Practice Paper of the Academy of Nutrition and Dietetics:

Critical Thinking Skills in Nutrition Assessment and Diagnosis

ABSTRACT

The Nutrition Care Process and Model (NCPM) provides registered dietitian nutritionists (RDNs) and dietetic technicians, registered (DTRs) a framework to recognize, diagnose, and intervene upon nutrition-related health concerns. Within the NCPM, nutrition assessment is essential to develop a comprehensive evaluation of the client's nutrition history. The application of critical thinking skills to nutrition assessment is imperative to ensure appropriate acquisition and interpretation of data. The Academy of Nutrition and Dietetics' Career Development Guide, adapted from the Dreyfus Model of Skill Acquisition, illustrates the progression of critical thinking skills as RDNs and DTRs gain knowledge and experience with practice. The Career Development Guide is characterized by the transition through the following stages: novice, beginner, competent, proficient, and advance practice/expert. The foundation of dietetics knowledge is obtained during the novice and beginner stages. Throughout, the primary objective is introduction of the NCPM and nutrition assessment theory via dietetics education and the application of nutrition assessment in supervised practice. Next, RDNs and DTRs transition to the competent stage of practice. During this phase, entry-level knowledge and skill are applied to patient care settings and critical thinking skills develop as RDNs and DTRs gain experience. Subsequently, RDNs and DTRs move to the proficient stage as the ability to prioritize attention, generalize, apply problem-solving skills to new scenarios, and identify innovative solutions develops. Some RDNs and DTRs may transition to the advance practice/expert stage during which critical thinking becomes intuitive. Critical thinking skills are essential to ensure diagnostic accuracy; however, more research is needed to further describe progression of critical thinking skills among RDNs and DTRs.

Nutrition assessment is an essential component of the Nutrition Care Process and Model (NCPM), as it is the initial step in developing a comprehensive evaluation of the client's nutrition history. A comprehensive nutrition assessment requires the ability to observe, interpret, analyze, and infer data to diagnose nutrition problems. This practice paper provides insight into the process by which critical thinking skills are utilized by both registered dietitian nutritionists (RDNs) and dietetic technicians, registered (DTRs).

HISTORICAL CONTEXT OF NUTRITION ASSESSMENT

Although not recognized as a separate profession until the early 20th century, the roots of dietetics practice can be traced to antiquity. In Ancient Greece, Hippocrates described the relationship between diet and health.[1] During the 19th century, Florence Nightingale recognized the importance of nutrition in recovery from injury.[2] Continuing this tradition, until the early 20th century the focus of dietetics practice was on provision of safe, wholesome food.[3]

At the beginning of the 20th century, diet modifications became an accepted component of treatment of disease. However, most RDNs were employed in food service and did not have direct patient care responsibilities through the 1940s and 1950s.[4] Although physicians were responsible for nutrition therapy, medical education devoted very little time to nutrition and dietetics, leaving many physicians ill prepared to manage complex nutrition problems. Thus, it is not surprising that reports appeared illustrating a shocking incidence of malnutrition among hospitalized patients.[5-7]

In the 1960s RDNs in the hospital setting focused primarily on translating physician diet orders into foods served. Recognizing the need for improvement in nutrition care for hospitalized patients, RDNs began the move from the kitchen to the bedside. Pioneering RDNs identified the need to identify and treat malnutrition in hospitalized patients as an opportunity to expand their skills outside of food service into clinical practice. As a result, beginning in the 1960s nutrition assessment became an integral component of dietetics practice. Although, as time

progressed, there was no unifying conceptual framework for critical thinking in nutrition assessment.

As the complexity of nutrition care increased, the need for a technical level of dietetics practice became obvious. Consequently, the DTR credential was first offered in the early 1980s.[8] Within health care settings, DTRs work under the supervision of RDNs and assist in the delivery of medical nutrition therapy.

The Nutrition Care Process and Model

In 2003, the NCPM was adopted.[9] The NCPM provides RDNs and DTRs a framework to support critical thinking and decision making in all areas of dietetics practice. The NCPM includes four steps that describe the work of dietetics:

- Nutrition Assessment
- Nutrition Diagnosis
- Nutrition Intervention
- Nutrition Monitoring and Evaluation

Adoption of the NCPM gave RDNs in all practice settings a common framework for assessing nutrition status and to accurately diagnose nutrition-related problems for which a nutrition intervention is the primary treatment. Parallel to the NCPM, the International Dietetics and Nutrition Terminology (IDNT) provides a standardized health care terminology specific to dietetics practice that facilitates clear communication between RDNs and DTRs and other health care providers.[10] The IDNT includes terminology specific to each component of the NCP including assessment of nutritional status of individuals and groups. The NCPM does not delineate knowledge and skill acquisition throughout dietetics career progression; however, a set of critical thinking skills was described including the ability to conceptualize; think rationally, creatively, and autonomously; and to be inquiring.[9]

CRITICAL THINKING IN NUTRITION ASSESSMENT

In 2010 the Academy of Nutrition and Dietetics released the Career Development Guide (CDG) to demonstrate how practitioners might integrate knowledge and experience to attain critical thinking skills that lead to increased competencies and levels of practice.[8] The CDG was adapted from the Dreyfus Model of Skill Acquisition and from research focused on career development in nursing.[11,12]

The Dreyfus Continuum of Practice Model

In the 1980s Stuart and Hubert Dreyfus published results of research describing their model of skill acquisition [12]. The Dreyfus model consists of five stages that begin at the student or novice level and progress through the expert level. Although not originally intended to be used in health care, the Dreyfus model has since been adopted in medical and nursing education [11,13]. An important distinction made in the Dreyfus model is the difference between "knowing that" and "knowing how."[12,14] Individuals who "know that" are able to cite the rules related to a given situation. "Knowing how" refers to the ability to complete a task in the work setting. **Figure 1** provides a description of the characteristics of each stage of the Dreyfus mode [12]. The transition between "knowing that" and "knowing how" appears as clinicians move from competent to proficient practice.

Benner's Application of the Dreyfus Model

Benner utilized the Dreyfus model as the conceptual framework for her research into development of expertise in nursing practice.[11] One difference between the Benner and Dreyfus models is Benner's inclusion of the term "intuition" in her definition of expert practice.[11] According to Benner, when there is high uncertainty, limited facts, and no precedent, experts use intuition to direct decision-making. Others have criticized Benner's inclusion of intuitive practice as a component of expertise.[15] However, Lyneham's work identified cognitive intuition, or subconscious processing and rationalization of information, as a component of expert nursing in the Emergency Department.[14] Recent research also questions the conceptual framework of the Dreyfus model as applied to medical education. In a review and critique of the Dreyfus model as used in medical education, Pena felt that the Dreyfus model did not fully explain how physicians gain clinical skills because Dreyfus oversimplified the complex processes associated with acquisition of clinical skills by physicians.[16] While utilization of the Dreyfus model is appropriate for initial work in defining stages of dietetics practice, there may be other factors contributing to skill acquisition that are now unknown. Other models of critical thinking besides Dreyfus or Benner may better describe acquisition of critical thinking skills in dietetics practice. Therefore, a brief review of some of those models is helpful here.

Other Models Describing Critical Thinking

Several measures of critical thinking skills have been described in health professional education. Although it is beyond the scope of this practice paper to extensively review critical thinking models, a brief discussion is presented here. In a systematic review of the literature Ross and colleagues compared three measures of critical thinking to determine how well the measures correlated with academic success in health professional training.[17] Measures studied included the California Critical Thinking Skills Test, California Critical Thinking Disposition Inventory, and Watson-Glaser Critical Thinking Appraisal. Results indicated that critical thinking

Stage	Characteristics
Novice	Focus on rules: • Rule dependent, unable to recognize context • Unable to exercise discretionary judgment
Advanced beginner	Connect relevant contexts to the rules: • Begins to recognize and understand context • Learns instructional principles that guide actions, no sense of practical priority • All aspects of work may be treated separately and will likely have equal importance
Competent	Develop schemes to distinguish less important from more important context: • Competence develops after sufficient practice • Select rules or perspectives appropriate to the situation • Develops emotional attachment to the task at hand
Proficient	Recognition of problems and best approaches for solving: • Prioritize appropriate treatments • Uses past experience to form patterns and solve problems • Actions guides by situational discriminations
Expert	Highest level of situational discrimination and immediate determination of action: • Fluid, unconscious performance; use of intuition to support decision-making • Perceives a situation as a whole; does not waste time on irrelevant distractions • No longer relies on principles to guide performance

Figure 1. Description of the characteristics for each stage of the Dreyfus Model of Skill Acquisition.

skills as measured by any of these tests had only a moderate correlation to academic success and that Watson-Glaser and the California Critical Thinking Skills Test were superior to the California Critical Thinking Disposition Inventory.[17]

Paul's critical thinking model defines critical thinking as "thinking about your thinking while you are thinking in order to make your thinking better."[18] Paul's model consists of three components, thoughts or reasoning, intellectual standards, and intellectual traits. There are eight elements of thought, each with a different focus on reasoning ability. The ten elements of reasoning help determine if a given question is thoroughly examined, and eight intellectual traits that define insight and integrity.[19] To date, there is no research studying application of Paul's model in dietetics education.

THE DIETETICS CAREER DEVELOPMENT GUIDE

The CDG provides a framework to guide advanced practice for RDNs and DTRs, as seen in **Figure 2.**[8] The acquisition of knowledge and experience throughout the six stages, adapted from the Dreyfus Model of Skill Acquisition, leads to improved critical thinking skills and professional competencies. The novice and beginner phases represent the foundation of the dietetics practice – dietetics education followed by the supervised practice experience. The competent stage characterizes entry-level knowledge and skill. RDNs and DTRs move to the proficient stage through the first three or more years of practice. Proficient RDNs and DTRs demonstrate job performance knowledge and skills within a focus area of dietetics practice and approach practice at a higher level than supervised practice. Expert RDNs and DTRs have achieved the highest level of skill acquisition or knowledge in a focused or generalized area of practice. According to the CDG, expert practitioners use "intuitive grasp of situations based on deep, tacit understanding" in practice.[8]

There are two major differences between the CDG and the Benner and Dreyfus models. First, while Dreyfus and Benner include the "Advanced Beginner" stage, the CDG includes the characteristics of the advanced beginner in its definition of the beginner stage. Second, the CDG includes "Advanced Practice" as a separate stage of career development. Advanced practice is defined separately from the CDG as "a high level of skills, knowledge and behaviors." The individual exhibits a set of characteristics that include leadership and vision and demonstrates effectiveness in planning, evaluating, and communicating targeted outcomes."[8] The CDG defines *Expert* as "a RDN or DTR who is recognized within the profession and has mastered the highest degree of skill or knowledge…"[8] Although approved by the Academy's Council on Future Practice, there are no accompanying citations to validate the knowledge or skills needed to reach the level of advanced practice or the difference between advanced practice and expert practice in nutrition and dietetics. In 2012 one study examined the components of advanced-level critical thinking in dietetics. Participants in a Delphi study achieved consensus that having a master's degree, completion of an advanced practice residency, coursework in research, and advanced continuing education were essential components of advanced dietetics practice.[20] Additional research is needed in dietetics practice to further validate this model.

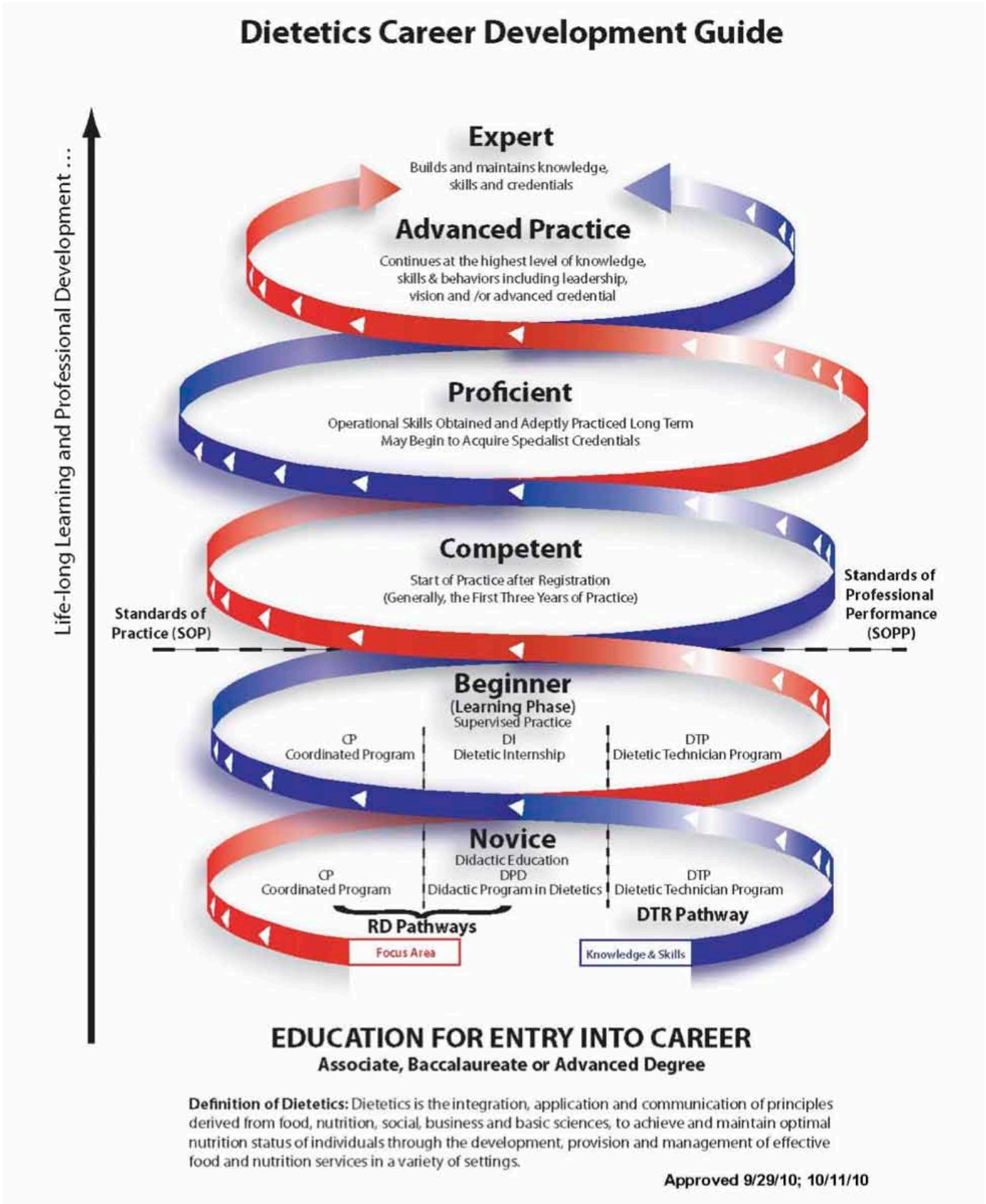

Figure 2. The Dietetics Career Development Guide illustrates the transition from novice to advanced practice via acquisition of knowledge and experience Reprinted from the Academy's Career Development Guide.

ATTAINMENT OF CRITICAL THINKING SKILLS IN NUTRITION ASSESSMENT

Nutrition assessment is the first step in the NCPM and utilizes hands-on critical thinking to diagnose nutrition problems.[9] As the current version of the NCPM does not specify levels of practice, it is important to carefully define skills needed to ensure best practices. The differences in knowledge and skill defined by the stages of the CDG should be expected to apply to nutrition assessment skill development as in all other areas of practice. Thus, in order to ensure that practitioners provide safe, high quality nutrition care, nutrition assessment skill development must be better defined.

Novice

During the novice stage the primary objective is introduction of the NCPM and nutrition assessment theory. During this phase, dietetics students are able to identify and summarize the five categories included in nutrition assessment – food/nutrition history, medical tests, laboratory data and procedures, client history, anthropometric data, and nutrition focused physical exam, along with the principles associated with obtaining information. Minimal critical thinking is utilized during this phase. When the Dreyfus model is applied to nutrition assessment it can be expected that novices in dietetics practice understand the difference between normal and abnormal findings (knowing that) through comparing results to tables or charts of normal values. For example, dietetics students are taught to compare a list of lab results to tables of normal values for those labs. Results that do not fall within published normal ranges are automatically considered abnormal. This thought process does not utilize critical thinking and relies on application of rules learned in the classroom.

In addition, individuals at the novice stage of dietetics practice are learning about the skills needed to accurately assess nutrition status and may have the opportunity to practice components of nutrition assessment via simulations or role playing, but would not be expected to independently complete nutrition assessments in a health care setting. At completion of the didactic phase of dietetics education, students are able to state the components included in nutrition assessment but have limited experience with the application of nutrition assessment to a patient population.

Beginner

RDNs and DTRs begin to acquire experience throughout supervised practice, yet translating the five categories of nutrition assessment from the text book to the bedside can be overwhelming for a dietetic intern. Beginners do not have sufficient experience to apply past learning to new situations and may neglect important components of the assessment when faced with novel situations. Therefore, a framework for conducting nutrition assessment was derived from the sequential approach physicians utilize to complete a history and physical, as seen in **Figure 3.**[21] The framework proposed here provides a methodical approach to collect, organize, and categorize data to identify potential nutrition problems.

Throughout the beginner phase, interns start to acquire skills by conducting nutrition assessments with supervision in situations that are controlled or uncomplicated; for example, patients who have obvious signs and symptoms of nutrition diagnoses or those with well-controlled co-morbid health conditions. Initially RDNs and DTRs just beginning practice know the rules and are typically able to cite rules for nutrition assessment, but have not had sufficient experience to apply rules in non-standard situations. For example, a dietetic intern can utilize a number of tools to determine calories and protein from a client's 24-hour recall and identify the quality of nutrient intake, but have difficulty in identifying discrepancy between reported and actual intake. Under the supervision of an RDN, the intern gains insight with each patient encounter. Autonomy increases as interns participate in nutrition assessment for increasingly complex populations, learn to efficiently collect data, and identify nutrition-related problems. A hallmark of the beginning phase of practice is collection of large amounts of data with little thought to how that data will be used to determine nutrition status.

Competent

Upon entry to independent practice, RDNs and DTRs can recognize patients at nutrition risk, gather appropriate nutrition assessment information, interpret the data correctly, and formulate a nutrition diagnosis in increasingly complex situations. Using knowledge gained over time, competent practitioners understand the implications of abnormal results, and the complex interactions between data in each of the assessment categories. For example, beginners may accept at face value patient reports of weight gain in spite of severely restricted energy intake. Competent RDNs and DTRs would question the client further, knowing that errors in reporting intake are commonly seen or that fluid retention or errors in weighing technique would more likely be responsible for the weight gain described.

During this phase critical thinking skills continue to develop as RDNs and DTRs gain efficiency in the ability to distinguish between relevant data related to the patient's condition and irrelevant information available within the medical record. Competent practitioners gradually develop the ability to quickly separate the relevant from the irrelevant. Gøtzsche states that: "We must ask ourselves if the tests which we request are necessary, if we interpret the

Sequence/Content of Physician-based History and Physical	NUTRITION ASSESSMENT FROM THE NCP Sequence/Content	Considerations for further inquiry to explore possible nutrition diagnoses
Approach to the interview Review the medical record, check the problem list, allergies, medications and laboratory results **Identifying data** Describes demographic data, including age, gender, and source of history **Chief complaint** The one or more *symptoms* causing patient to seek care **Present illness** Complete and chronologic account of the *problems* prompting the patient to seek care	**Medical tests/Laboratory data/Procedures** Before visiting the patient review the medical record and examine possibility of a nutrition-related etiology to chief compliant/present illness: 1) Nutrition-associated medical and surgical history 2) Medication/supplement usage 3) Laboratory assessment	1) Are the symptoms/problems prompting the patient to seek care related to nutrition? 2) What is the influence of past medical/surgical history and prescribed medications on current nutritional status? 3) Based on biochemical or test/procedure results, is the patient adhering to appropriate MNT? 4) What nutrition diagnosis should be considered? 5) Is there significant nutrient-medication interactions associated with a prescribed medication? 6) What additional biochemical, test/procedures or other information is required to rule in or out a possible etiology for nutrition diagnosis?
Past history List all childhood and adult illnesses, including medical, surgical, obstetric/gynecologic and psychiatric **Family history** Outlines age and health/cause of death of grandparents, parents and siblings and presence/absence of specific illness in the family, such as hypertension, colon cancer, etc.	**Food/Nutrition history** Establish rapport; verify nutrition-associated medical/surgical history and medication/supplement usage. Obtain data regarding the patient's MNT, dietary restrictions, food habits, eating patterns, and identification of factors influencing nutrient intake	(1) Based on the assessment of the medical history, has the patient been adequately educated on appropriate MNT? (2) Do over the counter supplements interact with current prescriptions; is the primary health care team aware of supplement usage? (3) Has there been a change in usual food intake? (4) Describe typical meal patterns; are there identifiable barriers that led to alteration in usual intake? (5) Have GI symptoms interfered with usual food intake? (6) Utilizing the nutrition history, identify adequacy and appropriateness of carbohydrate, protein, and fat intake in the diet
Personal and social history Describes educational level, occupation, current household, personal interests and lifestyle	**Client history** Reflection of how the patient's current status influences nutrition-related health	Are there psychosocial, socioeconomic, functional and behavioral factors related to: 1) Knowledge, readiness to learn and behavior change? 2) MNT adherence? 3) Food access; can the patient get out of bed/chair/wheelchair without assistance; can the patient independently leave home? 4) Food preparation; can the patient complete activities of daily living or is help required for food preparation; does the patient require assistance in setting up meals (does someone have to help open containers, butter bread or cutting meats)?

Figure 3 (Part 1). Framework to categorize and collect nutrition assessment data. Adapted from the sequential approach physicians utilize to complete a history and physical. *(continued on following page)*

Review of symptoms inquiry of presence/absence of common *symptoms* related to each major body system	**Anthropometrics** 1) Height 2) Weight (current, usual, ideal) 3) BMI	(1) What percentage of weight loss has the patient had over the past one, three or six months? (2) What is the patient's weight trend; in some cases patients are seen frequently with only 1 to 2 pound weight loss at each visit, yet the cumulative weight loss may be significant. (3) Is the patient's weight unchanged despite a long-term decrease in oral intake; consider the patient's altered body composition instead of weight alone. (4) Has the patient experienced unintentional weight gain; review the interval history, medications, test/procedures and food/nutrition history to determine an etiology unrelated to calorie excess.
Physical examination System-based examination of each region of the body	**Nutrition-focused physical assessment** 1) General 2) Vitals 3) Skin 4) Nails 5) Hair 6) Head 7) Eyes 8) Nose 9) Mouth 10) Neck/Chest 11) Abdomen 12) Musculoskeletal	(1) General: assess level of consciousness; is the patient awake and appropriate for oral intake? Observe for alterations in motor skills, contractures or amputations: are there physical observations that may influence oral intake or energy requirements: (2) Vitals: assess temperature, respirations, pulse and blood pressure for fever, dehydration, systemic inflammatory response syndrome, hypertension (3) Skin: observe for abnormal color/uniformity (pallor, bruising, dermatitis), loss of thickness, scaling or hyperkeratosis and loss of turgor (4) Nails: observe for transverse ridge or koilonychias (5) Hair: observe for thinning, dryness/brittleness, corkscrew appearance, depigmentation/demarcated bands of pigment (6) Head: observe nasolabial folds for erythema or seborrhea (7) Eyes: inquire about night blindness, observe corner of eyes for fissure/redness, dryness of conjunctiva/sclera/cornea, bitot's spots (8) Nose: presence oxygen delivery or feeding device (9) Mouth: observe for carries and loose/missing teeth, swollen/bleeding gum, tongue for glossitis/atrophic lingual papillae, lips for pallor/dryness and cheilosis/angular stomatitis, observe (10) Neck/Chest: presence tracheostomy or vascular access device (11) Abdomen: observe for abdominal distention, auscultate for bowel sounds Musculoskeletal: Observe for muscle wasting via gross atrophy, squared off shoulder/bicep, thin quadriceps; observe for wasting of fat depots via prominent scapula/clavicle, sagging skin; observe edema in lower extremities

Figure 3 (continued). Framework to categorize and collect nutrition assessment data. Adapted from the sequential approach physicians utilize to complete a history and physical.

results correctly, and if they serve the purpose we expect them to serve."[22] Ability to sift through data improves with training and/or experience.[23-25] When the amount and source of information gathered by student dietitians was compared to expert dietitians in diabetes practice, it was noted that students gathered significantly more data than experts.[26]

Traditional dietetics supervised practice experiences do not focus on learning to limit data obtained from the medical record or laboratory and diagnostic testing during the nutrition assessment. There may be a lingering inability to distinguish between relevant and irrelevant assessment factors. For these reasons, there is a tendency to ask for more information. It is not uncommon for competent practitioners to focus on the medical record rather than the patient.

As the RDN or DTR moves from competent to proficient practice, the ability to recognize relevant information and efficiently organize food/nutrition history, medical tests, laboratory data and procedures, client history, anthropometric data, and physical exam data within a framework to assess nutritional status becomes more fully developed.

Proficient

The proficient stage is achieved with broad exposure to variations in practice. Throughout this stage the RDN or DTR can prioritize areas requiring attention, generalize from previous experience, and apply problem-solving skills to new or different scenarios and identify innovative solutions to a problem. A key characteristic of the proficient stage is development of organized thought patterns used in diagnosing nutrition problems. This diagnostic reasoning, a complex and not completely understood theory, includes pattern recognition, hypothetico-deductive reasoning, use of algorithms, and exhaustive methods, as seen in Figure 4.[25,27,28]

Bayes Theorem is a mathematical model that serves as a theoretical basis of many diagnostic strategies; use of Bayes Theorem allows clinicians to determine the probability that

a diagnosis is present given results of diagnostic testing.[29] Either formally or informally, the proficient RDN or DTR applies Bayes Theorem to the diagnosis of health problems by determining the pretest probability, or the level of certainty that a nutrition diagnosis is present. The pretest probability then guides decision making in choosing additional diagnostic tests or procedures that would hopefully confirm the diagnosis. The posttest probability is the RD or DTR's estimate of the chance that the patient would have the nutrition diagnosis in question after appropriate testing has been completed.[30] The following example of how proficient RDNs utilize Bayes Theorem to support diagnosis of nutrition problems illustrates these concepts. A patient who is trying to lose weight may present with a history of no weight loss and reported intake that is significantly less than estimated requirements. RDNs proficient in the use of pretest and posttest probabilities might use the following thought process:

- The patient's energy requirements for weight loss were estimated using established equations with sufficient validity and reliability.
- The patient has no other signs or symptoms or a medical diagnosis associated with abnormally low energy requirements.
- There is low probability that this patient has exceptionally low energy requirements.
- Ordering an endocrine consult along with additional lab testing would increase certainty about the patient's energy requirements by less than 5%.
- Careful review of the patient's diet and physical activity records would increase certainty about the patient's energy balance by more than 75%.
- Before ordering an endocrine consult and additional lab testing it is decided to carefully review the patient's diet and physical activity records

Advanced Practice/Expert

Through life-long learning and professional development, RDNs and DTRs acquire the highest level of nutrition assessment skill. At the advanced practice/expert stage critical thinking becomes intuitive and the RDN or DTR is able to respond to a complex case quickly with accurate determination of relevant clinical data, the prioritization of information to identify a nutrition diagnosis, and explain the rationale for evidence-based clinical decisions. At the same time, the RDN can integrate current data related to the patient's condition and anticipate future nutrition-related problems.

At the expert stage, diagnostic expertise most likely consists of a combination of intuitive and analytical thinking.[31,32] As clinicians gain experience they develop the ability to critically evaluate tests to be ordered or questions to be asked depending on the situation at hand and prior exposure to similar cases, rather than simply by applying rules. For example, when a patient presents with a dry, scaly rash on the face, experienced clinicians will first determine if there are other indicators before automatically assuming the patient has riboflavin deficiency. This thought process develops following sufficient exposure to similar cases where a similar rash was not associated with riboflavin unless other factors were present in the patient history. The experienced RDN or DTR would direct the nutrition assessment to identify all possible causes of the rash. For example, questioning might reveal that the patient had spent the previous week hiking in a cold, windy environment. The nutrition-focused physical exam would determine if the rash was present on other areas of the body or only on the areas exposed to cold and wind. Depending on results of the diet history regarding riboflavin intake, this information would be used to either rule in or rule out riboflavin deficiency as a cause of the rash. Expert RDNs and DTRs have the ability to quickly gather and process information, can develop alternate

Diagnostic thought process	Characteristics
Pattern recognition	• Multiple similar examples from previous experience stored in memory • New case recognized as similar to one seen in the past • Clinician selects best match of current case to previous experience
Hypothetico-deductive reasoning	• Gather data during nutrition assessment • Create a theory, or hypothesis, of all possible factors that might affect the outcome • Deduce predictions based on the formulated hypothesis • Conduct testing or questioning to find evidence to disprove hypothesis
Diagnostic algorithm	• Decision tree approach • Ask a series of yes/no questions
Exhaustive listing	• Every possible question is asked • Every possible diagnostic test is run • Used most often by novice or advanced beginners • May be used in new or unique situations

Figure 4. Diagnostic thought processes used by health care professionals..

problem-solving strategies when needed and understand their own capabilities.[33]

In addition, at this stage the highest level of knowledge, skills, and behavior allow RDNs and DTRs to reflect on outcomes of nutrition practice. Advanced practice and expert practitioners must continually evaluate nutrition assessment performance within their institution/organization by designing and implementing quality improvement initiatives. Changes to the approach of nutrition assessment are justified via collection of data to streamline or improve the application for peers. Advanced practice/expert RDNs and DTRs can critique the nutrition literature and identify gaps in knowledge and with appropriate resources expert RDNs and DTRs can apply clinical and population-based research to study and optimize nutrition care.

RECOMMENDATIONS FOR DIETETICS EDUCATION

Dietetics education should include exposure to diagnostic thought processes, including Bayes Theorem, that enable RDNs at the advanced, beginner, and competent stages of skill acquisition to develop the framework needed to diagnose nutrition problems with efficiency and accuracy. Lack of exposure to critical thinking in the diagnostic thought process may increase the possibility that diagnostic errors will be made. Two primary sources of diagnostic error have been identified: errors due to the system in which the clinician practices and errors caused by faulty cognitive processing.[34-36] Figure 5 describes other sources of diagnostic error that RDNs and DTRs must be aware of and develop strategies for avoidance.[34-36] It is vital that dietetics educators include exposure to clinicians who have expert diagnostic skills throughout the didactic and supervised practice components of dietetics education in order to ensure development of cognitive processes. Dietetics educators may find Trowbridge's Twelve Tips for Teaching Avoidance of Diagnostic Error[37] useful:

- Understand how heuristics impact clinical reasoning
- Promote use of diagnostic time outs
- Promote practice of worst case scenarios
- Promote use of systematic approach to common problems
- Ask why
- Teach and emphasize the value of the clinical exam
- Teach Bayesian theory as a way to avoid premature closure
- Acknowledge how the patient makes the clinician feel
- Promote asking "What can't we explain?"
- Embrace zebras: do not completely rule out the rare or exotic condition until all information is known
- Encourage learners to slow down
- Admit one's own mistakes

Type of error	Characteristics
Attitude of "I know this"	• Claiming expert knowledge without sufficient experience • Failure to seek information in uncertain situations • Disregard for clinical decision support tools or knowledge from other experts • Refusal to consider other opinions
Premature closure	• Narrowing the choice of potential diagnoses too early in the assessment • Not considering other possibilities because the correct diagnosis is "obvious"
Unconscious use of heuristics	• Failure to create a differential diagnosis because the diagnosis is thought to be "obvious" based on previous experience • Overlooking less-obvious signs or symptoms of other potential diagnoses
Confirmation bias	• Tendency to seek information that confirms what is thought • Insufficient seeking of information that may rule out the diagnosis in question
Complacency	• Justifying diagnostic errors by thoughts that nutrition diagnoses aren't as important as medical or nursing diagnoses • Failing to learn from previous diagnostic errors

Figure 5. Sources of diagnostic error.

RECOMMENDATIONS FOR PRACTICE

RDNs and DTRs must be responsible for evaluating their level of practice through use of the CDG and Standards of Practice and Standards of Professional Performance.[38] Safe, efficient, high-quality patient care requires that the practitioner only practice at their current skill level. Through life-long learning and professional development guidance it is possible to progress to the advanced practice or expert stage in the CDG.

CONCLUSION

This practice paper describes the progression of critical thinking skills in dietetics practice utilizing the CDG Honest evaluation and reflection on current knowledge and skill level ensure that RDNs and DTRs are able to safely

	Medical test/lab data & procedures	Food/nutrition history	Client history	Anthropometric	Nutrition-focused physical exam
Novice	Learn principles and methods: Identify normal values Recall medical terminology	Learn principles and methods: Describe differences in food recall methods	Learn principles and methods: Recognize factors within patient's history that may influence nutritional status	Learn principles and methods: Calculate ideal body weight, body mass index, percent ideal body weight, percent weight change	Learn principles and methods: List physical assessment characteristics associated with changes in nutritional status
Beginner	Collect, organize/ categorize data Compares results to normal values	Utilize 24-hour recall, multiple day food diaries and food frequency questionnaire, as appropriate, to obtain nutrition history Accepts all information provided without question	Collect pertinent client history data Does not probe for additional, relevant information	Calculates and compares results to Ideal weight or BMI, recognizes obvious anthropometric anomalies Difficult to differentiate inconsistencies: stated and measured weight or changes in fluid status	Performs nutrition focused physical examination but cannot identify abnormal findings with certainty
Competent	Evaluate health and disease conditions for nutrition-related consequences, including medical and family history and co-morbidities, medication management and diagnostic test, procedures, evaluations (SOP 1.2, 1.2A,1.2C,1.2E)	Evaluate dietary intake for factors that affect health and conditions including nutrition risk, including adequacy and appropriateness of food, beverage and nutrient intake and current diet prescription (SOP 1.1 & 1.1A and 1.1B)	Evaluate health and disease conditions for nutrition-related consequences, including physical activity, habits and restrictions(SOP 1.2 and 1.2F) Evaluates psychosocial, socioeconomic, functional and behavioral factors related to food access, selection, preparation and understanding of health condition (SOP 1.3) Evaluates client knowledge, readiness to learn and potential behavior change, including previous nutrition care/MNT (SOP 1.4 and 1.4A)	Evaluate health and disease conditions for nutrition-related consequences, including anthropometric measurements findings (SOP 1.2 and 1.2B1)	Evaluate health and disease conditions for nutrition-related consequences, including physical findings (SOP 1.2 and 1.2B)

Figure 6 (Part 1). Progression of registered dietitian critical thinking skills at each level of practice as applied to the Dreyfus model of skill acquisition.
(continued on following page)

Proficient	Evaluate health and disease conditions for nutrition-related consequences Utilizes diagnostic reasoning to determine nutrition diagnosis and prioritize intervention in setting of current disease, co-morbidities and available diagnostic test and procedures data in context with other nutrition assessment findings	Evaluate dietary intake for factors that affect health and conditions Utilizes diagnostic reasoning to identify inconsistencies between food/ nutrition data within context of other nutrition assessment findings; probes for additional information to clarify and prioritize intervention as appropriate	Evaluates nutrition-related consequences of lifestyle Utilizes diagnostic reasoning to recognizes when information provided does not fit within context of other nutrition assessment findings; uses patient cues to determine appropriate questions to obtain pertinent data; prioritize intervention as appropriate	Evaluates weight history in conjunction with health status Utilizes diagnostic reasoning to determine etiology of weight changes; prioritizes intervention as appropriate	Evaluate health and disease conditions for nutrition-related physical findings Utilizes diagnostic reasoning to identify obvious physical signs/symptoms in context of other nutrition assessment findings; prioritizes intervention as appropriate
Advanced Practice/ Expert	Evaluate health and disease conditions for nutrition-related consequences In addition to diagnostic reasoning and prioritizing care, utilizes intuition to infer health and disease conditions for nutrition-related consequences	Evaluate dietary intake for factors that affect health and conditions In addition to diagnostic reasoning and prioritizing care, utilizes intuition to determine relationship between nutrient intake and disease state	Evaluates nutrition related consequences of lifestyle In addition to diagnostic reasoning and prioritizing care, utilizes intuition to reflect upon how the patient's education level, occupation, and current household impact health status	Evaluates weight history in conjunction with health status In addition to diagnostic reasoning and prioritizing care, utilizes intuition to predict future weight changes	Evaluate health and disease conditions for nutrition-related physical findings In addition to diagnostic reasoning and prioritizing care, utilizes intuition to identify physical findings in context of other nutrition assessment findings

Figure 6 (continued). Progression of registered dietitian critical thinking skills at each level of practice as applied to the Dreyfus model of skill acquisition.

and accurately assess nutrition status in all practice settings. When dietetics practice is viewed as a continuum from novice through expert practice, critical thinking skills evolve as RDNs and DTRs gain knowledge and experience with practice. Figures 6 and 7 each summarize the progression of critical thinking skills for the RDN and DTR, respectively, at each level of practice as applied to the Dreyfus model of skill acquisition.[38]

Critical thinking skills are thought to be essential to diagnostic accuracy in all of the health care professions.[39] At this time very little is known about knowledge and skill acquisition of RDNs and DTRs. A PubMed search resulted in no publications focused on the progression of RDNs and DTRs from the novice to expert levels of practice. Yet, knowledge regarding evolution of critical thinking skills of RDNs and DTRs is growing. Additional research is required to further describe progression of critical thinking skills between stages. The NCPM includes critical thinking skills as an intrinsic factor of dietetics practice. The model assumes that RDNs and DTRS at all levels of practice have the same ability to organize and categorize data gathered in the nutrition assessment into a meaningful framework that allows accurate diagnosis of nutrition problems. However, this assumption may not be entirely accurate. As a result it is important to delineate how critical thinking skills evolve in the application of nutrition assessment.

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	Medical test/lab data & procedures	Food/nutrition history	Client history	Anthropometric	Nutrition-focused physical exam
Novice/ Beginner	Learn principles and methods and collect, organize/categorize data Identify normal values Recall medical terminology	Learn principles and methods and utilize 24-hour recall, multiple day food diaries and food frequency questionnaire, as appropriate, to obtain nutrition history	Learn principles and collect pertinent client history data Recognize factors within patient's history that may influence nutritional status	Learn principles and calculates and compares results to Ideal weight or BMI, recognizes obvious anthropometric anomalies	Learn principles and methods and performs nutrition focused physical examination but cannot identify abnormal findings with certainty
Competent	Conducts interviews and/or review records for medical and family history co-morbidites; medication; diagnostic tests and procedures (SOP 1.3A,C,E)	Collects, record and calculate dietary/ nutrient intake data Compares calculated intake to standards that have been identified by the RD, summarizes dietary intake information (SOP 1.2A-E)	Conducts interviews and/or review records for physical activity habits/restrictions, psychosocial, socioeconomic and behavioral factors related to food access, selection, preparation and understanding of health condition (SOP 1.3F-G)	Conducts interviews and/or review records for anthropometric measurements (SOP 1.3B1)	Conducts interviews and/or review records for physical observation (SOP 1.3B)
Proficient	Evaluate health and disease conditions for nutrition-related consequences Utilizes diagnostic reasoning to determine nutrition diagnosis and prioritize intervention in setting of current disease, co-morbidities and available diagnostic test and procedures data in context with other nutrition assessment findings	Evaluate dietary intake for factors that affect health and conditions Utilizes diagnostic reasoning to identify inconsistencies between food/ nutrition data within context of other nutrition assessment findings; probes for additional information to clarify and prioritize intervention as appropriate	Evaluates nutrition related consequences of lifestyle Utilizes diagnostic reasoning to recognizes when information provided does not fit within context of other nutrition assessment findings; uses patient cues to determine appropriate questions to obtain pertinent data; prioritize intervention as appropriate	Evaluates weight history in conjunction with health status Utilizes diagnostic reasoning to determine etiology of weight changes; prioritizes intervention as appropriate	Evaluate health and disease conditions for nutrition-related physical findings Utilizes diagnostic reasoning to identify obvious physical signs/symptoms in context of other nutrition assessment findings; prioritizes intervention as appropriate
Advanced Practice/ Expert	Evaluate health and disease conditions for nutrition-related consequences In addition to diagnostic reasoning and prioritizing care, utilizes intuition to infer health and disease conditions for nutrition-related consequences	Evaluate dietary intake for factors that affect health and conditions In addition to diagnostic reasoning and prioritizing care, utilizes intuition to determine relationship between nutrient intake and disease state	Evaluates nutrition-related consequences of lifestyle In addition to diagnostic reasoning and prioritizing care, utilizes intuition to reflect upon how the patient's education level, occupation, and current household impact health status	Evaluates weight history in conjunction with health status In addition to diagnostic reasoning and prioritizing care, utilizes intuition to predict future weight changes	Evaluate health and disease conditions for nutrition-related physical findings In addition to diagnostic reasoning and prioritizing care, utilizes intuition to identify physical findings in context of other nutrition assessment findings

Figure 7. Progression of dietetic technician, registered critical thinking skills at each level of practice as applied to the Dreyfus model of skill acquisition.

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