

Challenges and opportunities for nutrition education and training in the health care professions: intraprofessional and interprofessional call to action^{1–4}

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ABSTRACT

Understanding and applying nutrition knowledge and skills to all aspects of health care are extremely important, and all health care professions need basic training to effectively assess dietary intake and provide appropriate guidance, counseling, and treatment to their patients. With obesity rates at an all-time high and the increasing prevalence of diabetes projected to cost the Federal government billions of dollars, the need for interprofessional nutrition education is paramount. Physicians, physician assistants, nurses, nurse practitioners, pharmacists, dentists, dental hygienists, occupational therapists, physical therapists, speech and language pathologists, and others can positively affect patient care by synchronizing and reinforcing the importance of nutrition across all specialty areas. Although nutrition is a critical component of acute and chronic disease management, as well as health and wellness across the health care professions, each profession must reevaluate its individual nutrition-related professional competencies before the establishment of meaningful interprofessional collaborative nutrition competencies. This article discusses gaps in nutrition education and training within individual health professions (ie, nursing, pharmacy, dentistry, and dietetics) and offers suggestions for educators, clinicians, researchers, and key stakeholders on how to build further capacity within the individual professions for basic and applied nutrition education. This “gaps methodology” can be applied to all health professions, including physician assistants, physical therapists, speech and language pathologists, and occupational therapists. *Am J Clin Nutr* 2014;99(suppl):1184S–93S.

INTRODUCTION

Nutrition, defined as the process by which one takes in and utilizes nutrients (1), plays a pivotal role in all aspects of health care including growth and development, health promotion and disease prevention, and acute and chronic disease management. Nutrition is important to the practice of all health care professionals. A working group meeting on “Future Directions for Implementing Nutrition across the Continuum of Medical Education, Training, and Research” was convened by the National Heart, Lung, and Blood Institute, Division of Cardiovascular Sciences, and cosponsored by the NIH Office of Disease Prevention, Division of Nutrition Research Coordination (2). The purpose of the meeting was to recommend strategies for implementing nutrition education, research, and training across the continuum of the medical and health care professions (2). An

important outcome of the working group was to disseminate these multidisciplinary deliberations to engage leaders, educators, clinicians, researchers, and key stakeholders to continue the dialogue and implement nutrition across the continuum of medical and health care profession education, training, and research. This article introduces the concept of synchronized interprofessional nutrition competencies and complements the discussions on research priorities in nutrition education (3), nutrition priorities for medical education (4), and medical training (5).

The evolution of health care strategies since the 1972 Institute of Medicine (IOM)⁵ report “Future Directions for the National Health Care Quality and Disparities” has shown some progress, but education regarding health care practice per se has not yet motivated overall health care change (6). Subsequent meetings of the IOM have concluded that, although isolated approaches to the interprofessional training of health care professionals exists, it has yet to become the national norm in our postsecondary institutions and professional training programs (7, 8). A key question that is relevant for all institutions considering such reforms is “What is the definition of being interprofessional?”

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⁵ Abbreviations used: ADA, American Dental Association; ADEA, American Dental Education Association; AND, Academy of Nutrition and Dietetics; BHP, Bureau of Health Professions; CDR, Commission on Dietetic Registration; HRSA, Health Resources Services Administration; IOM, Institute of Medicine; JCIPE, Jefferson’s Center for Interprofessional Education; MCH, Maternal and Child Health; OT, occupational therapist; PA, physician assistant; PGY, postgraduate year; PN, parenteral nutrition; PT, physical therapist; RD, registered dietitian; RN, registered nurse; SLP, speech and language pathologist.

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As elaborated by D’Amour and Oandasan (9) the concept of “interprofessionalality” is defined as follows: “The process by which professionals reflect on and develop ways of practicing that provides an integrated and cohesive answer to the needs of the client, family, and populations. Interprofessionality requires a paradigm shift, since interprofessional practice has unique characteristics in terms of values, codes of conduct, and ways of working.”

To develop an interprofessional approach to implementing nutrition into the health care team, 3 areas of professional competencies need to be addressed (10). Individual professional competencies remain the distinct domain of each profession, including dentistry, medicine, nursing, nutrition and dietetics, occupational therapy, pharmacy, physician assistant (PA), physical therapy, and speech and language therapy. This article first addresses the competencies relevant to several of these health care professions. Subsequently, competencies in common among these professions and interprofessional collaborative competencies are presented (11) (Table 1).

INTRAPROFESSIONAL NUTRITION EDUCATION AND TRAINING

Nursing

Nutrition and scope of practice within nursing

Nursing is the largest health care occupation in the United States (12), with >3 million registered nurses (RNs) (13). Nurses provide holistic care (physical, social, mental, and spiritual needs) to individuals, families, communities, and populations across the care continuum (14). The scope of nursing practice

includes not only curative and palliative care but also health promotion, disease prevention, and coordination of care (14). Nurses are diagnosticians and formulate “clinical judgments about individual, family, or community experiences/responses to actual or potential health problems” (15). Nursing diagnoses then “provide the basis for selection of nursing interventions to achieve outcomes for which the nurse has accountability” (15). Nutrition is 1 of 13 domains in nursing practice and is defined as “the activities of taking in, assimilating, and using nutrients for the purposes of tissue maintenance, tissue repair, and the production of energy” (15). Approved nursing diagnoses for nutrition focus on imbalances or impaired abilities related to ingestion, metabolism, and hydration (including fluid and electrolytes).

Present state of nutrition education for nurses

Nutrition has been a component of nursing care since Nightingale (16), the founder of modern nursing, noted nutrition (ie, “taking food”) as the second most important area for nursing. Nurses were initially responsible for preparing and serving food to the sick until the discipline of dietetics was founded (17). As role differentiation between nurses and dietitians continued during the period of 1950–1970 (17), the required hours of specific nutrition coursework in nursing curriculum shifted to an “integrated” approach (17). Even though the mandatory required educational hours in basic nutrition and diet therapy for RN licensure was eliminated (17), nutrition was and continues to be testable content on the RN licensure examination. Today, the National Council Licensure Examination for Registered Nurses (NCLEX-RN) includes nutrition topics such as nutrition assessment and monitoring, diet therapy, and enteral and

TABLE 1
Operational definitions of interprofessional concepts¹

Interprofessional education	When students of ≥2 professions learn about, from, and with each other to enable effective collaboration and improve health care
Interprofessional collaborative practice	When multiple health care workers from different professional backgrounds work together with patients, families, caregivers, and communities to deliver the highest quality of care
Interprofessional teamwork	The levels of cooperation, coordination, and collaboration characterizing the relations between professions in delivering patient-centered care
Interprofessional team-based care	Care delivered by intentionally created, usually relatively small work groups in health care, who are recognized by others as well as by themselves as having a collective identity and shared responsibility for a patient or group of patients
Professional competencies in health care	Integrated enactment of knowledge, skills, and values/ attitudes that define the domains of work of a particular health care profession applied in specific care contexts
Interprofessional competencies in health care	Integrated enactment of knowledge, skills, and values/ attitudes that define working across the professions, with other health care workers, and with patients, along with families and communities, as appropriate, to improve health outcomes in specific care contexts
Interprofessional competency domain	A generally defined cluster of more specific interprofessional competencies that are conceptually linked and serve as theoretical constructs

¹ Adapted from reference 8.

parenteral nutrition (18). Because nutrition is testable content on the NCLEX, the assumption is that nutrition (basic and applied) is included in nursing education programs, even though formal nutrition competencies are not explicated in *The Essentials of Baccalaureate Education for Professional Nursing Practice* (19). Similarly, nutrition courses are not required at the graduate level as noted in *The Essentials of Master's Education in Nursing* (20) or the *Advanced Practice Registered Nurses Consensus Model* (21), but nutrition as a focal area of practice is included in the core competencies (3).

Didactic approaches for incorporating nutrition content into nursing education include stand-alone nutrition courses, an integrated approach where nutrition is woven throughout nursing courses, and a combination of these 2 (hybrid model). Nutrition content is included in many prelicensure nursing textbooks [eg, fundamentals of practice (22), clinical skills (23), adult health (24), and gerontology (25)]. Furthermore, there are numerous nutrition textbooks written for RNs (eg, a 2013 amazon.com search on “Nutrition Books for Nurses” resulted in 294 nutrition books written for nurses) as well as advanced-practice nurses (26, 27). Clinical approaches include nutrition-focused learning during clinical rotations in the laboratory setting and with simulation. Information on nutrition education in US schools of nursing is now outdated. Stotts et al (28) surveyed US nursing school faculty and course directors in 1987. All 264 Bachelor of Science in Nursing programs that responded included nutrition content (integrated or hybrid), and 54% required at least one stand-alone nutrition course that included, on average, 32 ± 21.5 h of nutrition content (28). Almost all programs taught nutrition assessment, and most taught enteral and parenteral nutrition therapy and diet counseling (28). Only 70% of the programs taught nutritional biochemistry. The majority (70%) of the programs did not include a clinical nutrition learning experience (28). Nurses (57.5%) and dietitians (67%) were primarily responsible for teaching nutrition courses, although a small percentage reported that physicians or pharmacists taught the course (28). An alarming finding is that only 50% of the graduate program faculty who responded felt that the nutrition content was adequate (28). Programs that included nutrition focused on dietary assessment and counseling, enteral and parenteral therapy, evaluation of treatment, and differentiation of roles of the health care team (28). Again, nutritional biochemistry was rarely taught (28).

Nutrition and the future of nursing: a call to action and building capacity

Nutrition must be integrated throughout a nurse's professional career, including how and when to interact with registered dietitians (RDs) and other nutrition professionals. The IOM's *Future of Nursing* calls on the nursing profession to “adopt a framework of continuous lifelong learning that includes basic education, residency programs, and continuing competence” (14). Nutrition competencies should be incorporated into nurse residency programs, as well as annual continuing education. Although nutrition certifications exclusively for nurses do not currently exist, nurses should be encouraged to obtain interdisciplinary certification in nutrition support, diabetes education, or lipid management. Nursing leaders need to consider how nutrition is incorporated into the evolving “milestones for

mandated skills, competencies and professional development” (14). At present, 62.2% of nurses work in hospital settings (13); however, with the transformation of health care and the aging population, the demand for nurses working in outpatient, ambulatory settings will increase (14), and so should the approach to incorporating nutrition in these settings.

The critical question moving forward is to what extent, if any, are current nutrition education models preparing nurses to apply nutrition principles in new, transformative, and expanded roles such as care coordinators and health coaches? An informal survey of nurse practitioners conducted by a publishing company in 2011 indicated that nutrition was their number one topic of interest, and they requested that additional content be developed to help them achieve the skills they needed in everyday clinical settings.

Addressing the adequacy of nutrition education needs to be a multipronged effort. A contemporary survey of nutrition education at all levels of nursing education is warranted. As the IOM notes, “nursing schools are grappling with the explosion of research and knowledge to provide health care in complex systems by adding layers of content that requires more instruction—there needs to be a fundamental thinking of this approach” (14). Adding courses without identification of core nutrition competencies for nurses at all levels (including nursing faculty) is a “Band-Aid” approach. If nurses receive a formal course in nutrition, it is often at the undergraduate level (28). Recommendations on how to integrate nutrition content across various courses at the graduate level could be highly effective. The key is to identify advanced nutrition competencies that could potentially be threaded into the Direct Care Core 3 P's (advanced physiology/pathophysiology, advanced health assessment, and advanced pharmacology), as well as disease management (acute and chronic) and health prevention courses and clinical learning activities (20).

Now is the time to revisit the crucial role nurses play in promoting nutritional health and well-being across the life span. Recommendations from The Bipartisan Policy Center's 2012 report entitled “Lots to Lose: How America's Health and Obesity Crisis Threatens Our Economic Future” that are germane to nursing include the following: 1) better training of health care professionals to provide care that addresses the issues of diet, physical activity, wellness, and disease prevention; 2) the infusion of nutrition and physical activity information and behavioral methodologies in the education, training, and continuing education of all health care professionals; and 3) training and credentialing of nurses as health coaches to deliver preventive services to those at high risk of developing chronic conditions (29). Thought leaders and experts in nursing, along with key stakeholders from the American Association of Colleges of Nursing, the National League for Nursing, the National Council of State Board of Nursing, the American Nurses Credentialing Center, and relevant nursing specialty organizations, need to work together to build such nutrition capacity for nursing. Nursing as a discipline has successfully mobilized interdisciplinary resources in response to calls to action in genetics (30), end of life (31), and geriatrics (32, 33). Approaches to building nutrition capacity for nursing can be modeled after these. For example, the Hartford Geriatric Nursing Initiative is one of the most extensive movements in nursing and is an exemplar of not only building capacity but sustaining capacity. Key components of the Hartford Geriatric Nursing Initiative

model include identification of need, early and sustained buy-in from key stakeholders, primary and secondary sources of funding, identification of key competencies for prelicensure, undergraduate and graduate nursing, coordinated approach to building capacity, quality education and practice resources, and preparation of the next generation of leaders, educators, and researchers in gerontologic nursing (34–36).

Pharmacy

Nutrition and scope of practice within pharmacy

Nationally, there are 281,560 pharmacists whose primary purpose is to dispense medications to patients and to offer advice on their safe use (37). Pharmacists practice in pharmacy and drug stores, hospitals, extended-care facilities/nursing homes, and home care and home infusion. They have managerial, clinical, including both general and specialty, distributional, dispensing, and research roles. The future vision of the Joint Commission of Pharmacy Practitioners describes pharmacists as health care professionals responsible for providing patient care that ensures optimal medication therapy outcomes (38). Before parenteral nutrition (PN), pharmacist practice in nutrition was in the sale of vitamins and as a resource for drug-nutrient interactions. Although these continue, the development of PN created the role of pharmacists in nutrition. Specific knowledge of pharmaceutical sciences related to solution stability, compatibility, and sterile preparation was essential to translating the science of intravenous nutrition to clinical practice (39). Safety and efficacy issues with PN required specialized knowledge for optimal provision. This initial need to include pharmacists in PN development and inclusion in patient care evolved into interdisciplinary direct patient care practices that include nutrition assessment, care planning, initiation of therapy, monitoring, management of nutrition services, and advancement of nutrition care as defined by American Society for Parenteral and Enteral Nutrition nutrition support pharmacist standards of practice (40). This is the primary nutrition practice of pharmacists. As noted in a recent survey, ~50% of health care system pharmacies provide nutrition consultation services (41). Other reports suggest that pharmacists play a nutrition role in disease management (diabetes and cardiovascular disease) (42), obesity (43), and anorexia-cachexia (44). An expanded role of consultant pharmacists in nutrition management based on changes in Centers for Medicare and Medicaid Services' focus on nutrition has been described by Martin (45).

Present state of nutrition education for pharmacists

Education in pharmacy school after admission is 4 y, with each year depicted as P1, P2, P3, and P4, and includes both didactic and experiential components (46). There is further training via postgraduate residencies [postgraduate year (PGY)-1 and PGY-2] for more specific direct patient care and advanced operations of pharmacies accredited by the American Society of Health-System Pharmacists (47, 48). Didactic curricula for pharmacy schools have been described (38). Nutrition components of the curricula include the following:

- Nutrition, essential nutrients: tier 1A
- Nutrition assessment: tier 1B
- PN: tier 1B

- Enteral nutrition: tier II
- Formula intolerance: tier II

Tier I components must be covered by all institutions of higher education; in tier 1A the graduate should receive extensive instruction and be proficient in providing care, and in tier 1B the graduate should be exposed to the disease state. Tier II should be covered in pharmacy school. Unfortunately, opinions of faculty and practitioners express the reality that this only occurs if there is faculty available to instruct pharmacy students.

Nutrition and pharmacy: a call to action and building capacity

Although there is no specific mention of nutrition functions in PGY-1 (47) or PGY-2 (48) residency training, there are 3 specialty residencies available for nutrition, of which only 2 were filled in 2012 (49). A noted concern is that pharmacy leaders feel that PN is a less commonly used therapy and so there is less interest and fewer resources allocated to this area of study. There is, however, the ability to become board-certified in nutrition support therapy; the Board of Pharmaceutical Specialties now has 523 board-certified pharmacists in nutrition support (designated as BCNSP) (50), and the National Board of Nutrition Support Certification has recently offered their examination to pharmacists (based on a professional practice audit that found interdisciplinary roles in nutrition were similar) (51). The Board of Pharmaceutical Specialties examination is based on several domains such as develop and implement a therapeutic plan of care, management of nutrition support operations, patient care management, compounding operations, and advancement of nutrition support practices (50).

Nutrition practice in pharmacy is very specific to the advanced practices involved with enteral nutrition and PN in which a pharmacist's unique knowledge and practice are clearly delineated. This overshadows the potential and necessary role pharmacists may have in health and promotion and disease management. As a health care provider, pharmacists must play a role in nutrition care. Approximately 250 million Americans walk into a pharmacy weekly (37), so pharmacists have extraordinary access to the public and to provide nutrition education. As more diseases become redefined with broader definitions, such as prehypertension and prediabetes, pharmacists are left on the sidelines as others attempt to influence behavior, nutrition, and physical activity to improve the health of our nation and to hopefully avoid the development of disease. The Joint Commission of Pharmacy Practitioners' vision assigns this responsibility to pharmacists: "promotion of wellness, health improvement, and disease prevention" (52). At present, the practice is specific and at an advanced level whereby the need is elsewhere and the preparation of pharmacists is inconsistent. There is a need to address nutrition in practice (53), including how and when to interact with RDs and other certified nutrition professionals, and in pharmacy curricula to successfully meet the need of patients for disease prevention and chronic and acute management.

Dentistry and dental hygiene

Nutrition and scope of practice in dentistry and dental hygiene

Nutrition is recognized as an important component of oral care. The major oral problems (dental caries, periodontal disease,

and oral infections) all have nutritional/dietary implications. The oral cavity is the pathway for nutrition, so any problems in the oral cavity (missing teeth, pain, infections, etc) can affect desire and ability to eat and can affect subsequent nutritional status. Conversely, dietary and nutritional factors can play major roles in initiation and/or extension of oral disease or promotion of oral health. Dietary and nutritional factors can influence the oral flora, the salivary flow rate, oral structure development, and tooth mineralization, remineralization, and maturation. Dietary patterns of carbohydrate intake are directly related to dental caries risk. Undernutrition can lower resistance to oral infections. Dietary supplement excesses can have temporary or permanent effects on oral hard and soft tissue.

A variety of dental professional organizations, including the American Dental Association (ADA) (54), the American Dental Hygienists Association (55), the Academy of Nutrition and Dietetics (AND) (56), and the American Academy of Pediatric Dentistry (57), publish nutrition guidelines for dental practice. Although there is wide recognition of the importance of nutrition in dental practice, a major disconnect exists between the acknowledgment of the importance of nutrition and the implementation of clinical strategies to diagnose nutritional issues and provide meaningful interventions in clinical practice. When surveyed, practitioners acknowledge the importance of nutrition for patient care, but admit that they feel inadequately trained, and thus uncomfortable, providing nutrition interventions (58). Rarely are RDs readily available as resources to dental teams, so team members are usually on their own in this regard.

For this reason, efforts have been made starting in the 1960s to develop model programs to train dentists, dental students, and dental hygiene students in applied nutrition strategies for clinical practice (59, 60). There are many challenges to accomplishing this goal. Most important, if the faculty member assigned to teaching nutrition in a dental school does not have applied clinical nutrition expertise, the clinical applications will not be taught (and more importantly, modeled), so nutrition will not be seen by students as applicable to patient care (60). Often, a basic science faculty member, such as a biochemist, is assigned to teach nutrition. In such cases, unless the professor joins with a clinician to teach clinical implication strategies, the essential link from science to practice is lost. Other issues such as lack of curriculum time, conflicting values of decision makers, etc, are similar to other disciplines. For these reasons, nutrition educators in dental and dental hygiene education have been striving to improve the nutrition education of dental and dental hygiene students that will meet the needs of contemporary clinical practice.

Present state of nutrition education for dental and dental hygiene students

Although the dentist is the primary dental care provider and sets the standards for the practice, he or she may not be the principal dental nutrition care provider. That role is usually assigned to the dental hygienist as a component of preventive care (or disease prevention and health promotion). Dental hygienists are considered allied health care professionals and work closely with dentists or independently (as determined by the scope of practice at the state level).

The Commission on Dental Accreditation of the ADA is the accrediting body for dental schools and dental hygiene schools

(61). The American Dental Education Association (ADEA) (62), the professional association for dental education, works closely with the ADA in policy development. Although there is no accreditation requirement for nutrition education per se for dental students, it is implied by requiring competency "in the application of biomedical science knowledge in the delivery of patient care" and competency in "health promotion and disease prevention" (63). The ADEA does emphasize nutrition specifically in its "Foundation Knowledge and Skills for the New Dentist," which lists, under Health Promotion, "the ability to provide intervention, motivation, and nutrition as essential health promotion/disease prevention strategies" (63).

Dental hygiene accreditation standards for dental hygiene education specifically state nutrition as a biomedical science requirement (ie, ADEA Hygiene 2-10 Biomedical Science content must include content in anatomy, physiology, chemistry, biochemistry, microbiology, immunology, general pathology and/or pathophysiology, nutrition, and pharmacology), but there is no stated competency in applied nutrition. The spectrum of nutrition education in dentistry focuses on nutrition as foundation knowledge, applied nutrition basics, and the translation to patient care.

The number of hours devoted to nutrition has remained fairly consistent and is low compared with other curriculum areas (61). A 2001 survey of US and Canadian dental schools found that only 41% of schools reported that students provided diet counseling for patients, and only 28% of schools had an RD on the faculty to provide clinical nutrition education (64). Another study found that although dentists were motivated to include nutrition in their clinical care, most felt unqualified to provide dietary guidance and thus shied away from doing so (65). A survey conducted by the ADEA in 2011 (66) found that of 24 US dental schools reporting, there was an average of 15.9 h of didactic nutrition taught with a range of 7–40 h, and no clinical hours reported. In contrast, dental hygiene programs not only included didactic nutrition content (on average, 32.7 h) but also an average of 4.9 h of laboratory and 9.3 clinical hours for a total of 46.9 h. This likely reflects the acknowledged role of the dental hygienist as the clinical prevention educator. All of the dental schools surveyed reported teaching nutrition in their curricula. The majority of faculty were biochemists and those from "nutrition-related disciplines," followed by RDs and those with graduate coursework in applied nutrition. Some dentists were also teaching nutrition. In most cases, nutrition was taught as part of the biochemistry course or as part of a preclinical course. Some schools did have stand-alone nutrition courses, and the fewest number included nutrition as part of a clinical course. Less than half of respondents reported changes in their nutrition programs resulting from curriculum changes, but those who did reported nutrition being redistributed through other courses rather than being stand-alone courses. This may reflect the move to systems-based curricula currently influencing current curricular changes.

Nutrition teaching in dental and dental hygiene schools has always had to fight to maintain a baseline presence and has never achieved optimal integration. Many barriers conspire to undermine efforts to develop better nutrition curricula in dental education. Traditionally, people trained in applied nutrition are not employed in dental schools. If they are, it is often on a part-time or ad hoc basis, which does not allow time for developing the

crucial allegiances needed to move visions forward. Thus, the science of nutrition is more likely to be taught by scientists already teaching subjects other than the clinical applications and models. Consequently, the broad spread of hours for nutrition in dental curricula likely reflects the varied levels of commitment to nutrition of the people making the programming and scheduling decisions rather than purposeful programmatic planning. This is further undermined by the lack of a consensus core curriculum that can serve as a benchmark. The dearth of evidence-based research on the efficacy of clinical nutrition interventions in practice is also a barrier to the implementation of nutrition strategies.

Nutrition and dentistry: a call to action and building capacity

Despite the limitations of past efforts to improve nutrition curricula in dental education, many models for applied nutrition do exist (61, 67) and several current trends may support forward movement in this area. There has been a burst of interest and activity in the area of interprofessional education. Strategic planning initiatives for dentistry (as well as for all other health care professionals) have pinpointed the need for competency in working successfully with other health care professions as a major curricular requirement for the dentist of the future. Developing alliances between RDs, other clinical nutrition professionals, and dentists around patient care is a natural opportunity in this area. Dentists have also allied with other health care professionals around areas of mutual concern and interest such as childhood obesity and type 2 diabetes. Such collaborations can foster increased interest in nutrition as it relates to these pressing issues as well. Contemporary technology has also provided an opportunity for developing resource for nutrition/dental collaborations. For example, MedEdPortal (<https://www.mededportal.org/>) is a valuable resource for medical and dental educational models and could provide dental nutrition models as well.

What we need going forward

Better synergy between dentistry, dental hygiene, and nutrition will be best served by focusing on the following several areas of current weakness:

- Research on clinical outcomes. More research is needed on the value of nutrition interventions in clinical dental practice.
- Curricular guidelines to assist in curriculum design. The movement in dentistry has been away from subject-specific curricular guidelines [although they did exist in the past (68)]. However, this has left a void for those attempting to develop or improve nutrition curricula. Thus, new curriculum guidelines or consensus statements for nutrition in dental education need to be developed and promulgated by professional associations to assist in curriculum design and implementation.
- Better dissemination of effective models. Good models of nutrition/dental curricula need to be made more readily available via MedEdPortal and other professional venues.
- Consensus on highest impact messages to impart to the public and dental patients (69).
- More accessible training in clinical applications. Avenues need to be developed to train the workforce that will be teaching nutrition in dental and dental hygiene schools in areas they may be lacking. This may mean educating dentists and/or dental hygienists in applied nutrition, teaching basic scientists

applied nutrition in dentistry, teaching nutritionists about nutrition in dentistry, or some combination of these. Only when we have educators who can make nutrition relevant to dentistry, will we move forward.

NUTRITION AND DIETETICS

Nutrition and scope of practice within dietetics

An RD or a registered dietitian nutritionist is a food and nutrition expert who has met the minimum academic and professional requirements to qualify for the credential "RD" by the AND (70). As of 2013, there were ~86,967 RDs in the United States and the majority work in the treatment and prevention of disease in hospitals, health maintenance organizations, private practice, or other health care facilities (70). In addition, a large number of RDs continue to work in community and public health settings and academia and research. A growing number of RDs work in the food and nutrition industry, in business, journalism, sports nutrition, and corporate wellness programs (70).

Undergraduate programs specific to dietetics always encompass education and training related to the science and application of nutrition. Achievement of an undergraduate degree, usually a Bachelor of Science degree in nutrition and dietetics, followed by a certified dietetic internship, entitles an individual to take a registration examination to become an RD.

According to the AND, an RD must fulfill the following minimum requirements:

- Earning a bachelor's degree with coursework approved by AND's Commission on Accreditation for Dietetics Education. Coursework typically includes food and nutrition sciences, foodservice systems management, business, economics, computer science, sociology, biochemistry, physiology, microbiology, and chemistry.
- Completing an accredited, supervised practice program at a health care facility, community agency, or foodservice corporation.
- Passing a national examination administered by the Commission on Dietetic Registration (CDR).
- Completing continuing professional educational requirements to maintain registration.
- Students must complete a 1200-h internship to sit for the RD examination.

Although all RDs are nutritionists, the reverse is not necessarily true. Graduate programs in nutrition leading to the master's- or doctoral-level degree represent advanced knowledge and understanding of nutrition and may accompany an RD credential as well as other clinical or health care professional degrees, including the medical doctor (MD), RN, or other clinical specialties. Thus, depending on the course or curriculum being taught, any number of professionals trained in nutrition and/or dietetics may be involved in medical nutrition education and in educating other health care specialties, but the training of RDs is specialized, in-depth nutrition science, research, and education, which distinguishes it from other disciplines.

Present state of nutrition and dietetics

Teaching programs in nutrition and dietetics were initially offered in the Department of Home Economics within the School

of Agriculture in many universities as early as 1904. Departments of Foods and Nutrition, Biochemistry, and Nutritional Sciences were created, and faculty with expertise in nutrition science, food and dietetics, food science, and foodservice management were hired. In keeping with the natural direction in dietetics education, a formal Didactic Dietetics Program (called “plan IV”), recognized by the AND, was instituted in 1974 (www.eatright.org). A Coordinated Program, incorporating the supervised practice component of dietetics education, was instituted in 1976 with 2 major options: General Dietetics and Food Service Administration. With the Coordinated Program came annual review and evaluation by the AND, not only of the clinical components but also of the didactic components of the dietetics education programs. At the present time, ~50% of RDs hold advanced degrees. Some RDs also hold additional certifications in specialized areas of practice, such as pediatric or renal nutrition, nutrition support, and diabetes education.

In 1969, the AND developed a voluntary system of credentialing to help ensure the competency of dietetics professionals through a standardized, quality-controlled process administered by the CDR (71).

The purpose of CDR is to serve the public by establishing and enforcing standards for certification and by issuing credentials to individuals who meet these standards. The CDR has sole and independent authority in all matters pertaining to certification including, but not limited to, standard setting, establishment of fees, finances, and administration. The CDR offers certification as dietetic technicians, RDs, and board-certified specialists in pediatric nutrition, renal nutrition, gerontologic nutrition, and sports dietetics (71).

The registration examination assesses only a cross-section of the knowledge and skills needed for entry-level competence, including principles of dietetics, nutrition care for individuals and groups, and management of nutrition programs and services and foodservice systems. Included within the principles of dietetics are a wide range of nutrition topics including food science, human physiology, biochemistry, and more recently, behavioral applications. The American Dietetic Association became the AND in 2012, and these and other evidence-based components remain integral to the fundamental training of RDs. The new name complements the focus of the organization to improve the nutritional well-being of the public while communicating the academic expertise of Academy members and supporting the organization’s history as a food- and science-based profession.

Nutrition Care Process

In 2003, the American Dietetic Association adopted the Nutrition Care Process and model in the interest of achieving the high-quality nutrition care needed to help achieve the “desired health services consistent with current professional knowledge,” as specified by the IOM (72, 73). The Nutrition Care Process is a standardized process rather than standardized care because it emphasizes the relation between the patient, client, or group and the dietetics professional by using state-of-science, evidence-based dietetics practice to meet individualized needs (74). The Nutrition Care Process defines common language, terms, key components, critical thinking characteristics, documentation elements, and other considerations related to standards of nu-

trition care. Essentials of the Nutrition Care Process include the following:

- Step 1: nutrition assessment to determine nutrient adequacy, health function, and behavioral status
- Step 2: nutrition diagnosis to determine the etiology, cause, and contributing risk factors
- Step 3: nutrition intervention to implement the evidence-based action or medical nutrition therapy appropriate to the condition
- Step 4: nutrition monitoring and evaluation to review and measure ongoing progress related to the established goals of intervention

NUTRITION AND OTHER HEALTH CARE PROFESSIONS

Nutrition is also an important component of education, training, practice, and research for PAs, physical therapists (PTs), occupational therapists (OTs), and speech and language pathologists (SLPs). These graduates are ideally positioned to serve as health coaches promoting lifestyle modifications, especially during the rehabilitative continuum. As nursing, pharmacy, and dentistry search inward for nutrition competencies within their professions and placement of nutrition in the curriculum, so must PAs, PTs, OTs, and SLPs and embrace a similar call to action. Advancing nutrition in these disciplines is best accomplished by identifying resources, champions, expert leaders, and key stakeholders (professional associations, regulatory bodies, and specialty societies) to mobilize efforts for health promotion and disease prevention. It is only through this inward reflection can we move toward interprofessional competencies.

THE INTERPROFESSIONAL NATURE OF NUTRITION

It is noteworthy that, in addition to dentistry, the American Association of Colleges of Nursing, The Association of American Medical Colleges, The American Association of Colleges of Pharmacy, and the Association of Schools of Public Health all provide language to support the collaborative and interprofessional development of nutritional approaches to address health care needs (8). Thus, the challenge at hand remains not in the support of the constituent societies but more so in the lack of institutional implementation of interprofessionalism into the educational environment. A part of this difficulty lies within the challenge of defining and fully understanding “What is interprofessionalism?” Understanding the concept of “collaborative competencies” aids greatly in making the transition toward full implementation of interprofessional educational initiatives. Interprofessional collaborative competencies help to more clearly delineate how interprofessional strategies differ from those of individual constituent societies and traditional scientific organizations. These competencies are the domain of those practices or organizations of societies that seek to define “interprofessionalism.” These concepts focus most importantly on the teamwork required to accomplish a patient-centered approach and toward developing the nature of the relation between the team members and the competency development for interprofessional collaborative practice. Within this third domain of “interprofessionalism” there are operative definitions essential to understanding how interprofessional approaches differ from the typically discipline-specific concepts that constitute the

historic practices of professional societies. These include interprofessional domains of education, collaborative practice, teamwork, team-based care, competencies in health care, and competency-based domains (Table 1). Note that these definitions center more on how care is delivered and less on the traditional professional alignment of what care is delivered. These definitions are centered on deliberate practice models and focus on how care is delivered. By doing so, the interprofessional approach to the health sciences honors and respects individual professional competencies, it builds on common competencies, and seeks to establish interprofessional collaborative competencies for the benefit of the patients and communities we serve. With proper discovery, planning, coordination, and implementation, nutrition and dietetics can become uniquely poised to address today's health care needs with our professional allies, through innovative and collaborative development of interprofessional deliberate-practice nutrition approaches.

Interprofessional models of nutrition in action

Increasingly, innovative approaches to interprofessional models of education, training, and practice are being implemented and evaluated (75). Examples of current interprofessional models of nutrition in action include programs supported by the Health Resources Services Administration (HRSA), formal and informal interprofessional education initiatives in the university settings, and models to address adult hospital malnutrition.

HRSA programs

The HRSA is a division of the Department of Health and Human Services, and its mission is to improve health and to achieve health equity through access to quality services, a skilled health workforce, and innovative programs. The HRSA supports the training of the health care workforce with a focus on interprofessional training for team-based care. The Bureau of Health Professions (BHP) programs train health care professionals and place them where they are needed most. Grants support scholarship and loan repayment programs at colleges and universities to meet critical workforce shortages and to promote diversity within the health care professions. BHP programs tackle a range of current health care workforce challenges. There are numerous reports of shortages of primary care physicians, nurses, and public health and allied health care professionals. The Health Professions Training programs make grants to health professions schools and training programs, which use the funds to develop, expand, and enhance their efforts to train the health care workforce America needs. At this time, nutrition has a limited focus for the BHP.

The Maternal and Child Health (MCH) Bureau's Division of MCH Workforce Development provides national leadership and direction in educating and training the nation's future leaders in maternal and child health. Special emphasis is placed on the development and implementation of interprofessional, family-centered, community-based, and culturally competent systems of care across the entire life course with experiences in one life stage shaping health in later stages.

There is an emphasis on leadership education and promoting interdisciplinary training, practice, and interorganizational collaboration to enhance systems of care for MCH populations. The graduate and postgraduate education programs train several

disciplines in interdisciplinary settings: for example, medicine, nursing, psychology, nutrition, dentists, and social work. Some of the interdisciplinary programs are Leadership Education in Adolescent Health, Leadership Education in Neurodevelopmental and Related Disabilities, Pediatric Pulmonary Centers, Schools of Public Health, and Public Health Nutrition graduate education. This training is especially important for the MCH populations—prenatal, neonatal, high-risk infants, pediatrics, children with special health care needs and/or developmental disabilities, adolescence, and families—as it relates to the prevention of chronic diseases in a life course perspective.

Jefferson's Center for Interprofessional Education

Jefferson's Center for Interprofessional Education (JCIPE) was founded in 2007 at the Thomas Jefferson University in Philadelphia. JCIPE is dedicated to improving interprofessional care by implementing and evaluating patient-centered education throughout the Thomas Jefferson University curriculum (76). JCIPE aims to define the future of interprofessional care by creating a culture of collaborative educational practice and setting the standards for patient-centered care and team-based training. The JCIPE Health Mentors Program offers students from Jefferson Medical College and the Schools of Nursing, Pharmacy, and Health Professions (occupational, physical, and couples' and family therapy) to learn first-hand from a patient about things that really matter to patients living with health conditions and/or impairments. Students work in teams to meet with their health mentor and are required to create wellness plans and safety assessments and to develop behavior change strategies over a 2-y period, considering the patients chronic medical conditions. Teams present during small group sessions to 2 faculty members who facilitate discussion and provide feedback. This program is an excellent example of how nutrition can be formally and informally woven into interprofessional education by using health mentor sessions, cases, lectures, as well as during small group sessions. However, if a school does not have a formal nutrition and dietetics program in place, nutrition students may not be part of the interprofessional education process. Therefore, it is very important that clinical dietitians are invited to the table for interprofessional education curriculum development and preceptor opportunities.

Drexel's interprofessional nutrition research initiatives

Interprofessional research initiatives related to nutrition topics are another way to model the transdisciplinary approach to nutrition. Health and wellness is the overarching research theme at Drexel University's College of Nursing and Health Professions. Researchers and students in nursing, nutrition, rehabilitation sciences, creative arts therapy, and couples' and family therapy collaborate on several research projects that have a nutrition component. For example, one of the authors (RAD-G) is a site investigator for the annual Nutrition Day screening program at Hahnemann University Hospital. Nursing, nutrition, creative arts therapy and pre-med students work as a team with faculty and clinical mentors to collect and analyze the data on a yearly basis. Students learn valuable lessons in hospital-based nutrition screening.

Alliance to Advance Patient Nutrition

The Alliance to Advance Patient Nutrition, an interdisciplinary group of professional organizations (Academy of Medical-Surgical Nurses, AND, American Society for Parenteral and Enteral Nutrition, and Society of Hospital Medicine) and industry (Abbott Nutrition), was recently created to address adult hospital malnutrition. In their interdisciplinary call to action paper, the Alliance presents a novel care model to address hospital malnutrition based on 6 principles that can be used by all members of the health care team (77).

CONCLUSIONS

Understanding and applying nutrition knowledge and skills to all aspects of health care are extremely important, and all health care professions need basic training to effectively assess dietary intake and provide appropriate guidance, counseling, and treatment to their patients. With obesity rates at an all-time high and the increasing prevalence of diabetes projected to cost the federal government billions of dollars, the need for interprofessional nutrition education is paramount. Physicians, PAs, nurses, nurse practitioners, pharmacists, dentists, dental hygienists, OTs, PTs, SLPs, and others can positively affect patient care by synchronizing and reinforcing the importance of nutrition across all specialty areas. Although nutrition is a critical component of acute and chronic disease management, as well as health and wellness across the health care professions, each profession must first reevaluate its individual nutrition-related professional competencies to establish meaningful interprofessional collaborative nutrition competencies.

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