24%)
nutrition counseling based on problem solving strategy	5 (0.20%)
nutrition counseling based on self monitoring strategy	5 (0.20%)

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Intervention NCP **Terms** Documented for All Patient Cases	*n* = 2525 term documentations
nutrition-related laboratory result intepretation	5 (0.20%)
content related nutrition education	4 (0.16%)
decreased carbohydrate diet	4 (0.16%)
decreased protein diet	4 (0.16%)
decreased saturated fat diet	4 (0.16%)
dietary liquid consistency - spoon thick liquids	4 (0.16%)
increased carbohydrate diet	4 (0.16%)
pureed diet	4 (0.16%)
specific foods/beverages or groups	4 (0.16%)
commercial beverage, medical food supplement therapy	3 (0.12%)
decreased fat diet	3 (0.12%)
decreased fluid diet	3 (0.12%)
nutrition counseling based on social support strategy	3 (0.12%)
collaboration by nutrition professional with other nutrition professional	2 (0.08%)
decreased sodium diet	2 (0.08%)
diet modified for specific foods or ingredients	2 (0.08%)
fat modified diet	2 (0.08%)
food environment change	2 (0.08%)
increased calcium diet	2 (0.08%)
increased soluble fiber diet	2 (0.08%)
IV fluid delivery	2 (0.08%)
manage non-nutritive food additives intake	2 (0.08%)
modify schedule of food/fluids	2 (0.08%)
nutrition prescription	2 (0.08%)
other meal and snack component or characteristic	2 (0.08%)
other strategy for nutrition counseling	2 (0.08%)
referral by nutrition professional to other providers	2 (0.08%)
texture modified diet	2 (0.08%)
commercial food, medical food supplement therapy	1 (0.04%)
decreased cholesterol diet	1 (0.04%)
decreased fructose diet	1 (0.04%)
decreased simple carbohydrate intake	1 (0.04%)
fluid modified diet	1 (0.04%)
grain modified diet	1 (0.04%)
manage alcohol intake	1 (0.04%)
manage other bioactive substances	1 (0.04%)
management of nutrition-related over-the-counter medications	1 (0.04%)

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Intervention NCP **Terms** Documented for All Patient Cases	*n* = 2525 term documentations
menu selection assistance	1 (0.04%)
modify meal location, feeding environment	1 (0.04%)
multivitamin, multimineral supplement therapy	1 (0.04%)
nutrition counseling based on relapse prevention strategy	1 (0.04%)
nutrition counseling based on rewards/contingency management strategy	1 (0.04%)
nutrition counseling based on transtheoretical model and stages of change approach	1 (0.04%)
nutrition related skill interpretation	1 (0.04%)
other feeding assistance	1 (0.04%)
other nutrition education topics	1 (0.04%)
other theoretical basis or approach to nutrition counseling	1 (0.04%)
purpose of medical food supplement therapy	1 (0.04%)
recommended nutrition education	1 (0.04%)
residential settings	1 (0.04%)
soluble fiber modified diet	1 (0.04%)
vegetable modified diet	1 (0.04%)

Table 33: Frequencies (%) for Intervention NCP Term Domains Documented for All Patient Cases

Intervention NCP **Domains** Documented for All Patient Cases	*n* = 2525 domain documentations
Nutrition Education	1613 (63.88%)
Food and/or Nutrient Delivery	787 (31.17%)
Nutrition Counseling	102 (4.04%)
None documented	12 (0.48%)
Coordination of Nutrition Care	11 (0.44%)

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Table 34: Frequencies (%) for Intervention NCP Terms Documented for Cases with Follow-up

Intervention NCP **Terms** Documented for Cases with Follow-up Visits	*n* = 1156 term documentations
recommended nutrition modifications	150 (12.98%)
nutrition relationship to health/disease	126 (10.90%)
other nutrition education	123 (10.64%)
physical activity guidance	81 (7.01%)
priority modifications, nutrition education	65 (5.62%)
other or related nutrition education topics	59 (5.10%)
other application of nutrition education	58 (5.02%)
general/healthful diet	57 (4.93%)
nutrition influence on health education	56 (4.84%)
modify composition of meals/snacks	51 (4.41%)
nutrition related skill education	44 (3.81%)
skill development, nutrition education	39 (3.37%)
purpose of the nutrition education	29 (2.51%)
nutrition related laboratory result interpretation	23 (1.99%)
survival information, nutrition education	20 (1.73%)
consistent carbohydrate diet	18 (1.56%)
result interpretation, nutrition education	17 (1.47%)
nutrition counseling based on goal setting strategy	15 (1.30%)
technical nutrition education	10 (0.87%)
decreased energy diet	9 (0.78%)
none documented	9 (0.78%)
carbohydrate modified diet	7 (0.61%)
management of nutrition-related prescription medication	7 (0.61%)
nutrition counseling based on motivational interviewing strategy	6 (0.52%)
nutrition counseling based on stress management	5 (0.43%)
decreased saturated fat diet	4 (0.35%)
decreased simple carbohydrate diet	4 (0.35%)
dietary liquid consistency - spoon thick liquids	4 (0.35%)
increased energy diet	4 (0.35%)
nutrition-related laboratory result interpretation	4 (0.35%)
pureed diet	4 (0.35%)
commercial beverage, medical food supplement therapy	3 (0.26%)
nutrition counseling based on self monitoring strategy	3 (0.26%)
referral by a nutrition professional to community agencies or programs	3 (0.26%)

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Intervention NCP **Terms** Documented for Cases with Follow-up Visits	*n* = 1156 term documentations
specific foods/beverages or groups	3 (0.26%)
consistent carbohydrate intake	2 (0.17%)
energy modified diet	2 (0.17%)
increased carbohydrate diet	2 (0.17%)
increased protein diet	2 (0.17%)
increased soluble fiber diet	2 (0.17%)
IV fluid delivery	2 (0.17%)
nutrition counseling based on cognitive-behavioral theoretical approach	2 (0.17%)
nutrition counseling based on health belief model	2 (0.17%)
nutrition counseling based on problem solving strategy	2 (0.17%)
other or related nutrition education	2 (0.17%)
collaboration by nutrition professional with other providers	1 (0.09%)
content-related nutrition education	1 (0.09%)
decreased fat diet	1 (0.09%)
decreased simple carbohydrate intake	1 (0.09%)
increased complex carbohydrate diet	1 (0.09%)
nutrition counseling based on relapse prevention strategy	1 (0.09%)
nutrition counseling based on rewards/contingency management strategy	1 (0.09%)
nutrition counseling based on social support strategy	1 (0.09%)
nutrition counseling based on transtheoretical model and stages of change approach	1 (0.09%)
nutrition prescription	1 (0.09%)
nutrition related skill interpretation	1 (0.09%)
other meal and snack component or characteristic	1 (0.09%)
other nutrition education topics	1 (0.09%)
other theoretical basis or approach to nutrition counseling	1 (0.09%)
soluble fiber modified diet	1 (0.09%)
vegetable modified diet	1 (0.09%)

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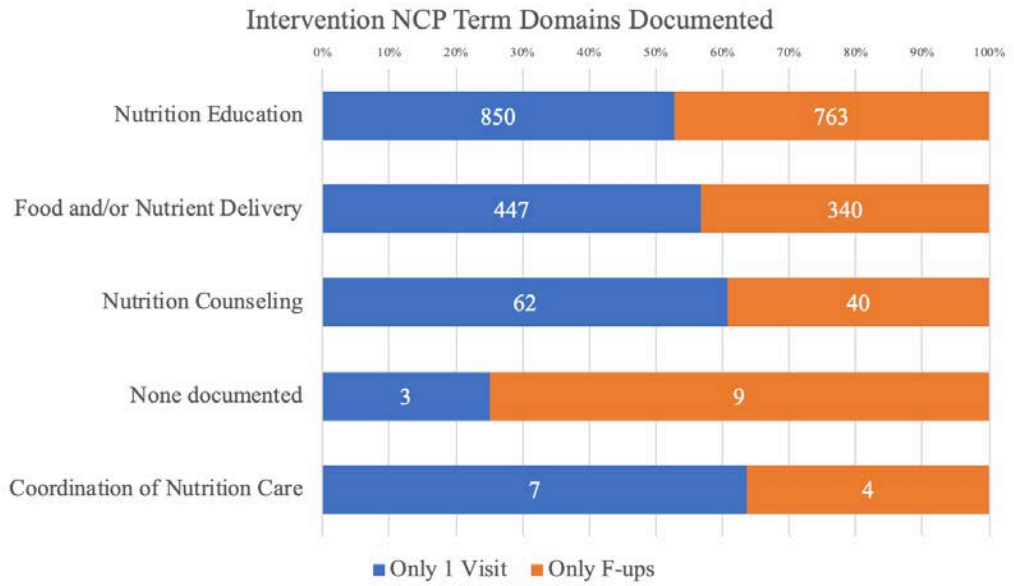
Table 35: Frequencies (%) for Intervention NCP Term Domains Documented for Cases with Follow-up

Intervention NCP **Domains** Documented for Cases with Follow-up	*n* = 1156 domain documentations
Nutrition Education	763 (66.00%)
Food and/or Nutrient Delivery	340 (29.41%)
Nutrition Counseling	40 (3.46%)
None documented	9 (0.78%)
Coordination of Nutrition Care	4 (0.35%)

Figure 14: Frequencies (%) for Intervention NCP Term Domains Documented: Only 1 Visit and Follow-up



Frequencies for NCP Monitoring & Evaluation terms documented for all patient cases are shown in Table 36. Frequencies for NCP Monitoring & Evaluation terms documented for only patient cases who had follow-up visits are shown in Table 37. Frequencies for total number of terms used within each NCP step are shown in Table 38, and illustrated in Figure 15. Since "other nutrition education" was the second most frequently documented NCP Intervention term

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(10.36% of NCP Intervention terms for all patient cases), it seemed prudent to include the free-text entries RDNs documented in conjunction with their entry of "other nutrition education;" these are shown in Table 39. Because of the nature of free-text entries, only minor edits (fixing typographical errors mainly) were made in order to accurately preserve the raw entries.

Table 36: Frequencies (%) for Monitoring & Evaluation NCP Terms Documented for All Patient Cases

Monitoring & Evaluation NCP **Terms** Documented for All Patient Cases	*n* = 1990 term documentations
glycosylated hemoglobin measurement	347 (17.44%)
glucose, fasting	145 (7.29%)
weight	119 (5.98%)
total carbohydrate intake	115 (5.78%)
glucose, casual	99 (4.97%)
body mass index	87 (4.37%)
total energy intake	60 (3.02%)
knowledge/skill level - control food portions	51 (2.56%)
physical activity history	49 (2.46%)
area(s) and level of nutrition knowledge/skill	48 (2.41%)
triglycerides, serum	48 (2.41%)
total carbohydrate estimated intake in 24 h	44 (2.21%)
weight change	43 (2.16%)
type of carbohydrate needed	36 (1.81%)
total energy measured intake in 24 h	34 (1.71%)
knowledge/skill level - food label	33 (1.66%)
knowledge/skill level - disease/condition	24 (1.21%)
food intake amount - fruits and vegetables	23 (1.16%)
total carbohydrate estimated needs	21 (1.06%)
food intake amount - vegetables	20 (1.01%)
knowledge/skill level - nutrition recommendations	20 (1.01%)
oral fluid intake - soda, regular	19 (0.95%)
consistency of physical activity	18 (0.90%)
total energy estimated needs	17 (0.85%)
food intake - amount	15 (0.75%)
meal or snack pattern - number of meals	14 (0.70%)
none documented	14 (0.70%)

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Monitoring & Evaluation NCP **Terms** Documented for All Patient Cases	*n* = 1990 term documentations
cholesterol, serum	13 (0.65%)
oral fluid intake - juice	13 (0.65%)
total fiber intake	13 (0.65%)
weight gain	12 (0.60%)
food intake amount - concentrated sweets	11 (0.55%)
glucose tolerance test	11 (0.55%)
saturated fat estimated intake in 24 h	11 (0.55%)
duration of physical activity	9 (0.45%)
frequency of physical activity	9 (0.45%)
nutrition related self management as agreed upon	9 (0.45%)
saturated fat intake	9 (0.45%)
sodium intake	9 (0.45%)
food intake amount - fruits	8 (0.40%)
oral fluid intake	8 (0.40%)
sodium estimated intake in 24 h	8 (0.40%)
type of physical activity	8 (0.40%)
finding of obesity	7 (0.35%)
food-derived fluid intake	7 (0.35%)
meal or snack pattern	7 (0.35%)
simple carbohydrate estimated intake in 24 h	7 (0.35%)
vegetable servings estimated in 24 h	7 (0.35%)
food intake amount - fats and oils	6 (0.30%)
food variety	6 (0.30%)
knowledge/skill level - food/nutrient requirement	6 (0.30%)
measured weight	6 (0.30%)
number of meals estimated in 24 h	6 (0.30%)
peak postprandial capillary plasma glucose	6 (0.30%)
total carbohydrate from diet	6 (0.30%)
total protein intake	6 (0.30%)
food intake amount - grains	5 (0.25%)
knowledge/skill level - laboratory results compared to desirable	5 (0.25%)
preprandial capillary plasma glucose	5 (0.25%)
recommended body mass index	5 (0.25%)
total fiber estimated intake in 24 h	5 (0.25%)
diagnosis specific or global nutrition-related knowledge score	4 (0.20%)
eligibility for community food and nutrition programs	4 (0.20%)
knowledge/skill level - plan meals snacks	4 (0.20%)

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Monitoring & Evaluation NCP **Terms** Documented for All Patient Cases	*n* = 1990 term documentations
motivation, nutrition related beliefs and attitudes	4 (0.20%)
nutrition related self monitoring at agreed upon rate	4 (0.20%)
oral fluid intake - water	4 (0.20%)
simple sugar carbohydrate intake	4 (0.20%)
binge eating behavior	3 (0.15%)
body compartment estimates	3 (0.15%)
caregiver, companion in eating environment	3 (0.15%)
daily stress level	3 (0.15%)
empty energy servings estimated in 24 h	3 (0.15%)
knowledge/skill level - food preparation/cooking	3 (0.15%)
knowledge/skill level - select healthful foods/meals	3 (0.15%)
other sedentary activity time	3 (0.15%)
prescription medication use	3 (0.15%)
readiness to change nutrition-related behaviors	3 (0.15%)
self-efficacy - weight loss	3 (0.15%)
strength, physical activity	3 (0.15%)
total protein estimated intake in 24 h	3 (0.15%)
type of food or meal - convenience frozen meals	3 (0.15%)
cholesterol, HDL	2 (0.10%)
cholesterol, LDL	2 (0.10%)
education	2 (0.10%)
fat servings estimated in 24 h	2 (0.10%)
frequency of alcohol intake	2 (0.10%)
intensity of physical activity	2 (0.10%)
knowledge/skill level - self-management parameters	2 (0.10%)
knowledge/skill level - self-monitor	2 (0.10%)
liquid meal replacement or supplement intake	2 (0.10%)
nutrition related avoidance behavior	2 (0.10%)
participation in community food and nutrition programs	2 (0.10%)
prescription medication - alter glucose levels	2 (0.10%)
soluble fiber intake	2 (0.10%)
total fat estimated intake in 24 h	2 (0.10%)
type of carbohydrate intake	2 (0.10%)
type of fat needed	2 (0.10%)
type of food or meal	2 (0.10%)
types of food/meals	2 (0.10%)
total carbohydrate measured intake in 24 h	2 (0.10%)

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Monitoring & Evaluation NCP **Terms** Documented for All Patient Cases	*n* = 1990 term documentations
body mass index	1 (0.05%)
meal or snack pattern - number of meals	1 (0.05%)
ability to recall nutrition goals	1 (0.05%)
alcohol intake: drink size or volume	1 (0.05%)
avoidance - specific foods	1 (0.05%)
blood urea nitrogen measurement	1 (0.05%)
calcium intake	1 (0.05%)
calcium needs	1 (0.05%)
creatinine measurement, serum	1 (0.05%)
diet quality index - Health Eating Index (HEI)	1 (0.05%)
digestive system - abdominal distension, bloating, cramping, pain	1 (0.05%)
eats alone	1 (0.05%)
ext., muscles and bones - edema, peripheral	1 (0.05%)
finding of constipation	1 (0.05%)
finding of dizziness	1 (0.05%)
finding of edema of calf	1 (0.05%)
finding of excess subcutaneous fat	1 (0.05%)
finding of increased appetite	1 (0.05%)
food intake amount - fruit and vegetables	1 (0.05%)
food intake amount - milk/milk products	1 (0.05%)
food intake amount - percent total meal eaten	1 (0.05%)
fruit servings estimated in 24 h	1 (0.05%)
growth pattern indices, percentile ranks	1 (0.05%)
knowledge/skill level - consequences of food behavior	1 (0.05%)
knowledge/skill level - health knowledge gap	1 (0.05%)
location of eating environment	1 (0.05%)
meal or snack pattern - number of snacks	1 (0.05%)
number of snacks estimated in 24 h	1 (0.05%)
nutrition knowledge of individual client	1 (0.05%)
nutrition-related avoidance behavior	1 (0.05%)
nutrition-related self management as agreed upon	1 (0.05%)
oral fluid intake - milk	1 (0.05%)
oral fluid measured intake in 24 h	1 (0.05%)
pattern of alcohol consumption	1 (0.05%)
prescription medication	1 (0.05%)
prescription medication - insulin or insulin secretagogues	1 (0.05%)
previous diet/nutrition education/counseling	1 (0.05%)

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Monitoring & Evaluation NCP **Terms** Documented for All Patient Cases	*n* = 1990 term documentations
self-reported nutrition-related adherence score	1 (0.05%)
self-selected diets followed	1 (0.05%)
sodium needs	1 (0.05%)
total carbohydrate estimated intake	1 (0.05%)
total energy measured intake	1 (0.05%)
total fluid estimated needs	1 (0.05%)
total protein estimated needs	1 (0.05%)
total protein from diet	1 (0.05%)
type of fiber needed	1 (0.05%)
type of food or meal - ready to eat food selections	1 (0.05%)
unscientific nutrition related beliefs, attitudes	1 (0.05%)
vitamin K intake	1 (0.05%)
weight change intent	1 (0.05%)

Table 37: Frequencies (%) for Monitoring & Evaluation NCP Terms Documented for Cases with Follow-up

Monitoring & Evaluation NCP **Terms** Documented for Cases with Follow-up Visits	*n* = 766 term documentations
glycosylated hemoglobin measurement	141 (18.41%)
total carbohydrate intake	55 (7.18%)
weight	51 (6.66%)
glucose, fasting	49 (6.40%)
glucose, casual	43 (5.61%)
body mass index	33 (4.31%)
total energy intake	33 (4.31%)
weight change	25 (3.26%)
triglycerides, serum	24 (3.13%)
total energy measured intake in 24 h	20 (2.61%)
total carbohydrate estimated intake in 24 h	19 (2.48%)
knowledge/skill level - control food portions	12 (1.57%)
area(s) and level of nutrition knowledge/skill	11 (1.44%)
nutrition related self management as agreed upon	9 (1.17%)
total energy estimated needs	9 (1.17%)
none documented	8 (1.04%)

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Monitoring & Evaluation NCP **Terms** Documented for Cases with Follow-up Visits	*n* = 766 term documentations
physical activity history	8 (1.04%)
sodium intake	8 (1.04%)
weight gain	8 (1.04%)
food intake - amount	7 (0.91%)
total fiber intake	7 (0.91%)
cholesterol, serum	6 (0.78%)
food intake amount - fruits and vegetables	6 (0.78%)
oral fluid intake - juice	6 (0.78%)
finding of obesity	5 (0.65%)
food intake amount - vegetables	5 (0.65%)
food variety	5 (0.65%)
food-derived fluid intake	5 (0.65%)
knowledge/skill level - disease/condition	5 (0.65%)
knowledge/skill level - food label	5 (0.65%)
oral fluid intake	5 (0.65%)
saturated fat estimated intake in 24 h	5 (0.65%)
saturated fat intake	5 (0.65%)
simple carbohydrate estimated intake in 24 h	5 (0.65%)
total carbohydrate estimated needs	5 (0.65%)
type of carbohydrate needed	5 (0.65%)
type of physical activity	5 (0.65%)
food intake amount - concentrated sweets	4 (0.52%)
knowledge/skill level - laboratory results compared to desirable	4 (0.52%)
knowledge/skill level - nutrition recommendations	4 (0.52%)
recommended body mass index	4 (0.52%)
sodium estimated intake in 24 h	4 (0.52%)
vegetable servings estimated in 24 h	4 (0.52%)
caregiver, companion in eating environment	3 (0.39%)
eligibility for community food and nutrition programs	3 (0.39%)
meal or snack pattern - number of meals	3 (0.39%)
peak postprandial capillary plasma glucose	3 (0.39%)
strength, physical activity	3 (0.39%)
total carbohydrate from diet	3 (0.39%)
binge eating behavior	2 (0.26%)
body compartment estimates	2 (0.26%)
consistency of physical activity	2 (0.26%)
daily stress level	2 (0.26%)

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Monitoring & Evaluation NCP **Terms** Documented for Cases with Follow-up Visits	*n* = 766 term documentations
food intake amount - fats and oils	2 (0.26%)
food intake amount - grains	2 (0.26%)
frequency of physical activity	2 (0.26%)
glucose tolerance test	2 (0.26%)
knowledge/skill level - food preparation/cooking	2 (0.26%)
knowledge/skill level - food/nutrient requirement	2 (0.26%)
knowledge/skill level - select healthful foods/meals	2 (0.26%)
measured weight	2 (0.26%)
number of meals estimated in 24 h	2 (0.26%)
oral fluid intake - soda, regular	2 (0.26%)
oral fluid intake - water	2 (0.26%)
simple sugar carbohydrate intake	2 (0.26%)
soluble fiber intake	2 (0.26%)
total protein intake	2 (0.26%)
types of food/meals	2 (0.26%)
cholesterol, LDL	1 (0.13%)
diagnosis specific or global nutrition-related knowledge score	1 (0.13%)
duration of physical activity	1 (0.13%)
empty energy servings estimated in 24 h	1 (0.13%)
food intake amount - fruits	1 (0.13%)
frequency of alcohol intake	1 (0.13%)
intensity of physical activity	1 (0.13%)
knowledge/skill level - self-monitor	1 (0.13%)
nutrition related avoidance behavior	1 (0.13%)
nutrition related self monitoring at agreed upon rate	1 (0.13%)
nutrition-related avoidance behavior	1 (0.13%)
oral fluid measured intake in 24 h	1 (0.13%)
preprandial capillary plasma glucose	1 (0.13%)
prescription medication	1 (0.13%)
prescription medication - alter glucose levels	1 (0.13%)
prescription medication use	1 (0.13%)
self-efficacy - weight loss	1 (0.13%)
self-reported nutrition-related adherence score	1 (0.13%)
self-selected diets followed	1 (0.13%)
total carbohydrate measured intake in 24 h	1 (0.13%)
total fat estimated intake in 24 h	1 (0.13%)
total fiber estimated intake in 24 h	1 (0.13%)

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Monitoring & Evaluation NCP **Terms** Documented for Cases with Follow-up Visits	*n* = 766 term documentations
total protein from diet	1 (0.13%)

Table 38: Frequencies (%) for NCP Terms Documented

NCP **Terms** Documented	*n* = 12,709 term documentations	
	All Visits	Only F-up
Assessment	1756 (19.47%)	778 (21.09%)
Diagnosis	773 (8.57%)	330 (8.95%)
Etiology	789 (8.75%)	372 (10.08%)
Signs & Symptoms	1187 (13.16%)	287 (7.78%)
Intervention	2525 (27.99%)	1156 (31.34%)
Monitoring & Evaluation	1990 (22.06%)	766 (20.76%)
Total	9020 (100%)	3689 (100%)

Figure 15: Frequencies (%) for NCP Term Domains Documented: Only 1 Visit and Follow-up

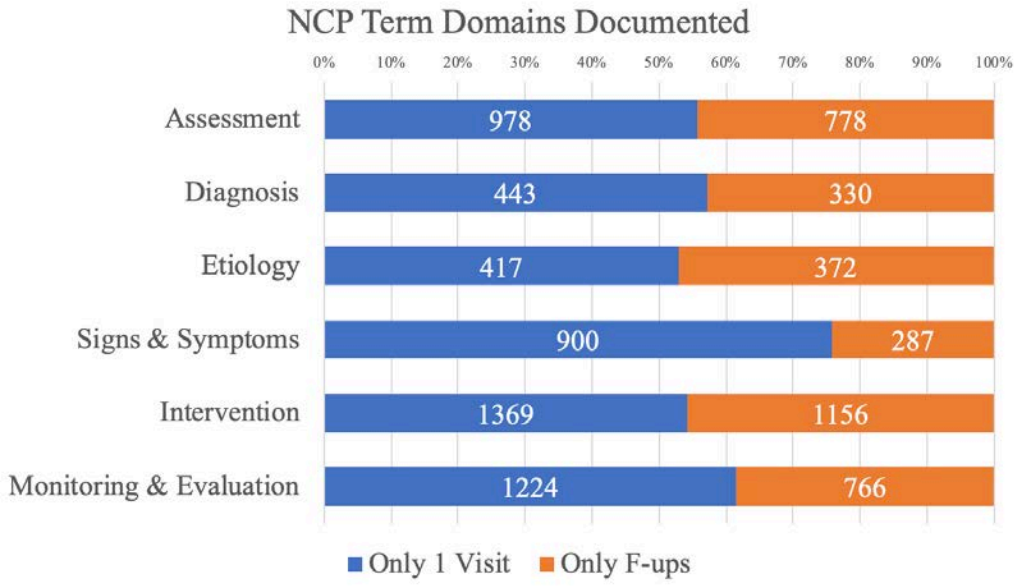

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Table 39: Other Nutrition Education Terms Documented

Other Nutrition Education Free-Text Entries	*n* = 277 term documentations
benefits of 7% wt loss and regular exercise for wt loss and better bg levels	21 (9.25%)
inclusion of physical activity and its effect on weight loss	12 (5.29%)
diabetes and complications	10 (4.41%)
pathophysiology of lipids	10 (4.41%)
eat meal every 4-5 hours	7 (3.08%)
not specified	5 (2.20%)
benefits of adequate protein in the diet and ideas to increase protein intake	4 (1.76%)
daily exercise and its effect on High Blood Sugars	4 (1.76%)
heart healthy	4 (1.76%)
1500 calorie diet 40%CHO, 30%Fat, 30%PRO	3 (1.32%)
45-60 minutes per day physical activity	3 (1.32%)
behavior Change and discussed barriers	3 (1.32%)
benefits of 7% wt loss and benefits of regular exercise	3 (1.32%)
benefits of 7% wt loss and regular exercise	3 (1.32%)
diabetes and Complications	3 (1.32%)
educated on carb counting and label reading	3 (1.32%)
foods that contain carbohydrates	3 (1.32%)
increase physical activity for weight loss	3 (1.32%)
answered pt's questions r/t food choices	2 (0.88%)
carb counting and label reading	2 (0.88%)
fiber increasing fruits and veggies and benefits	2 (0.88%)
fiber, labels	2 (0.88%)
fiber, labels, cho counting, my plate	2 (0.88%)
fiber, labels, salt intake, water, myplate	2 (0.88%)
fiber, my plate, food groups, serving sizes, goals	2 (0.88%)
general healthy eating, carbohydrate foods, portion sizes	2 (0.88%)
healthy food choices pamphlet	2 (0.88%)
high quality CHO intake	2 (0.88%)
importance of analysis of daily calorie intake for at least 1-2days/wk	2 (0.88%)
importance of food log and SMBG	2 (0.88%)
low sodium for HTN, liver disease, CKD	2 (0.88%)
Pre Weight Loss Surgery Nutrition Behavior Goal Sheet Reviewed	2 (0.88%)
pt has gained 8lb since the last visit. Reinforced the benefits of 7% wt loss	2 (0.88%)
reinforce the importance of portion control for weight loss	2 (0.88%)

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Other Nutrition Education Free-Text Entries	*n* = 277 term documentations
reviewed Healthy guidelines including fruits, veggies, fiber, whole grains, physical activity, water, eating three times a day	2 (0.88%)
sat fat intake	2 (0.88%)
shopping on a budget	2 (0.88%)
whole grains and how they contribute to fiber intake and cardioprotective dietary pattern	2 (0.88%)
15-20 g CHO snack choices, behavior change pre-weight loss surgery goal sheet	1 (0.44%)
1500 calorie diet 35%CHO, 30%Fat, 35%PRO	1 (0.44%)
169g CHO per day	1 (0.44%)
180 g CHO for the day	1 (0.44%)
60g CHO per meal; 20g CHO per snack	1 (0.44%)
adding more healthy fats to diet	1 (0.44%)
answered pt's and his wife's questions r/t food choices	1 (0.44%)
answered pt's questions r/t food choices and provide verbal ideas for portion control	1 (0.44%)
answered pt's questions r/t food choices for ketogenic diet, encouraged to add more non-starchy vegetables in the diet	1 (0.44%)
applauded for increased exercise and brainstormed for ideas to continue with PA during overseas trip	1 (0.44%)
appropriate carbohydrate choices	1 (0.44%)
balanced plate	1 (0.44%)
benefits of protein, how to recognize protein sources and read labels	1 (0.44%)
carbohydrate foods and portion amounts	1 (0.44%)
carbohydrate intake and relationship to serum triglyceride	1 (0.44%)
cardiac diet, sodium content of food and how to decrease	1 (0.44%)
cardioprotective Dietary Pattern	1 (0.44%)
CHO counting, Fiber, reading labels, importance of physical activity	1 (0.44%)
CHO intake and how it relates to rising of blood sugars	1 (0.44%)
choose whole wheat/whole grains in place of refined grains (bread, rice, pasta)	1 (0.44%)
choosing whole grains and less concentrated sweets more often	1 (0.44%)
choosing Whole Grains and less concentrated sweets more oftern	1 (0.44%)
complex vs simple carbohydrates	1 (0.44%)
complex vs simple carbohydrates	1 (0.44%)
consistent carbohydrate intake	1 (0.44%)
consistent CHO and pro choice each meal	1 (0.44%)
consistent meal times	1 (0.44%)
crash diets and why they are not helpful in the long run	1 (0.44%)
DASH	1 (0.44%)
desired weight goal during gestational period based on pre-pregnancy weight	1 (0.44%)

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Other Nutrition Education Free-Text Entries	*n* = 277 term documentations
discussed his recent blood work and HgbA1C	1 (0.44%)
Discussed how pt life would be different he she lost weight	1 (0.44%)
discussed how pt life would be different if she lost weight	1 (0.44%)
eat small and frequent meals	1 (0.44%)
education on hypoglycemia and rule of 15	1 (0.44%)
education on the mechanism of diabetes oral medication and importance of SMBG	1 (0.44%)
education on the mechanism of newly prescribed diabetes oral medication	1 (0.44%)
exercise effect on blood sugar	1 (0.44%)
fiber and whole grains	1 (0.44%)
fiber, Label reading, 150 mins of physical activity	1 (0.44%)
fiber, Labels, CHO Counting, wt. loss and reduced risks	1 (0.44%)
fiber, labels, Nutrition Prescription	1 (0.44%)
fiber, my plate, food groups, serving sizes, goals	1 (0.44%)
fiber, whole grains, label reading	1 (0.44%)
foods that contain CHO, myplate, meal planning, diet high in fiber	1 (0.44%)
how to decrease salt intake by eating more produce	1 (0.44%)
importance of a food log	1 (0.44%)
importance of balanced carbohydrate intake with meals and snacks vs. complete restriction of carbohydrates	1 (0.44%)
importance of protein	1 (0.44%)
importance of self care while caring for a family member	1 (0.44%)
individualized meal plan	1 (0.44%)
inclusion of physical activity and its effect on weight loss	1 (0.44%)
label reading via teachback	1 (0.44%)
label, fiber, exercise, alcohol consumption and diabetes	1 (0.44%)
label, fiber, shopping, eating meal regularly, being consistent with exercise and healthy eating	1 (0.44%)
labels	1 (0.44%)
labels, reviewed food log, myplate, spiking sugar and cravings with concentrated simple sugar	1 (0.44%)
less reliance on fried foods	1 (0.44%)
low Na for CHF	1 (0.44%)
low pro for CKD	1 (0.44%)
make half of grains consumed whole grains	1 (0.44%)
more balanced meals	1 (0.44%)
myplate, and 1500 calorie diet plan	1 (0.44%)
need to limit sodium intake r/t CKD	1 (0.44%)
portion size	1 (0.44%)

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Other Nutrition Education Free-Text Entries	*n* = 277 term documentations
pt has gained 3lb since the last visit.	1 (0.44%)
pt has gained 4lb r/t vacation. Reinforced the benefits of 7% wt loss and regular exercise for wt loss and better bg levels	1 (0.44%)
pt has lost 4lb. Applauded for his effort and reinforced the benefits of 7% wt loss	1 (0.44%)
pt should be consistently eating 250 grams of CHO per day	1 (0.44%)
pt. continues to find barriers to make changes	1 (0.44%)
purpose of increasing activity, application, types of activities	1 (0.44%)
reading nutrition labels, fiber, what foods have CHO	1 (0.44%)
recording booklet including food, activity and fluid	1 (0.44%)
reinforce the importance of regular exercise and brainstorm for ideas to increase PA	1 (0.44%)
reinforced the importance of regular exercise for wt loss and better bg levels	1 (0.44%)
reviewed activity level	1 (0.44%)
reviewed activity level and overcoming barriers	1 (0.44%)
sources of soft proteins to add to ramen noodles to aid improved glycemic control	1 (0.44%)
specific meals created with pt for diabetes and promoting wt gain	1 (0.44%)
two week post op gastric sleeve guidelines reviewed	1 (0.44%)
use measuring cups to determine accurate portion size and thus CHO count	1 (0.44%)
Use measuring cups to determine accurate portion size and thus CHO count	1 (0.44%)
using the motivational interview technique, reinforced the 5. importance of carb counting, portion control, regular exercise, and SMBG	1 (0.44%)

Preliminary Statistical Analyses

Both Microsoft Excel (version 16.16.22) and IBM SPSS Statistics version 26 were used to conduct the statistical analyses, and statistical significance was set at $p < .05$. Descriptive statistics are expressed for categorical variables as frequency (percentage), and for continuous and discrete variables as mean (standard deviation). Predictors of problem resolution were examined using a univariate analysis with each of the variables against problem resolution to determine if the relationship is significant enough ($p < .10$) to be included in the stepwise

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regression. Variables whose relationship was significant enough (p <.10) were entered into the multivariate, backward stepwise, logistic regression.

Chi Squared assumptions

Before performing the chi squared tests, assumptions were examined.

All observations are independent: The values for all categories are mutually exclusive, and therefore independent.

Expected count or cases in each cell should be greater than 1: All cells had an expected count of at least 1.

No more than 20% of cells should be less than 5: None of the data examined met the assumptions for chi squared. Even after attempting to recategorize the data, all samples still remained with >20% (sometimes greater than 50%) of cell counts less than 5. Details are described within each respective objective.

Logistic Regression Assumptions

Before performing the logistic regression tests, assumptions were examined and met.

Discrete dependent variable: The dependent variable for the first regression was *NCP Quality Audit Score Category*, which is measured at the ordinal level (A, B, C). For each of the two remaining logistic regressions the was *Problem Resolution*, which is measured at the nominal level (yes/no).

Linearity between the logit of dependent variable and continuous independent variables: The independent variables for the first two logistic regressions was *Number of Visits*, a discrete variable. The independent variables for the last, stepwise, logistic regression included *Number of Visits* (discrete), *Location* (nominal), and *NCP Linkages* (nominal). Therefore, none of the independent variables were continuous, and linearity was not applicable.

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Independence: The nature of this study is that data is collected and organized on a case-by-case basis. Therefore, each patient case had only one value for each of the independent variables.

No multicollinearity: Multicollinearity was assessed using tolerance and Variance Inflation Factor (VIF). Tolerance for each independent variable was found to be > 0.1 (range 0.66—0.97), and VIF was found to be < 3 for each independent variable (range 1.03—1.52). Review of the correlation matrix revealed no concerning correlations between independent variables >0.7 (range -0.52—0.34).

Statistical Analyses to Answer Research Objectives

Objective #1 Identify the most commonly used NCP terms within each ADIME domain in diabetes MNT (Aim #1)

Frequencies for NCP terms and domains within each ADIME section of the NCP used in the data analyzed for this secondary analysis are shown in Tables 24-38. The following is a summary of the top 5 most frequently used terms within each ADIME section of the NCP for all patient cases:

Assessment

- glycosylated hemoglobin measurement (16.86%)
- body mass index (5.92%)
- glucose, fasting (4.16%)
- knowledge/skill level - disease/condition (3.36%)
- total carbohydrate intake (3.13%)

Diagnosis

- excessive carbohydrate intake (36.74%)
- food and nutrition related knowledge deficit (11.13%)

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- excessive energy intake (10.35%)
- inconsistent carbohydrate intake (6.60%)
- altered nutrition-related laboratory values (5.43%)

Etiology

- food and nutrition related knowledge deficit (56.65%)
- disordered eating pattern (11.03%)
- excessive energy intake (3.55%)
- uncertainty how to apply nutrition knowledge (3.17%)
- lack of prior nutrition related education (2.03%)

Intervention

- nutrition relationship to health/disease (11.70%)
- other nutrition education (10.36%)
- recommended nutrition modifications (10.08%)
- priority modifications, nutrition education (6.13%)
- other application of nutrition education (5.43%)

Monitoring & Evaluation

- glycosylated hemoglobin measurement (17.44%)
- glucose, fasting (7.29%)
- weight (5.98%)
- total carbohydrate intake (5.78%)
- glucose, casual (4.97%)

And, the following is a summary of the top 5 most frequently used terms within each ADIME section of the NCP for only patient cases with follow-up visits:

Assessment

- glycosylated hemoglobin measurement (23.52%)
- glucose, fasting (7.07%)
- weight (6.30%)
- total carbohydrate intake (5.01%)
- body mass index (4.24%)

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Diagnosis

- excessive carbohydrate intake (42.42%)
- food and nutrition related knowledge deficit (9.70%)
- inconsistent carbohydrate intake (7.88%)
- undesirable food choices (7.27%)
- excessive energy intake (3.64%)

Etiology

- food and nutrition related knowledge deficit (59.95%)
- disordered eating pattern (11.83%)
- excessive energy intake (4.57%)
- excessive oral intake (2.42%)
- lack of prior nutrition related education (2.42%)

Intervention

- recommended nutrition modifications (12.98%)
- nutrition relationship to health/disease (10.90%)
- other nutrition education (10.64%)
- physical activity guidance (7.01%)
- priority modifications, nutrition education (5.62%)

Monitoring & Evaluation

- glycosylated hemoglobin measurement (18.41%)
- total carbohydrate intake (7.18%)
- weight (6.66%)
- glucose, fasting (6.40%)
- glucose, casual (5.61%)

As indicated in Table 40, the only difference when comparing the most commonly used term per ADIME section between all patient cases versus only those cases with follow-up visits occurred in the NCP Intervention.

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Table 40: Comparison of the Most Commonly used NCP Term Used for each ADIME section between All Patient Cases and Only Cases with Follow-up Visits

Most Common NCP **Term** Documented in each ADIME Section		
	All Visits	**Only F-up**
Assessment	glycosylated hemoglobin measurement	glycosylated hemoglobin measurement
Diagnosis	excessive carbohydrate intake	excessive carbohydrate intake
Etiology	food and nutrition related knowledge deficit	food and nutrition related knowledge deficit
Intervention	**nutrition relationship to health/disease**	**recommended nutrition modifications**
Monitoring & Evaluation	glycosylated hemoglobin measurement	glycosylated hemoglobin measurement

Objective #2 Examine the relationship between the etiology-intervention link present and problem resolution (Aim #1)

H_0: There is no relationship between etiology-intervention link and problem resolution.

H_a: There is a relationship between etiology-intervention link and problem resolution.

A chi-square test was performed to determine the relationship between the etiology-intervention link presence (yes/no) in NCP documentation and problem resolution (yes/no) in patient cases who had follow-up visits (n = 146). The assumptions for chi-square validity were not met because two cells (50%) had an expected cell count less than five. The violation of the chi-square assumptions stems from only 5 total cases having a "no" response for Etiology Intervention link; only 2 of the 5 cases with no etiology-intervention link had the problem resolved. When the 2-sided Fisher's exact test was examined for this 2x2 table after chi-square

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assumptions were violated, the results were not significant (p = .605). No significant relationship exists in this data between etiology-intervention link presence and problem resolution.

Objective #3 Examine the relationship between the etiology-intervention link present and goal progress (Aim #1)

H_0: There is no relationship between etiology-intervention link presence and goal progress.

H_a: There is a relationship between etiology-intervention link presence and goal progress.

Etiology-intervention link was documented for all patient cases. However, goal progress could only be assessed in those patient cases who had follow-up visits. The first 5 indicators (NCP Signs & Symptoms from the NCP Diagnosis PES statement) were examined for progress made upon subsequent visits. Indicator #1 corresponded with goal progress #1, indicator #2 with goal progress #2, and so on, up to the indicator #5 and goal progress #5.

Goal Progress #1 of 5: A chi-square test was performed to determine the relationship between the etiology-intervention link presence (yes/no) in NCP documentation and goal progress #1 (yes/no) in patient cases who had follow-up visits and distinguishable goal progress (n = 86). The assumptions for chi-square validity were not met because 2 cells (50%) had an expected cell count less than five. The violation of the chi-square assumptions stems from only 2 total cases having a "no" response for etiology intervention link; only 1 of the 2 cases with no etiology-intervention link had the problem resolved. When the 2-sided Fisher's exact test was examined for this 2x2 table after chi-square assumptions were violated, the results were not significant (p = .466). No significant relationship exists in this data between etiology-intervention link presence and goal progress #1.

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Goal Progress #2 of 5: A chi-square test was performed to determine the relationship between the etiology-intervention link presence (yes/no) in NCP documentation and goal progress #2 (yes/no) in patient cases who had follow-up visits and distinguishable goal progress (n = 46). The assumptions for chi-square validity were not met because 2 cells (50%) had an expected cell count less than five. The violation of the chi-square assumptions stems from 0 cases having a "no" response for etiology-intervention link and "no" for problem resolution; only 1 case having a "no" response for etiology-intervention link and "yes" for problem resolution. When the 2-sided Fisher's exact test was examined for this 2x2 table after chi-square assumptions were violated, the results were not significant (p = 1). No significant relationship exists in this data between etiology-intervention link presence and goal progress #2.

Goal Progress #3 of 5: A chi-square test was performed to determine the relationship between the etiology-intervention link presence (yes/no) in NCP documentation and goal progress #3 (yes/no) in patient cases who had follow-up visits and distinguishable goal progress (n = 20). The assumptions for chi-square validity were not met because 3 cells (75%) had an expected cell count less than five. The violation of the chi-square assumptions stems from 0 cases having a "no" response for etiology-intervention link and "no" for problem resolution; only 1 case having a "no" response for etiology-intervention link and "yes" for problem resolution; and only 2 cases with a "yes" for etiology-intervention link, but a "no" for problem resolution. When the 2-sided Fisher's exact test was examined for this 2x2 table after chi-square assumptions were violated, the results were not significant (p = 1). No significant relationship exists in this data between etiology-intervention link presence and goal progress #3.

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Goal Progress #4 of 5: A chi-square test was attempted to determine the relationship between the etiology-intervention link presence (yes/no) in NCP documentation and goal progress #4 (yes/no) in patient cases who had follow-up visits and distinguishable goal progress (n = 11). Chi-square could not be computed because the crosstab only consisted of a 1x2 table due to only "yes" responses for etiology-intervention link without any "no" responses available for this sample. Because the table was only 1x2, Fisher's exact could not be computed. Of this sample of "yes" responses for etiology-intervention link, 4 cases did not have problem resolution, and 7 cases did have problem resolution. No significant relationship exists in this data between etiology-intervention link presence and goal progress #4.

Goal Progress #5 of 5: A chi-square test was attempted to determine the relationship between the etiology-intervention link presence (yes/no) in NCP documentation and goal progress #5 (yes/no) in patient cases who had follow-up visits and distinguishable goal progress (n = 3). Chi-square could not be computed because the crosstab only consisted of a 1x2 table due to only "yes" responses for etiology-intervention link without any "no" responses available for this sample. Because the table was only 1x2, Fisher's exact could not be computed. Of this sample of "yes" responses for etiology-intervention link, 2 cases did not have problem resolution, and 1 case did have problem resolution. No significant relationship exists in this data between etiology-intervention link presence and goal progress #5.

Objective #4 Examine the relationship between the NCP quality audit score category and total number of visits (Aim #1)

H_0: There is no relationship between the NCP quality audit score category and number of visits.

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H_a: There is a relationship between the NCP quality audit score category and number of visits.

Assumptions for performing a logistic regression were met, as outlined in the previous, *Preliminary Statistics* section. An ordinal logistic regression was performed to test the relationship between NCP quality audit score category (A/B/C) and total number of visits, which included all patient cases (n = 564). Overall model fit was assessed, and the ordinal logistic regression model was not a good fit, as indicated by the results of the likelihood ratio chi-square test ($\chi^2(1) = .000$, $p = .998$). The ordinal logistic regression was unable to predict NCP quality audit score category based on number of visits due to the significantly skewed data for the dependent variable. Of the 3 categories for NCP quality audit score category, 98.2% of the data was categorized as "A," and only 1.2% and 0.5% for "B" and "C," respectively. No significant relationship was found between NCP quality audit score category and total number of visits in this dataset.

Objective #5 Examine the relationship between the NCP quality audit score category and problem resolution (Aim #1)

H_0: There is no relationship between the NCP quality audit score category and problem resolution.

H_a: There is a relationship between the NCP quality audit score category and problem resolution.

Assumptions for performing a logistic regression were met, as outlined in the previous, *Preliminary Statistics* section. An ordinal logistic regression was performed to test the relationship between NCP quality audit score category (A/B/C) and problem resolution in only those patient cases who had follow-up visits (n = 146). Overall model fit was assessed, and the

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ordinal logistic regression model was not a good fit, as indicated by the results of the likelihood ratio chi-square test ($\chi^2(1) = 1.078$, $p = .299$). The ordinal logistic regression was unable to predict NCP quality audit score category based on problem resolution due to the significantly skewed data for the dependent variable. Of the 3 categories for NCP quality audit score category, 97.3% of the data was categorized as "A," and only 1.4% for each of "B" and "C." No significant relationship exists between NCP quality audit score category and problem resolution in this dataset.

Objective #6 Examine the relationship between the number of visits and problem resolution (Aim #1)

H_0: There is no relationship between the number of visits and problem resolution.

H_a: There is a relationship between the number of visits and problem resolution.

Assumptions for performing a logistic regression were met, as outlined in the previous, *Preliminary Statistics* section. A binary logistic regression was performed to test the relationship between total number of visits and problem resolution (yes/no) in only those patient cases who had follow-up visits ($n = 146$). Overall model fit was assessed, and the binary logistic regression model was not a good fit, as indicated by the results of the likelihood ratio chi-square test ($\chi^2(1) = .001$, $p = .974$). The binary logistic regression was unable to predict problem resolution based on number of visits due to the significantly skewed data for the both the dependent and independent variables. Of the 2 categories for the dependent variable, problem resolution (yes/no), 74% of the data was categorized as "no," and 26% for "yes." Of the options for total number of visits, 71.2% had 2 visits, 12.3% had 3 visits, 11% had 4 visits, 3.4% had 5 visits, and .7% had 6, 7, and 8 visits, respectively. No significant relationship exists between total number of visits and problem resolution in this dataset.

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Objective #7 Determine which indicators are being tracked (Aim #1)

The *Signs and Symptoms* piece of the NCP Diagnosis as a PES statement was utilized to extract indicators. Frequencies for indicator terms and domains used in the data analyzed for this secondary analysis are shown in Tables 13-16. The following is a summary of the top 5 most frequently used indicator terms.

Frequencies (%) for the top 5 indicators for all patient cases (*n* = 1187):

- glycosylated hemoglobin measurement (18.45%)
- glucose, fasting (9.44%)
- total carbohydrate intake (6.49%)
- weight (6.40%)
- body mass index (4.89%)

Frequencies (%) for the top 5 indicators for only those patients who had follow-up visits (*n* = 287):

- glycosylated hemoglobin measurement (18.12%)
- total carbohydrate intake (9.41%)
- glucose, fasting (8.01%)
- weight (5.23%)
- body mass index (4.88%)

Objective #8 Determine which indicators showed improvement with MNT (Aim #1)

Indicators were assessed for goal progress in patient cases who had at least one follow-up visit. Positive goal progress (annotated in the dataset as "yes") was considered when a) the indicator's value remained the same, or b) improved (i.e. any reduction in a previously clinically glycosylated hemoglobin measurement). Frequencies for goal progress category for patient cases with follow-up visits are shown in Table 17 and illustrated in Figure 6. Frequencies for the indicator terms documented for patient cases with follow-up visits and positive goal progress (*n*

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= 123) are shown in Table 41. The top indicator which showed improvement in goal progress was *glycosylated hemoglobin measurement* (29.27%).

Table 41: Frequencies (%) of Indicator NCP Terms Documented for Indicator NCP Terms for Patient Cases with Follow-up Visits and Positive Goal Progress

Indicator NCP Terms for Patient Cases with Follow-up Visits and Positive Goal Progress	*n* = 123 term documentations
glycosylated hemoglobin measurement	36 (29.27%)
glucose, fasting	13 (10.57%)
total carbohydrate intake	11 (8.94%)
weight	7 (5.69%)
total energy intake	6 (4.88%)
weight change	5 (4.07%)
knowledge/skill level - control food portions	4 (3.25%)
triglycerides, serum	4 (3.25%)
body mass index	3 (2.44%)
total carbohydrate estimated intake in 24 h	3 (2.44%)
total energy measured intake in 24 h	3 (2.44%)
food intake amount - concentrated sweets	2 (1.63%)
glucose, casual	2 (1.63%)
oral fluid intake - juice	2 (1.63%)
simple carbohydrate estimated intake in 24 h	2 (1.63%)
sodium intake	2 (1.63%)
binge eating behavior	1 (0.81%)
caregiver, companion in eating environment	1 (0.81%)
cholesterol, serum	1 (0.81%)
eligibility for community food and nutrition programs	1 (0.81%)
food intake amount - fats and oils	1 (0.81%)
food intake amount - fruits and vegetables	1 (0.81%)
food-derived fluid intake	1 (0.81%)
knowledge/skill level - disease condition	1 (0.81%)
knowledge/skill level - food label	1 (0.81%)
knowledge/skill level - food preparation/cooking	1 (0.81%)
knowledge/skill level - food/nutrient requirement	1 (0.81%)
meal or snack pattern - number of meals	1 (0.81%)
number of meals estimated in 24 h	1 (0.81%)

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Indicator NCP Terms for Patient Cases with Follow-up Visits and Positive Goal Progress	*n* = 123 term documentations
preprandial capillary plasma glucose	1 (0.81%)
saturated fat intake	1 (0.81%)
saturated fat intake	1 (0.81%)
total carbohydrate estimated needs	1 (0.81%)
total fiber intake	1 (0.81%)

Objective #9 Determine which NCP Etiology Matrix category has the highest problem resolution rate in diabetes MNT (Aim #1)

Etiology Matrix category was assessed for problem resolution in patient cases who had at least one follow-up visit. Frequencies for the Etiology Matrix category documented for patient cases with follow-up visits and problem resolution (*n* = 96) are shown in Table 42. By far, the most common Etiology Matrix category associated with problem resolution was *knowledge* (72.92%).

Table 42: Frequencies (%) of Etiology Matrix Categories for Patient Cases with Follow-up Visits and Problem Resolution

Etiology Matrix Categories for Patient Cases with Follow-up Visits and Problem Resolution	*n* = 96 category documentations
Knowledge	70 (72.92%)
Beliefs-Attitudes	7 (7.29%)
Physiologic-Metabolic	6 (6.25%)
Behavior	5 (5.21%)
N/A	5 (5.21%)
Psychological	3 (3.13%)

*N/A due to no etiology documented

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Objective #10 Determine which NCP Interventions have the highest problem resolution rate in diabetes MNT (Aim #1)

Intervention NCP terms and domains were assessed for problem resolution in patient cases who had at least one follow-up visit. Frequencies for the Nutrition Intervention NCP Domains and Nutrition Intervention NCP terms documented for patient cases with follow-up visits and problem resolution (n = 278) are shown in Table 43 and Table 44, respectively. By far, the most common Intervention NCP Domain associated with problem resolution was *Nutrition Education* (66.19%). The most common Nutrition Intervention NCP term associated with problem resolution was *recommended nutrition modifications* (16.91%).

Table 43: Frequencies (%) of Intervention NCP Domains for Patient Cases with Follow-up Visits and Problem Resolution

Intervention NCP **Domains** for Patient Cases with Follow-up Visits and Problem Resolution	n = 278 term documentations
Nutrition Education	184 (66.19%)
Food and/or Nutrient Delivery	74 (26.62%)
Nutrition Counseling	14 (5.04%)
None Documented	6 (2.16%)

Table 44: Frequency (%) of Intervention NCP Terms for Patient Cases with Follow-up Visits and Problem Resolution

Intervention NCP **Terms** for Patient Cases with Follow-up Visits and Problem Resolution	n = 278 term documentations
recommended nutrition modifications	47 (16.91%)
nutrition relationship to health/disease	33 (11.87%)

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Intervention NCP **Terms** for Patient Cases with Follow-up Visits and Problem Resolution	*n* = 278 term documentations
other nutrition education	31 (11.15%)
physical activity guidance	22 (7.91%)
priority modifications, nutrition education	19 (6.83%)
other application of nutrition education	18 (6.47%)
nutrition influence on health education	12 (4.32%)
other or related nutrition education topics	10 (3.60%)
general/healthful diet	10 (3.60%)
nutrition related skill education	8 (2.88%)
purpose of the nutrition education	7 (2.52%)
none documented	6 (2.16%)
nutrition related laboratory result interpretation	6 (2.16%)
consistent carbohydrate diet	5 (1.80%)
skill development, nutrition education	5 (1.80%)
survival information, nutrition education	5 (1.80%)
carbohydrate modified diet	4 (1.44%)
nutrition counseling based on motivational interviewing strategy	4 (1.44%)
result interpretation, nutrition education	4 (1.44%)
modify composition of meals/snacks	3 (1.08%)
nutrition counseling based on goal setting strategy	3 (1.08%)
nutrition counseling based on self monitoring strategy	3 (1.08%)
decreased energy diet	2 (0.72%)
IV fluid delivery	2 (0.72%)
technical nutrition education	2 (0.72%)
consistent carbohydrate intake	1 (0.36%)
management of nutrition-related prescription medications	1 (0.36%)
nutrition counseling based on relapse prevention strategy	1 (0.36%)
nutrition counseling based on rewards/contingency management strategy	1 (0.36%)
nutrition counseling based on transtheoretical model and stages of change approach	1 (0.36%)
other theoretical basis or approach to nutrition counseling	1 (0.36%)
vegetable modified diet	1 (0.36%)

Objective #11 Identify the most commonly tracked outcomes (Monitoring & Evaluation NCPT) (Aim #1)

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Frequencies for Monitoring & Evaluation NCP terms used in the data analyzed for this secondary analysis are shown in Table 36. The following is a summary of the top 5 most frequently used Monitoring & Evaluation NCP terms for all patient cases (*n* = 1990):

- glycosylated hemoglobin measurement (17.44%)
- glucose, fasting (7.29%)
- weight (5.98%)
- total carbohydrate intake (5.78%)
- glucose, casual (4.97%)

Objective #12 Determine significant predictors for problem resolution (Aim #1)

H_0: There are no significant predictors for problem resolution.

H_a: There are significant predictors for problem resolution.

Assumptions for performing a logistic regression were met, as outlined in the previous, *Preliminary Statistics* section. First, a univariate analysis tested each of the variables against problem resolution to determine if the relationship was significant enough ($p < .10$) to be included in the stepwise regression. Variables examined in the univariate analyses ($n = 146$) included all NCP step linkages (*Evidence-Diagnosis Link, Diagnosis-Etiology Link, Etiology-Intervention Link, Intervention-Goal Link,* and *Problem-Outcome Link*), *Location*, and *Total Number of Visits*. Variables whose relationship with problem resolution was not significant enough to be included in the model were: *Diagnosis-Etiology Link* ($p = .749$), *Etiology-Intervention Link* ($p = .476$), and *Total Number of Visits* ($p = .974$). Variables whose relationship was significant enough to be included in the stepwise regression were: *Evidence-Diagnosis Link* ($p = .008$), *Intervention-Goal Link* ($p = .073$), *Problem-Outcome Link* ($p = .064$), and *Location* ($p = .001$). A multivariate, backward stepwise, logistic regression was chosen to determine the most significant predictors of problem resolution using the remaining 4 predictor variables.

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Overall model fit was assessed, and the multivariate logistic regression model was good, as indicated by the results of the likelihood ratio chi-square test ($\chi^2(6) = 33.392$, $p < .001$). When all 4 predictors were entered into the backward regression model, the most significant (and only significant) predictor for problem resolution was *Evidence-Diagnosis Link* ($p = .033$). *Location* overall was a significant predictor ($p = .001$), but not when each individual location was analyzed. *Intervention-Goal Link* ($p = .082$) and *Problem-Outcome Link* ($p = .190$) were not determined to be significant predictors of problem resolution. The odds ratio for the *Evidence-Diagnosis Link* indicated that problem resolution was almost 3 times as likely when the Assessment step of the NCP was linked to the Indicators (Signs & Symptoms of the PES in the Diagnosis step of the NCP). Results of the predictors for problem resolution are summarized in Table 45.

Table 45: Results of a Backward Stepwise Logistic Regression for Predictors of Problem Resolution

Backward Stepwise Logistic Regression*
for Predictors of Problem Resolution

Variable	*B* (SE)	Exp (*B*) (95% CI)	*p*
Step 1			
Evidence-Diagnosis Link	.773 (.495)	2.166 (.821, 5.715)	.118
Intervention-Goal Link	1.731 (.995)	5.644 (.803, 39.677)	.082
Problem-Outcome Link	.884 (.675)	2.420 (.645, 9.082)	.190
Location			**.001**
Location (1)	-.363 (1.598)	.696 (.030, 15.958)	.820
Location (2)	-2.252 (1.669)	.105 (.004, 2.772)	.177
Location (3)	-1.562 (1.561)	.210 (.010, 4.473)	.317
Location (4)	.502 (1.504)	1.652 (.087, 31.494)	.738
Constant	-1.215 (1.532)	.297	.428
Step 2			
Evidence-Diagnosis Link	.993 (.466)	2.700 (1.083, 6.736)	**.033**
Intervention-Goal Link	1.650 (.969)	5.205 (.779, 34.765)	.089
Location			**.001**
Location (1)	-.490 (1.562)	.613 (.029, 13.089)	.754
Location (2)	-2.573 (1.623)	.076 (.003, 1.837)	.113

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Backward Stepwise Logistic Regression* for Predictors of Problem Resolution			
Location (3)	-1.586 (1.528)	.205 (.010, 4.091)	.299
Location (4)	.243 (1.456)	1.275 (.074, 22.124)	.867
Constant	-.993 (1.489)	.370	.505

*Goodness of fit: ($\chi^2(6) = 33.392$, $p < .001$). Nagelkerke $R^2 = .30$

Objective #13 Determine validity and reliability of a revised NCP quality audit tool on the diabetes population (Aim #2)

H_0: The revised NCP quality audit tool is not reliable and valid with the diabetes population

H_a: The revised NCP quality audit tool is reliable and valid with the diabetes population

Results for I-CVI for each question are indicated in Table 46. The result for S-CVI-UA was .958 for relevance, and .917 for clarity for the revised NCP quality audit tool. The result for S-CVI-Ave was .979 for relevance and .958 for clarity. The standard criteria for S-CVI-UA is .8 or higher, and S-CVI-Ave .9 or higher according to Polit et al.[119] Therefore, the results for S-CVI-UA and S-CVI-Ave indicate excellent relevance and clarity, and therefore high validity, for the revised NCP quality audit tool.

Table 46: Revised NCP Quality Audit Item Content Validity Index for Relevance and Clarity by Question

I-CVI for Relevance and Clarity on the Revised NCP Quality Audit Tool	*n* = 24 questions	
Audit Tool Question	I-CVI Relevance	I-CVI Clarity
NA 1	1	1
NA 2	1	1
NA 3	1	1
NA 4	0.5	1
ND 1	1	1
ND 2	1	0.5
ND 3	1	0.5

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ND 4	1	1
NI 1	1	1
NI 2	1	1
NI 3	1	1
NI 4	1	1
NI 5	1	1
NI 6	1	1
NM 1	1	1
NM 2	1	1
NE 1	1	1
NE 2	1	1
NE 3	1	1
NE 4	1	1
NE 5	1	1
NE 6	1	0.5
OQ 1	1	1
OQ 2	1	1

Results for inter-rater reliability and intra-rater reliability for each question in the the revised NCP quality audit tool are summarized in Table 47 and illustrated in Figure 16. According to Klaus Krippendorff,[120] who developed the Krippendorff's α coefficient, the "lowest conceivable limit" of is an $\alpha \geq .667$, and $\alpha \geq .800$ is preferred.[120] The overall result for Krippendorff's α regarding inter-rater reliability for the entire, revised NCP quality audit tool was $\alpha = .6684$, indicating the tool reached Krippendorff's "lowest conceivable limit"[120] of agreement for inter-rater reliability. A coefficient of $\alpha = 1.000$ indicates perfect reliability, while a coefficient of $\alpha = 0$ indicates complete absence of reliability as if the results were obtained by chance alone.[121] A negative value for α indicates degree of disagreement, where the more negative α is, the more polar the disagreement in scoring is. The overall result for Krippendorff's

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α regarding intra-rater reliability for the entire, revised NCP quality audit tool for rater CC was α = .8598, and for rater MC was α = .3194, which indicates low-moderate intra-rater reliability.

Inter-rater reliability between the two raters showed agreement ranging from α = -.2488 to α = 1.000. Low inter-rater agreement between the two raters existed in 13 of the 24 (54%) questions:

- NA 1, 3, and 4 (Nutrition Assessment);
- ND 4 (Nutrition Diagnosis);
- NI 1—4 (Nutrition Intervention);
- NE 2—4 (re-assessment in the follow-up visit); and
- OQ 1 and 2 (Overall Quality).

High inter-rater agreement existed in the 11 of the 24 (46%) questions, with perfect inter-rater agreement existed in the 10 of the 24 (42%) questions. High inter-rater agreement included NM 1 (Nutrition Monitoring). Perfect inter-rater agreement included:

- NA 2 (Nutrition Assessment);
- ND 1—3 (Nutrition Diagnosis);
- NI 5—6 (Nutrition Intervention);
- NM 2 (Nutrition Monitoring); and
- NE 1, 5, 6 (re-assessment in the follow-up visit).

Low intra-rater agreement existed in 8 of the 24 (33%) questions for rater CC, and 18 of the 24 (75%) questions for rater MC. High agreement existed in 2 of the 24 (8%) of questions for rater CC, and 0 questions for rater MC. Perfect intra-rater agreement existed in 14 of the 24 (58%) questions for rater CC, and 6 of the 24 (25%) questions for rater MC. For the total sum of all 24 revised NCP quality audit scores, inter-rater agreement was α = .4028. Intra-rater

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agreement for total scores was α = .8598 for rater CC, and α = .7652 for rater MC, with an average of α = .8125.

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Table 47: Revised NCP Quality Audit Tool Inter- and Intra-rater Agreement

Revised NCP Quality Audit Tool Inter- and Intra-rater Agreement by Question and by the Entire Tool		Inter-rater Agreement		Intra-rater Agreement Rater CC			Intra-rater Agreement Rater MC		
	Question	*n*	*Krippendorff's α (CI 95%)*	%	*n*	*Krippendorff's α (CI 95%)*	%	*n*	*Krippendorff's α (CI 95%)*	%
Assessment										
	NA 1	30	-.2488 (-.8038-.3062)	40.0	30	.2328 (-.3810-.6931)	66.7	30	-.0741 (-1.000-1.000)	80.0
	NA 2	30	1.000 (1.000-1.000)	100	30	1.000 (1.000-1.000)	100	30	1.000 (1.000-1.000)	100
	NA 3	30	.1944 (-.6111-.7986)	73.3	30	1.000 (1.000-1.000)	100	30	.4423 (-.3942-1.000)	86.7
	NA 4	30	-.1154 (-.9519-.7212)	73.3	30	1.000 (1.000-1.000)	100	30	-.0741 (-1.000-1.000)	73.3
Diagnosis										
	ND 1	30	1.000 (1.000-1.000)	100	30	1.000 (1.000-1.000)	100	30	.0000 (-1.000-1.000)	93.3
	ND 2	30	1.000 (1.000-1.000)	100	30	1.000 (1.000-1.000)	100	30	1.000 (1.000-1.000)	100
	ND 3	30	1.000 (1.000-1.000)	100	30	1.000 (1.000-1.000)	100	30	-.8125 (-.9420- -5536)	6.7
	ND 4	30	.1944 (-.6111-.7986)	73.3	30	.2328 (-.3810-.6931)	66.7	30	-.8125 (-.9420- -5536)	6.7
Intervention										
	NI 1	30	.1944 (-.6111-.7986)	73.3	30	.8466 (.5397-1.000)	66.7	30	.0114 (-.6477-.6705)	6.7

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Revised NCP Quality Audit Tool Inter- and Intra-rater Agreement by Question and by the Entire Tool		Inter-rater Agreement			Intra-rater Agreement Rater CC			Intra-rater Agreement Rater MC	
	Question	*n*	*Krippendorff's α (CI 95%)*	%	*n*	*Krippendorff's α (CI 95%)*	%	*n*	*Krippendorff's α (CI 95%)*	%
	NI 2	30	.1944 (-.6111-.7986)	73.3	30	.8612 (.5837-1.000)	93.3	30	.0994 (-.6211-.6398)	66.7
	NI 3	30	.6420 (-.0741-1.000)	93.3	30	.6420 (-0.741-1.000)	93.3	30	.1944 (-.6111-.7986)	73.3
	NI 4	30	.4423 (-.3942-1.000)	86.7	30	1.000 (1.000-1.000)	100	30	.0114 (-.6477-.6705)	60.0
	NI 5	30	1.000 (1.000-1.000)	100	30	.0000 (-1.000-1.000)	93.3	30	1.000 (1.000-1.000)	100
	NI 6	30	1.000 (1.000-1.000)	100	30	1.000 (1.000-1.000)	100	30	1.000 (1.000-1.000)	100
Monitoring										
	NM 1	30	.7680 (.3040-1.000)	93.3	30	1.000 (1.000-1.000)	100	30	.5972 (-.0069-1.000)	86.7
	NM 2	30	1.000 (1.000-1.000)	100	30	1.000 (1.000-1.000)	100	30	1.000 (1.000-1.000)	100
Evaluation										
	NE 1	30	1.000 (1.000-1.000)	100	30	1.000 (1.000-1.000)	100	30	1.000 (1.000-1.000)	100
	NE 2	30	-.0741 (-.6111-.4630)	46.7	30	1.000 (1.000-1.000)	100	30	-.2946 (-.6830-.2232)	33.3
	NE 3	30	.0000 (-1.000-1.000)	93.3	30	.0000 (-1.000-1.000)	93.3	30	-.5263 (-.9426- -.1100)	26.7
	NE 4	30	-.1154 (-1.000-.7212)	73.3	30	-.1154 (-1.000-.7212)	73.3	30	.3040 (-.3920-1.000)	80.0
	NE 5	30	1.000 (1.000-1.000)	100	30	1.000 (1.000-1.000)	100	30	-.9333 (-.9333- -.9333)	0
	NE 6	30	1.000 (1.000-1.000)	100	30	1.000 (1.000-1.000)	100	30	-.2083 (-1.000-.3958)	60

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Revised NCP Quality Audit Tool Inter- and Intra-rater Agreement by Question and by the Entire Tool	Inter-rater Agreement			Intra-rater Agreement Rater CC			Intra-rater Agreement Rater MC		
Question	*n*	*Krippendorff's α (CI 95%)*	%	*n*	*Krippendorff's α (CI 95%)*	%	*n*	*Krippendorff's α (CI 95%)*	%
Overall Quality									
OQ 1	30	-.1600 (-1.000-.5360)	66.7	30	.3040 (-.3920-1.000)	80	30	.0000 (-1.000-1.000)	93.3
OQ 2	30	.0814 (-.4434-.6063)	53.3	30	.5837 (.1675-1.000)	80	30	-.3810 (-.9947-.2328)	40
Entire Instrument									
All items	720	.6684 (.5883-.7427)	83.9	720	.8598 (.8038-.9103)	93.1	720	.3194 (.2138-.4191)	67.8
Total score	30	.4028 (-.0525-.7816)	0	30	.8598 (.7682-.9380)	26.7	30	.7652 (.6113-.8947)	6.7

CI = confidence interval
n = number of pairwise comparisons used for calculating kalpha and %

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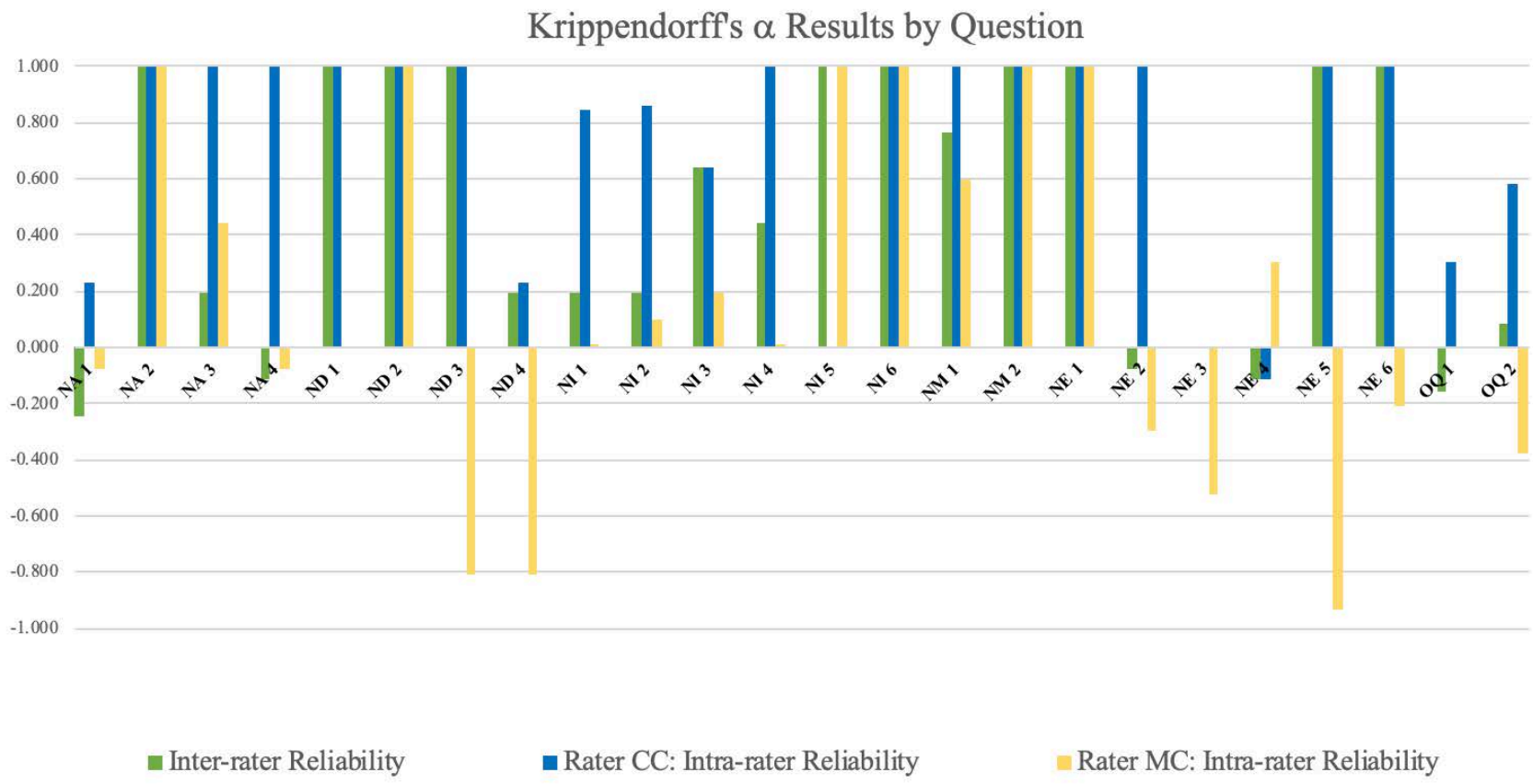
Figure 16: Krippendorff's Alpha Inter- and Intra-Rater Reliability Coefficient Results for the Revised NCP Quality Audit Tool by Question



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CHAPTER FIVE: DISCUSSION

This study examined the association between patient outcomes and NCP documentation quality, and the validity and reliability of a revised NCP quality audit tool on a diabetes-specific population. A major problem in the dietetics profession is the lack of ability to efficiently, and objectively, quantify the impact of MNT from the RDN on patient outcomes. The use of standardized language in MNT documentation using the NCP is critical in order to obtain outcomes data. This study found gaps within RDN application of the NCP, especially concerning step linkages, which has precluded the ability to extract significant outcomes concerning the effectiveness of MNT on diabetes management. Another key finding from this study is presence of the evidence-diagnosis link in the NCP to be a predictor of problem resolution (p = .033) in patients with diabetes. The research questions this discussion will help to answer include: 1) can outcomes can be predicted by NCP documentation quality? and 2) is a revised NCP quality audit tool valid and reliable on a diabetes-specific population?

NCP Terms Used in Diabetes MNT

In order to understand the association between MNT and outcomes, examining what NCP terms are being utilized in clinical practice is key. The Nutrition Assessment step of the NCP provides data to define if a nutrition problem is evident, and determines what that nutrition problem is. The most frequent Nutrition Assessment term used was *glycosylated hemoglobin measurement* (16.86% for all patient cases and 23.52% for only cases with follow-up visits, Tables 24 and 25, respectively). When considering the etiology of the Nutrition Diagnosis within the PES statement, it is prudent the etiology stems from a factor observed in the Nutrition Assessment. The most frequently used etiology was *food and nutrition related knowledge deficit* (59.95% for all patient cases, and 56.65% for cases with follow-up, Tables 28 and 30,

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respectively), which should indicate that a knowledge deficit was assessed. Yet, the term *knowledge/skill level – disease/condition* represented only 3.36% of Nutrition Assessment terms used for all patient cases, and 0.77% for only cases with follow-up visits (Tables 24 and 25, respectively); and, other knowledge-based Nutrition Assessment terms represented less than 3% of all Nutrition Assessment terms used. The Diet-NCP-Audit tool attempts to analyze if the Nutrition Intervention directly addresses all items in the Nutrition Assessment (question 13b); and the mean score for question 13b in this dataset was 0.972(±0.148) out of possible scores of 0, 0.5, or 1 (Table 20 and Figure 9). Although the mean score for question 13b indicates a relatively large incidence (96%) of cases scoring 1 out of 1 on question 13b, this simply indicates that the NCPT listed in Nutrition Assessment were addressed in the Nutrition Intervention, *not* whether the Nutrition Assessment was comprehensively linked to the nutrition problem. Therefore, the Nutrition Intervention may be relevant given the set of Nutrition Assessment data, but it may not be adequately addressing the actual nutrition problem toward resolution. A gap exists within the Diet-NCP-Audit tool identifying the relevancy of the Nutrition Intervention against the Nutrition Assessment within the context of the nutrition problem. This inconsistency existing within RDN application of the NCP seems to demonstrate a lack of understanding about the true methodology behind the NCP and its application in MNT which is not captured within the Diet-NCP-Audit.

In 2016, Enrione and colleagues[87] described some of the discrepancies in NCP documentation, especially the lack of uniform interpretation within the Nutrition Diagnosis step of the NCP.[87] Authors state, "A clinically reliable and valid Nutrition Diagnosis is one that RDNs predicatively and consistently choose when interpreting the same assessment data that occur in practice."[87] The most frequently used Nutrition Diagnosis was *excessive carbohydrate intake* (36.74% for all patient cases and 42.42% for only cases with follow-up visits, Tables 26

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and 27, respectively). Yet, terms used in the Nutrition Assessment indicating observation of an "excessive carbohydrate intake" problem were sparse. The term *total carbohydrate intake* appeared as only 3.13% of the Nutrition Assessment terms for all patient cases, and 5.01% for cases with follow-up visits (Tables 24 and 25, respectively). Other Nutrition Assessment terms related directly to observations concerning carbohydrate intake each accounted for less than 2% of Nutrition Assessment terms used. The Diet-NCP-Audit tool analyzes if a nutrition problem is evident and documented, and if the Nutrition Diagnosis indicates a clear relationship among the elements of the PES (questions 1-4). The results of the Diet-NCP-Audit indicate that the Nutrition Diagnosis was often identified and the PES made sense regarding cohesiveness among its own elements. Mean scores for questions 1, 2, 3, and 4 were 2(±0.071), 1.98(±0.215), 1.94(±0.336), 1.94(±0.245), respectively (Table 20, Figure 9). However, the Diet-NCP-Audit tool does not address the necessary evidence-diagnosis linkage necessary for ensuring the Nutrition Diagnosis documented is an accurate portrayal of the *actual* nutrition problem in any given patient case. The Nutrition Diagnosis terms found in this study versus the Nutrition Assessment terms used to define the problem indicate that a gap exists in the uniform interpretation of the Nutrition Diagnosis as described by Enrione and colleagues.[87] Again, this finding demonstrates an overall lack of understanding regarding application of NCP and chain links amongst RDNs.

At the time data was collected for this study, the ANDHII data entry platform did not contain a field for the RDN to identify the most appropriate Etiology Matrix category for the etiology chosen. Therefore, the Etiology Matrix category was classified by the PI, as outlined in Chapter Three. The most commonly identified Etiology Matrix category for cases with follow-up visits and problem resolution was *Knowledge* (72.92%, Table 42). The frequent use of *food and*

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nutrition related knowledge deficit etiology could indicate that many RDNs truly observe a lack of knowledge in their clientele; or, it may be an indication of lack of adequate time (perceived or actual) for critical thinking to determine a more granular etiology for the problem(s) observed. After Gardner-Cardani et al[74] surveyed RDNs regarding their perception of time needed for application of the NCP, authors found that many viewed the NCP would add time to their documentation and workload.[74] However, other studies have actually found the contrary when an adaptation period containing adequate training and practice was provided,[23,75,76] but support from leadership was a key component influencing success.[76,77]

Interestingly, very few interventions (4.04% in all patient cases and 3.46% in cases with follow-up, Tables 32 and 34, respectively) came from the *Nutrition Counseling* domain, and most came from the *Nutrition Education* domain (63.88% in all patient cases and 66% in cases with follow-up. Tables 33 and 35, respectively). This finding was also evident in the study from Chui et al,[8] where authors notes a "heavy focus" on interventions from the Nutrition Education Domain, and far less interventions from the Nutrition Counseling domain.[8] The most frequent Nutrition Intervention for all patient cases was *nutrition relationship to health/disease* (Table 32), and the most frequent Nutrition Intervention for cases with follow-up visits was *recommended nutrition modifications* (Table 34). Research from within the Academy's EAL[122] has identified improved diabetes outcomes when educational methods are combined with nutrition counseling methods as opposed to solely educational methods.[122] These results also call into question if an increase in Nutrition Counseling domain-based interventions would have an impact on the patient's personal investment, and therefore increase patient return for follow-up visits.

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Without capturing what are the most commonly measured Nutrition Monitoring & Evaluation terms used by RDNs, we have no way of knowing if current MNT practice amongst RDNs actually reflects the most current practice guidelines. The most common Nutrition Monitoring & Evaluation term used was *glycosylated hemoglobin measurement* (17.44% for all patient cases and 18.41% for cases with follow-up visits, Tables 36 and 37, respectively). From a clinical standpoint, it is expected and appropriate that glycosylated hemoglobin measurement is tracked when monitoring outcomes associated with diabetes MNT; so much so, the EAL has used glycosylated hemoglobin measurement as an outcome of interest when evaluating effectiveness of MNT from an RDN.[107] Glycosylated hemoglobin has long been known to be the most valuable tool in assessing glycemic control in patients with diabetes, as noted in *Standards of Medical Care in Diabetes—2020*, from the American Diabetes Association.[123] Additional diabetes nutrition care outcomes of interest suggested in the EAL[124] for and also evident in the most commonly used Nutrition Monitoring & Evaluation NCPT in this dataset (Tables 36 and 37) include glucose, fasting; weight; total carbohydrate intake; body mass index; total energy intake, knowledge/skill level - control food portions; area(s) and level of nutrition knowledge/skill; triglycerides, serum; and total carbohydrate estimated intake in 24 h.

NCP Step Linkages

Chain links between each step of the NCP were first discussed by Hakel-Smith and colleagues[32] in 2005, where authors emphasized the role of standardized language and NCP step linkages in order to "evaluate the effectiveness of nutrition care."[32] Later, Thompson et al[57] expanded on the idea of chain links, especially with regard to the role they have in demonstrating the RDN's critical thinking and rationale behind defining the nutrition problem and steps toward problem resolution. Murphy and colleagues[58] took the idea of chain links a step further by

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defining what a proper chain link between each step of the NCP must include, and how RDNs were using NCP chains in actual documentation in their practices.[58] A weakness of the Diet-NCP-Audit tool is that it does not adequately capture presence of linkages, and a revised NCP audit tool (discussed in a later section) specifically addresses NCP step linkages in order to tackle this concern.

Recently, Lewis et al[59] published the first study to actually find evidence of NCP chain linkages predicting problem resolution, and found presence of the etiology-intervention link to be the most significant predictor of problem resolution, with presence of the evidence-diagnosis link to be the second most significant predictor of problem resolution. In this study, presence of the etiology-intervention link was found to have no significant effect on problem resolution (p = .605), and no significant effect on goal progress (p = .466, p = 1, p = 1). However, presence of the evidence-diagnosis link *was* found to be a predictor of problem resolution in this study (p = .033). Thompson et al[57] described NCP chains as a critical component of establishing EBNPGs when combined with outcomes research, as a clear delineation of how that outcome was achieved in that particular condition is surfaced through the NCP chain. Murphy et al.[58] found that "evidence-initiated NCP chains" were significantly associated with rate of completed NCP chains,[58] which may explain the significant findings on the evidence-diagnosis link as a predictor for problem resolution from this study and from Lewis et al.[59]

Notably, this study found presence of an etiology-intervention linkage in 97.52% of all patient cases (Table 19 and Figure 8), while Lewis and colleagues[59] found presence of an etiology-intervention linkage in 65.2% of all patient cases.[59] The use of the informatic structure within ANDHII in this study as opposed to the EMR review used by Lewis et al[59] may explain some of this discrepancy in the etiology-intervention linkage frequency. The fields contained

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within ANDHII data entry may have influenced this linkage by prompting data entry, ultimately forcing the linkage. A post hoc power analysis was conducted on etiology-intervention linkage findings given this data's sample size of 146, effect size based on findings from Lewis et al,[59] and $\alpha < 0.05$. The post hoc analysis revealed the statistical power exceeded .99, indicating more than adequate power (i.e. power >.80).

One important explanation for lack of significant results for the etiology-intervention link on problem resolution nor goal progress in this study lies within the heavy emphasis on *food and nutrition related knowledge deficit* etiology. The *food and nutrition related knowledge deficit* etiology was used more than half of all documented etiologies without a clearly defined lack of knowledge documented (nor observed by the RDN?) in the Nutrition Assessment. The Nutrition Intervention may be appropriately directed toward resolving the etiology of *food and nutrition related knowledge deficit;* but, if the RDN has not clearly observed a lack of knowledge in a particular nutrition topic, the Nutrition Intervention may actually be misguided. Therefore, the etiology-intervention linkage is, in fact, present; but, the misguided MNT may not be resolving the *true* nutrition problem. This issue leaves the outcomes associated with MNT on problem resolution relatively poor in this sample, despite the presence of an etiology-intervention linkage in 97.52% of all patient cases (Table 19 and Figure 8). This observation underscores the importance of ***all*** NCP chain linkages working in concert to close the entire NCP loop, which was a key factor addressed in the revision of the NCP quality audit tool. Of the 146 patient cases with follow-up visits, exactly half the cases (73) contained a complete NCP chain including all linkages.

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NCP Documentation Quality

NCP documentation quality as defined by the Diet-NCP-Audit tool does not inherently address the presence of chain links, which is problematic. But the NCP-Diet-Audit tool does provide insight into facets of delivery of nutrition care that are important in the context of outcomes research. Throughout this dataset were discrepancies within cases that indicate an overall disparity in the RDN understanding of the importance and role of the Nutrition Diagnosis (including the entire PES statement), chain linkages, standardized terminology, and overall NCP documentation. In some cases, the RDN appeared to utilize the Monitoring & Evaluation section more as a pseudo "goal" section rather than a true outcomes-monitoring section, especially when defining goals is supposed to occur in the Nutrition Intervention section. For instance, in a case where a patient was assessed to have a total carbohydrate intake of "180% of kcal," the Nutrition Monitoring & Evaluation step indicated this was "normal/at goal" for that patient. Other observed discrepancies included:

- Documentation of a Nutrition Diagnosis as "new," despite the visit being a follow-up. The default value in ANDHII for Nutrition Diagnosis status is "new," which may explain this error.
- RDN choosing to enter patient visit documentation into ANDHII in batches, which made the dates for initial and follow-up visit(s) the same date, which skewed the ability to track outcomes from length of time between visits.
- Nutrition Diagnosis changing from initial encounter, but with no documentation indicating the status of the initial Nutrition Diagnosis, nor rationale for the change. Despite the change in Nutrition Diagnosis, the problem status was marked as "continued."

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- One visit had a documented intervention including the "diabetes exchange," which is an outdated practice regarding the EBNPG for T2DM.
- A "1500 mg NA diet" was a frequently documented intervention, although no rationale was given in support of this intervention. The EBNPG do not advise a universal, low-sodium diet for all persons with T2DM;[107] and, even in cases of hypertension[125] and/or CHF,[126] a 1500 mg sodium diet is not universally recommended.[127]
- In many cases, clearly abnormal Nutrition Assessment values were documented with a status of "normal/at goal." For instance, one case indicated a BMI of 43.9 kg/m^2 was "normal/at goal;" another indicated a fasting blood glucose value of 215 mg/dL was "normal/at goal." While individualized patient care dictates a spectrum of "normal" values dependent on the guidelines with consideration regarding the patient's particular situation, these values clearly exceeded the range of "normal/at goal." This finding indicates either a lack of RDN understanding on how to document patient data in ANDHII, or a problem with RDN judgement in determining status of values found.
- In some cases, the RDN documented two conflicting status values for one criterion. For example, one case listed both "excessive" and "inadequate" intake for Vitamin K for the same patient in the Nutrition Assessment.

Despite the inconsistencies noticed throughout the analysis of the data, the Diet-NCP-Audit results were significantly skewed toward a category of "A" (score values 20-26) at 97.3% of cases with follow-up visits (Table 22 and Figure 11), and 98.2% of all patient cases (Table 21 and Figure 10). This observation supports the importance of developing the revised audit tool to more clearly and consistently define quality of documentation. The mean score per visit was 24.42(±1.813), and the total score ranged from 1.5 to 26. Because of the skewed data for NCP

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quality audit score category, no significant relationship was found between NCP quality audit score category and total number of visits, nor between NCP quality audit score category and problem resolution.

The original data collection was obtained through RDNs from Michigan, Ohio, Florida, and Washington DC, which is illustrated in Figure 7. Interestingly, the collective data category for *Location* was a statistically significant predictor for problem resolution (p = .001), although the effect could not be distinguished when each location was independently tested. All of the RDNs who participated in the original data collection were located in the Eastern region of the United States. Future studies should attempt to include a more diverse participant pool representative of a wider span of the United States, and perhaps include international participants as well.

Number of Visits

Tracking the patient from initial encounter throughout all follow-up encounters is a crucial aspect of determining the effectiveness of MNT. For diabetes MNT, specifically, the EAL recommends "three to six medical nutrition therapy (MNT) encounters during the first six months," with improved outcomes associated with this recommendation.[124] In this study, only 146 cases (26% of all patient cases, Figure 3 and Table 10) of had at least one or more follow-up visit. Of those 146 cases, only 42 of them (29% of cases with follow-ups) had more than 2 follow-up visits (Figure 3 and Table 10). Lewis and colleagues[59] found that the Nutrition Problem improvement was positively correlated with number of visits. However, this study was unable to find a similar significant effect of total number of visits on problem resolution. One major difference in the findings from Lewis et al[59] was the mean number of visits, which was 4.3 in their study, and only 1.4 in this study (Figure 3 and Table 10). This difference may explain

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why several findings from Lewis et al[59] were significant (as opposed to similar nonsignificant findings in this study), as their mean number of visits was in direct alignment with that which is recommended by the EBNPG while the mean number of visits in this study fell far below the recommendation.

The lack of results connecting total number of visits with problem resolution may stem from some patients not followed through completely toward problem resolution. In other words, the documented cases in the Diabetes Registry may have been only a snapshot of the whole nutrition plan of care for that patient from start to finish; or, the patient failed to return for subsequent follow-ups for long enough to resolve their nutrition problem. Data from Lewis and colleagues[59] indicated far more return for follow-up visits than this study, which may be explained in their use of VA patients who experience a distinct continuity of care by design; authors also examined both inpatient and outpatient settings. The MNT is provided to patients at the VA at low or no cost, which also may have had a positive influence on the rate of return for nutrition care within that dataset. The patient data gathered for use in this secondary analysis came only from private-sector outpatient settings, and the patient may or may not have endured a financial burden with regard to return visits, ultimately impacting MNT attrition. We also must consider that the delivery of MNT upon the initial visit has an impact on the patient's personal investment in care. As mentioned previously, the limited application of Nutrition Interventions from the Nutrition Counseling domain may have a correlation with patient adherence in returning for care, and this possibility should be explored in future research.

In a recent study on follow-up attrition in ophthalmologic patients with diabetes by Suresh and colleagues,[128] authors found insurance coverage to be a significant predictor of follow-up frequency.[128] CMS considers MNT for T2DM a reimbursable expense, but limits the

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coverage to no more than 4 visits total per year the first year, and only up to 2 visits thereafter.[45] Moreover, although many third-party payers follow CMS guidelines, not all do. The patient's out-of-pocket expenses may be preventing adequate follow-up visits with the RDN. Furthermore, in 2018, only about 0.06% of eligible Medicare beneficiaries utilized MNT benefits.[129]

Nutrition Intervention Effectiveness

Goal progress was difficult to determine, since very few cases documented a definitive "goal" for each intervention in ANDHII. In this study, "goal progress" was determined by status of "indicators," which were directly derived from the Signs and Symptoms of the Nutrition Diagnosis PES statement. The rate of positive goal progress was 41% (Figure 6), and could only be determined for cases with follow-up visits. Of the remaining follow-up visits, 15% had no goal progress, and 44% were unknown for goal progress (Figure 6). The lack of consistency from one visit to the next in terms of clearly defined goals and/or goal progress prevented the extraction of true outcomes from this measure. The most common indicator tracked was *glycosylated hemoglobin measurement* (18.45% for all patient cases and 18.12% for only cases with follow-up visits, Tables 13 and 15, respectively), which seems quite appropriate in diabetes management. If RDNs documented clearly defined goals, researchers could obtain usable data connecting MNT to outcomes.

Perhaps inadequate patient adherence to the Nutrition Intervention precluded the ability for MNT to produce problem resolution. However, RDN documentation regarding a clearly defined Nutrition Prescription and clearly described effectiveness of the Nutrition Intervention was nearly nonexistent in this data, so determining the role of patient adherence for or against the results for problem resolution could not be elucidated. The data showed *recommended nutrition modifications* (16.91%) from the Nutrition Education domain as the most frequently used

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Nutrition Intervention for cases with follow-up visits and problem resolution (Table 44). This finding makes sense in the context of this dataset, as was previously noted regarding the high prevalence of Nutrition Interventions from the Nutrition Education domain. We must keep in mind that the problem resolution rate was only 26% overall (Figure 4). Therefore, although the Nutrition Education domain is the most widely represented in cases with problem resolution (66.19%, Table 43), perhaps problem resolution would be positively influenced with a wider variety of Nutrition Interventions with representatives from most (or all) domains.

Revised NCP Quality Audit Tool Validity and Reliability

The Academy Data Science Center revised the NCP quality audit tool, originally developed by Hakel-Smith et al,[32] in collaboration with the VA workgroup in an effort to fill the gaps found in use of the Diet-NCP-Audit tool, especially in terms of re-assessment and linkages. Mean total score for the revised NCP quality audit tool (was expectedly lower (M = 14.62, SE = 0.73), than that of the Diet-NCP-Audit tool (M = 23.21, SE = 0.92) since the Diet-NCP-Audit tool did not adequately penalize absence of NCP linkages (t (14) = 12.52, p < .000, r = .67).

Findings from the validity and reliability tests revealed the revised tool scored highly for validity (S-CVI-UA = .958 and S-CVI-Ave = .979 for relevance; S-CVI-UA = .917 and S-CVI-Ave = .958 for clarity), which indicates the revised NCP quality audit tool exhibits excellent validity.

The results for inter-rater reliability met the minimum threshold to be considered reliable according to Krippendorff, with α = .6684 ($\alpha \geq .667$ is considered the minimum coefficient benchmark considered reliable in Krippendorff's α).[120] The revised NCP quality audit tool exhibited low-moderate intra-rater reliability (rater CC α =.8598, rater MC α =.3194). In some cases, percentage of agreement was high, but Krippendorff's α was low while the percentage of

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agreement was high (NI 4 (inter-rater α = .4423, 86.7% agreement). This discrepancy is explained, in part, because Krippendorff's α will be lower when the data displays only a small variance in scores. Complete Krippendorrf's α coefficient results and percentages of agreement for each question and for the entire instrument are found in Table 47.

Disagreement existed between the two raters within the questions NA 1 and 4 (inter-rater α = -.2488 and α = -.1154, respectively) which focus on inclusion of relevant data in the Nutrition Assessment. Although Nutrition Assessment data is objective, the quantifiable disagreement indicates subjective differences in what is considered "relevant" data for inclusion in the Nutrition Assessment. Question NA 1 also exhibited marked disagreement regarding both raters' intra-rater agreement, which may indicate overall misunderstanding on application of this audit question. Disagreement also existed between the two raters regarding NA 3 (α =.1944), which focuses on the evidence-diagnosis linkage, suggesting that subjective discrepancies surrounding clinical judgement on what comprises satisfactory evidence of a nutrition problem. Question NA 2, which focuses on inclusion of comparative standards when applicable, produced 100% agreement on all three levels of inter- and intra-rater reliability.

Questions ND 1-3 exhibited perfect inter-rater agreement (each α = 1), as well as perfect intra-rater agreement for rater CC (α = 1); however, intra-rater agreement for questions ND 1 and 3 showed poor reliability for rater MC (each α = -.8125). Question ND 4, which focuses on the Signs & Symptoms portion of the Nutrition Diagnosis PES indicating a true nutrition problem exists, scored quite low in agreement among all three levels of inter- and intra-rater reliability (inter-rater α = .1944, CC intra-rater α = .2328, MC intra-rater α = -.8125). Again, this disagreement indicates a general misconception exists concerning what data would sufficiently

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demonstrate evidence for a nutrition problem, and whether extra data would nullify the score for that case.

Question NI 1 had low inter-rater agreement (α = .1944), and low intra-rater agreement for only one rater (MC, α = .0144) with high intra-rater agreement for the other rater (CC, α = .8466). Question NI 1 focuses on the intervention containing an "action consistent with goals of care." Notably, the discrepancies within question NI 1 may be attributed to the lack of a clearly delineated goal captured in ANDHII. At the time data was collected for this study, the ANDHII data entry platform did not clearly delineate a field within the Nutrition Intervention for the RDN to enter "goal(s)" or "goal progress." Therefore, in the data analysis for this study, goals had to be determined by first attempting to identify the goal from the Nutrition Intervention documentation, then examining the Nutrition Monitoring & Evaluation documentation for further indications of the RDN including any specific goals for the intervention(s). For the sake of the Diet-NCP-Audit, the PI and collaborating RDN agreed to consider a specific, measurable Nutrition Monitoring & Evaluation NCPT as a "goal."

Much the same as question NI 1, Question NI 2 had low inter-rater agreement (α = .1944), and low intra-rater agreement for only one rater (MC, α = .0944) with high intra-rater agreement for the other rater (CC, α = .8612). Question NI 2 focuses on inclusion of a clearly defined Nutrition Prescription in the documentation. The discrepancies within question NI 2 may be attributed to the lack of a clearly delineated Nutrition Prescription captured in ANDHII. At the time data was collected for this study, the ANDHII data entry platform did not clearly delineate a field within the Nutrition Intervention for the RDN to enter a Nutrition Prescription. The PI and second RDN considered inclusion of specific diet NCPT and/or relevant Nutrition

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Interventions with quantifiable action (i.e. 45 grams CHO per meal or 30 minutes of physical activity three times weekly) to satisfy the requirement for a Nutrition Prescription.

Questions NI 3 and 4, which focus on the etiology-intervention linkage, each exhibited low agreement across all three levels of inter- and intra-rater reliability (NI 3 inter-rater α = .6422; NI 4 inter-rater α = .4423; NI 3 CC intra-rater α = .6420; NI 3 MC intra-rater α = .1944; NI 4 MC intra-rater α = .0114), with the exception of intra-rater agreement for NI 4 for rater CC (α = 1). The lack of agreement on questions NI 3 and 4 is notable in this study since the etiology-intervention linkage also failed to produce statistically significant prediction of problem resolution despite presence of etiology-intervention linkage in 97.52% of all patient cases (Table 19 and Figure 8). The degree of disagreement on questions NI 3 and NI 4 suggest a more clearly defined, objective set of criteria is warranted. Questions NI 5 and 6, which focus on inclusion of standardized language and inclusion of plan for follow-up, respectively, exhibited perfect inter-rater agreement (each α = 1), as well as perfect intra-rater agreement for rater MC (α = 1); however, intra-rater agreement for questions NI 5 showed poor reliability for rater CC (α = 0).

Questions NM 1 and 2, which focus on use of standardized terminology and specific monitoring criteria, respectively, exhibited perfect inter-rater agreement (α = 1), as well as perfect intra-rater agreement for rater CC (α = 1); however, intra-rater agreement for questions NM 1 showed poor reliability for rater MC (α = .5972).

Question NE 1, which focuses on the re-assessment restating the Nutrition Diagnosis, exhibited perfect inter-rater agreement (α = 1), as well as perfect intra-rater agreement for both raters (each α = 1). Question NE 2, which focuses on use of standardized terms for evaluating Nutrition Diagnosis status, scored very poorly on inter-rater agreement (α = -.0741) and intra-rater agreement for rater MC (α = -.2946); however, perfect intra-rater agreement existed for NE

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2 for rater CC ($\alpha = 1$). Questions NE 3 and 4, which focus on documentation of Nutrition Intervention status and indicator/Nutrition Assessment data status, respectively, scored very poorly across all three levels of inter- and intra-rater reliability (NE 3 inter-rater $\alpha = 0$; NE 4 inter-rater $\alpha = -.1154$; NE 3 CC intra-rater $\alpha = 0$; NE 4 CC intra-rater $\alpha = -.1154$; NE 3 MC intra-rater $\alpha = -.5263$; NE 4 MC intra-rater $\alpha = .3040$). Questions NE 5 and 6 exhibited perfect inter-rater agreement ($\alpha = 1$), as well as perfect intra-rater agreement for rater CC ($\alpha = 1$); however, intra-rater agreement for questions NI 5 showed poor reliability for rater MC ($\alpha = -.9333$).

Question OQ 1, which focuses on clarity of language used, scored very poorly across all three levels of inter- and intra-rater reliability (inter-rater $\alpha = -.1600$, CC intra-rater $\alpha = .3040$, MC intra-rater $\alpha = 0$). These results suggest clearly defined criteria is warranted to reduce the subjectivity involved in determining if a) clear language is used, and b) how many "errors" dictate loss of points for this question. Question OQ 2, which focuses on the Nutrition Intervention stemming directly from the Nutrition Assessment observations, also scored very poorly across all three levels of inter- and intra-rater reliability (inter-rater $\alpha = .0814$, CC intra-rater $\alpha = .5837$, MC intra-rater $\alpha = -.3810$).

These findings indicate that modification of the following revised NCP quality audit tool questions is warranted to increase agreement amongst raters, especially in terms of more clearly defined criteria for objective scoring: NA 1, 3, and 4; ND 4; NI 1-4; NE 2-4; and OQ 1-2.

Limitations

Several limitations must be addressed within the context of this study. At the time of data collection for this study, the lack of standardized NCPT for the Etiology Matrix category of the PES within the Nutrition Diagnosis step of the NCP required clinical expertise to qualify the

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etiology into a domain for data analysis, which is a relatively subjective endeavor. The NCP documentation quality audit(s) have potential for the introduction of bias, as interpretation of the criteria often requires RDN clinical judgement to determine score. Efforts to minimize bias in the initial NCP quality audit included having another RDN score a subset of the data for pairwise comparison and conference on the rationale for scoring differences, resulting in agreed upon scoring consistency. Bias may also have been introduced when determining the main nutrition problem for each patient if more than one Nutrition Diagnosis was listed. The methodology used in this study mimicked the study by Chui and colleagues,[8] in that the assumption that the first problem listed is likely the most important to the RDN, and further problems were excluded from the analysis. All limitations and mitigation strategies for Aim #1 are summarized in Table 48.

Table 48: Study Limitations and Mitigations toward Resolution

Limitation	Mitigation
Lack of standardized NCPT for the Etiology Matrix category of the PES within the Nutrition Diagnosis itself	Used clinical expertise to determine Etiology Matrix category
Introduction of bias within the NCP quality audit	The PI collaborated with a second RDN; the RDNs conferred to discuss inter-rater differences, and ultimately agreed upon a score amongst the pairwise comparisons
More than one Nutrition Diagnosis (PES) is included	Only the first PES statement listed for each patient case will be considered in the data analysis, as was done by Chui and colleagues in 2019.[8]
Excessive numbers of NCPT utilized for certain steps of the NCP documentation in ANDHII	Terms were limited to the top 5 NCPT for Assessment, Intervention, and Monitoring & Evaluation for data analysis
Non-standardized terminology is used	NCP quality audit will not be affected by non-standardized terminology. Descriptive statistics include both NCPT and non-standardized terms.
Discrepancies between PI audit scoring and second RDN NCP audit (Diet-NCP-Audit)	Inter-rater discrepancies were discussed one by one, using a pairwise comparison, in order to reach a scoring consensus.

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Research results were limited by the available data, which was derived directly from the Diabetes Registry. Demographic data was not available by the nature of this registry data, and therefore correlations to demographic characteristics among the patterns observed could not be elucidated.

Aim #2 had its own set of limitations. The revised NCP quality audit tool was designed with a free-text, narrative charting style in mind, and some of the nuances of this style of documentation do not seem to be captured within ANDHII. For instance, the data capture process in ANDHII itself, at the time of the raw data collection for this registry study, did not contain fields for Nutrition Prescription, definitive intervention goals, nor definitive follow-up specifications. The lack of these clearly defined aspects of the NCP documentation required the PI and collaborating RDN to use clinical judgement in critical review of these cases in order to score the NCP quality audits for each aim. At the time of this study, the revised NCP quality audit tool manual was still being refined; also, the tool requires the rating RDNs to have a high level of NCP knowledge. The NCP experience level was not objectively assessed prior to scoring, and the rating RDNs did not receive formal training on implementation. Rating the validity and reliability of a tool not explicitly designed for informatics-based charting my not have accurately portrayed the validity and reliability the same as it may have in the context of free-text-based documentation. Future revisions in ANDHII to make the revised NCP quality audit tool more relevant for audits should include: dedicated fields for Nutrition Prescription, goal status, and reassessment plan; a prompt for the RDN to enter comparative standards used along with the Nutrition Assessment NCPT; and fields for Nutrition Intervention success or barriers for implementation. ANDHII revisions should also include more robust free-text fields

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within each section of the NCP, with the encouragement for the RDN to briefly document rationale used for choice of NCPT when appropriate.

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CHAPTER SIX: IMPLICATIONS FOR PRACTICE

Conclusions

This study determined that outcomes could not be predicted by NCP documentation quality given this dataset from the Diabetes Registry, and using the Diet-NCP-Audit tool. A large portion of the data was dramatically skewed, precluding the ability to extract usable outcomes. Part of the skewness can be attributed to the majority of the NCP Quality Audit Category data finding the highest quality of documentation when using the Diet-NCP-Audit tool, but despite a general lack of the overall chain-link concept within the documentation. The results of this study have indicated the Diet-NCP-Audit tool was inadequately assessing key aspects of the NCP critical for providing high-quality MNT, and critical for producing outcomes data. The revised NCP quality audit attempted to fill the gaps left by the Diet-NCP-Audit tool, but further revisions should be considered in order to improve agreement reliability prior to incorporation into practice.

These results have also unraveled a disparity in the way RDNs are both applying and documenting the NCP in MNT for diabetes. Although the Academy provides a series of training modules to familiarize the RDN with the most current NCPM and NCPT, gaps in explicit training concerning importance and use of chain links exist, and these gaps were evident in the findings from this dataset. These findings are consistent with research from Matthews, Palmer, and Capra[88] on the use of NCP and NCPT among RDNs, where authors found an undesirable variance among the NCPT selected, and authors suggest that inadequate training may be to blame.[88] Chui et al[8] also found although counseling skills, including behavior change facilitation, are required by RDNs, these methods are not being applied in practice; and, if they are, they are not being documented.[8] Ichimasa and colleagues[23] identified that use of the NCP increased physician support of nutrition care up to 90% in some cases.[23] Not only is improving the

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application and documentation of the NCP important for research, but it is an essential piece in the fight for RDN recognition among professional peers. A major difference in recognition amongst the RDN's allied health peers is the ability for many allied health professions to objectively link outcomes with care provided.[11,12] A need exists for continued support to educators/practitioners on how to apply the NCP and collect outcomes. Execution of actions surrounding education in an era where digital learning is prevailing are paramount.

Each facility, and each RDN has a role in a radical overhaul of NCP, NCPM, and NCPT knowledge and application in MNT in order to finally elevate the dietetics profession to the level deserved in healthcare. Dietetics leaders are charged with leading the way, from speaking the outcomes data toward public policy and insurance reimbursement reform to clinical nutrition managers improving support for their teams in the training and time necessary for full NCP understanding and utilization. In 2018 O'Sullivan and colleagues[81] found that lack of training and support, lack of understanding the rationale or benefits of NCP in patient care, and lack of motivation to change were among the biggest barriers to success with RDNs implementing the NCP into their practice.[81]

The results of this study ultimately uphold the constructs built within the systems theory, especially concerning the *latency* and *adaptation* constructs (Table 5). When RDNs utilize the standardized language through the NCPT, and enter their real patient cases into ANDHII, we are then able to actually objectively quantify the NCP. The objective outcomes data derived from use of the NCP fuels the EAL with translational research RDNs can use in practice. Thompson and colleagues[57] describe NCP chains as a critical component of establishing EBNPGs when combined with outcomes research, as a clear delineation of how that outcome was achieved in

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that particular condition is surfaced through the NCP chain.[57] This this evidence supports continuous updating of the EBNPG, and the cycle of proving the value of the RDN can continue.

Implications for Future Research

First, the way in which ANDHII allows users to enter data has been found to be lacking in some areas. For instance, no clearly identified area exists within the patient case platform in which to define the nutrition prescription, the goals for each intervention, nor the plan for follow-up, which are all fundamental pieces of the NCP. The way in which the ANDHII software downloads the raw data leaves the researcher to have to reorganize the data points manually, which can introduce errors as a matter of process; and, is excessively time-consuming. Improving the data input and extraction of ANDHII is paramount to continued MNT outcomes research. Continued financial investment in improving ANDHII to achieve its full potential is an important strategy for the Academy to advance the dietetics profession.

Future research should utilize the revised NCP quality audit tool for a more comprehensive analysis of documentation quality than the Diet-NCP-Audit tool was able to capture. In doing so, outcomes concerning the NCP quality audit are less likely to be as significantly skewed as was the case for this study. In some cases, the indicators being tracked actually changed between the initial and follow-up visits, therefore goal progress was unknown. Neither the Diet-NCP-Audit tool nor the revised NCP audit tool examined in this study have a means to detect this problem through documentation quality audits; future revisions to NCP quality audit tools should carefully consider this issue. An NCP quality audit tool designed specifically for informatics-based (e.g. ANDHII) charting should be considered for future NCP quality audits on this data platform. Future registry studies should also incorporate a means of revisiting RDN participants in order for researchers to further explore challenges and findings of

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interest in order to better capture the practice landscape. For instance, 74% of the total patient cases did not return for a follow-up visit. With the ability to return to the participating RDNs, researchers may have been able to determine if this attrition rate is particularly prevalent in the diabetes population, or if is generally a reflection of outpatient clinical practice as a whole.

Future studies should also explore if increased inclusion of interventions from the *Nutrition Counseling* domain has a positive impact on problem resolution rate and/or incidence of return visits. In this study, only 26% of the total patient cases recorded returned for at least one follow-up visit, which impaired the ability to extract outcomes data from MNT. As mentioned previously, the limited application of Nutrition Interventions from the Nutrition Counseling domain may have a correlation with patient adherence in returning for care, which reduced the number of cases with viable outcomes data. The application of Nutrition Intervention should be explored in future research, as should exploring the rationale behind the RDN's use (or lack thereof) of a diverse set of Nutrition Interventions from more domains. Further related to patient return for follow-up visits, evidence from Lin et al.[130] suggests utilizing technological reminders, such as telephone and/or text messages, to increase the likelihood the patient returns to care.[130] Research from Chen et al[56] suggests a NCP-based smartphone application designed to improve the RDN-patient connection and outcomes gathering through a digitized NCP framework may improve both compliance and outcomes if it is more convenient for the patient.[56] Research surrounding effectiveness of technology in return for MNT care should be investigated further.

This study focused on MNT for diabetes. Future research examining effectiveness of the NCP and MNT against outcomes from other medical conditions should be explored. Hand and colleagues[90] observed a "wide variation" in terms used in renal (HD) MNT, which would

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indicate a concern for the reliability of the NCPT among MNT for HD, and an area for future research.[90] Regarding malnutrition-associated outcomes, Sherry, Sauer, and Thrush[100] found that many patients who were identified at risk for malnutrition were not diagnosed, and malnutrition screening was inadequate.[100] Authors stated, "a web-based quality improvement tool could be used to capture the nutrition care practice at an institution level to provide directed approaches for addressing hospital malnutrition and improving care of patients at risk for malnutrition,"[100] which is exactly what ANDHII is designed to accomplish.

Advocating for a CMS update in MNT coverage has been on the forefront of dietetics practice for many years. Continued public policy advocacy efforts require MNT outcomes data to fortify efforts to improve MNT reimbursement. The current reimbursement guidelines for diabetes put limitations on the total number of hours per year a patient can receive MNT from an RDN. In the spirit of holistic, individualized diabetes management, the number of visits and frequency by which a patient is seen should be patient-driven. In order to solidify the platform on which to present this case to CMS for revision of MNT reimbursement legislation, we must have the data. In order to have the data, all RDNs are charged with fully embracing the entire NCPM. Desroches and colleagues[114] determined through the TPB framework lens that making RDNs aware of the NCP use and importance is not enough to motivate RDNs to use it in practice.[114] Uncovering the secret to what *will* ignite RDN enthusiasm to elevate the profession is vital, and begins with clinical nutrition managers leading the way. These dietetic leaders have a distinct role to enhance their own understanding of the intricacies within the NCPM, NCP, NCPT, and outcomes, and to ensure proficiency of each aspect of the NCP is met within their teams. The clinical nutrition manager is also responsible for developing creative methods through which to

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motivate their teams to embrace the rationale behind the NCP and outcomes research by cultivating each RDNs intrinsic motivation for elevating the profession.

Conclusion

RDNs must thoroughly study and apply the NCPT, documenting clear linkages between each step. RDNs must also enter their real patient data into ANDHII in order for researchers to support that MNT from the RDN is effective, and through what means it is effective. Overall, future research should ultimately center around strategies to fully engage RDNs in the appropriate, comprehensive application of NCP for the progression of the dietetics profession. Ultimately, the biggest call to action from this study is for RDNs to embrace the NCPM, to pledge to better understand and apply the NCP, and to advance the dietetics profession through improved NCP documentation along with use of ANDHII. The time to act is now.

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APPENDIX A: The Diet-NCP-Audit Tool Used for Aim #1

Audit instrument Diet-NCP-Audit

Record no _____

Question 1-12:
Yes = 2 p
Partly = 1 p
No = 0 p

Question 13 a-b
Yes = 1 p
Partly = 0,5 p
No = 0 p

Are the following statements consistent with the medical record reviewed? Answer in accordance with the scoring scale, and with support of the associated manual. The manual contains detailed descriptions of the various terms used and how they should be interpreted when scoring.

		Score		
1.	One or more nutrition problems have been identified and prioritized	0	1	2
2.	Possible etiology related to one or more nutrition problems is documented	0	1	2
3.	The documentation refers to signs (objective) and/or symptoms (subjective) related to one or more nutrition problems	0	1	2
4.	The documentation expresses a relationship between problem, etiology and signs/symptoms	0	1	2
5	The documentation includes a nutrition prescription	0	1	2
6.	The documentation includes interventions implemented or planned, alternatively a comment explaining why no intervention was undertaken	0	1	2
7.	The documentation includes evidence for the choice of interventions that are implemented or planned, or alternatively the decision to not undertake any interventions	0	1	2
8.	The documentation includes one or more goals for the intervention	0	1	2
9.	The documentation includes information about whether a follow-up appointment is planned, or alternatively whether the patient is discharged	0	1	2
10.	The documentation includes a plan for how to perform the monitoring and evaluation, or alternatively an explanation of why no monitoring and evaluation are planned	0	1	2
11.	The structure of the note follows the ADIME format of the Nutrition Care Process	0	1	2
12.	The language in the documentation is clear and cannot lead to misunderstanding	0	1	2
13.	***a)*** All the information documented is relevant to understanding the patient's nutritional status, problem and situation	0	0,5	1
	b) All relevant information documented in the assessment part is addressed in the intervention part.	0	0,5	1

Total score (max26) _____

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APPENDIX B: Revised NCP Quality Audit Tool for Aim #2

Nutrition Care Process Quality Audit Tool Criteria	Initial Assessment	Re-assessment
NA – NUTRITION ASSESSMENT – EVIDENCE – 4 points	Yes=1 No=0	Yes=1 No=0
NA 1. The RDN only documents assessment data when relevant to the nutrition problem and outside of normal limits (or required by local policy)		*n/a*
NA 2. The RDN uses Comparative Standards in the NA that are essential to the ND, when applicable		*n/a*
NA 3. The RDN's assessment data provides evidence that ~~a~~ the nutrition problem is present		*n/a*
NA 4. Assessment data is succinct, relevant, and supports the ND		*n/a*
ND - NUTRITION DIAGNOSIS - 4 points		
ND 1. **Problem:** label of the PES uses exact NCP terminology		*n/a*
ND 2. **Etiology:** is the root cause of the ND that a nutrition professional can resolve/mitigate S/Sx		*n/a*
ND 3. **Etiology:** in addition to free text etiology, the RDN documents the etiology matrix category		*n/a*
ND 4. **S/Sx:** provide evidence that the ND exists		*n/a*
NI – NUTRITION INTERVENTION – 6 points		
NI 1. Each nutrition intervention has an action consistent with the goals of care		*n/a*
NI 2. A nutrition prescription is written		*n/a*
NI 3. Intervention is directed at resolving the etiology and/or improving the signs/sx		*n/a*
NI 4. There is at least one intervention for each etiology listed in PES		*n/a*
NI 5. The RDN uses standardized terminology to document interventions		*n/a*
NI 6. Documentation specifies reassessment plan and timeline (i.e. Follow-up in 1 month/discontinuation)		*n/a*
NM – NUTRITION MONITORING SECTION – 2 points		
NM 1. The RDN uses standardized terminology to documents indicators (e.g. weight, glucose, total energy estimate intake in 24 hours) that reflect the s/sx to monitor upon reassessment		*n/a*
NM 2. Criteria for each indicator is specific (e.g. Weight less than 250# within 1 month)		*n/a*
NE – NUTRITION EVALUATION – REASSESSMENT SECTION - 6 points		
NE 1. The RDN restates the Nutrition diagnosis in the reassessment documentation	*n/a*	
NE 2. The RDN addresses the Status of ND using standard terms (resolved/unresolved)	*n/a*	
NE 3. The RDN documents the Intervention success or barriers to implementation/reasons for delay in in the application of each intervention.	*n/a*	
NE 4. The RDN reassesses the Nutrition indicator/assessment data (e.g. weight) from previous interaction (encounter).	*n/a*	
NE 5. The RDN evaluates the Goals (actions of the intervention) established at last visit using NCP terminology labels (e.g. goal met/achieved, goal not met/not achieved).	*n/a*	
NE 6. The RDN documents the effectiveness of each NI, or modifies NI when there is no evidence that the intervention has been effective.	*n/a*	
OVERALL QUALITY ASPECTS – 2 points		
OQ 1. Language in the note is clear		*n/a*
OQ 2. All relevant information included in the NA drives NI		*n/a*
Total Points	/18	/24

Quality Rating	Initial	Reassessment
Level C (low quality)	≤ 9	≤ 12
Level B (medium quality)	10-13	13-18
Level A (high quality)	14-18	19-24

Abbreviations: NA-Nutrition Assessment; ND-Nutrition Diagnosis; NI-Nutrition Intervention; NM-Nutrition Monitoring; NE-Nutrition Evaluation; PES-problem/etiology/signs and symptoms; S/Sx-signs and symptoms

Initially Developed by Dee Pratt, RD, LDN and Sherri Jones, MS, RD, LD, UPMC Presbyterian Shadyside. Reviewed and updated (2019) with the assistance of Nancy Hakel-Smith, PhD, RD; and Dee Pratt RD, LDN. Reviewed and updated (2019) by Academy staff. Reviewed and updated (2020) by Veterans Affairs (VA) Registered Dietitians and Academy staff.

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APPENDIX C: Letter from the AND Granting Permission for the Use of the NCPM Graphic Found in Figure 2

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June 23, 2020

Casey Colin, MS, RDN
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