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AHA SCIENCE ADVISORY

Medical Nutrition Education, Training, and Competencies to Advance Guideline-Based Diet Counseling by Physicians

A Science Advisory From the American Heart Association

ABSTRACT: Growing scientific evidence of the benefits of heart-healthy dietary patterns and of the massive public health and economic burdens attributed to obesity and poor diet quality have triggered national calls to increase diet counseling in outpatients with atherosclerotic cardiovascular disease or risk factors. However, despite evidence that physicians are willing to undertake this task and are viewed as credible sources of diet information, they engage patients in diet counseling at less than desirable rates and cite insufficient knowledge and training as barriers. These data align with evidence of large and persistent gaps in medical nutrition education and training in the United States. Now, major reforms in undergraduate and graduate medical education designed to incorporate advances in the science of learning and to better prepare physicians for 21st century healthcare delivery are providing a new impetus and novel ways to expand medical nutrition education and training. This science advisory reviews gaps in undergraduate and graduate medical education in nutrition in the United States, summarizes reforms that support and facilitate more robust nutrition education and training, and outlines new opportunities for accomplishing this goal via multidimensional curricula, pedagogies, technologies, and competency-based assessments. Real-world examples of efforts to improve undergraduate and graduate medical education in nutrition by integrating formal learning with practical, experiential, inquiry-driven, interprofessional, and population health management activities are provided. The authors conclude that enhancing physician education and training in nutrition, as well as increasing collaborative nutrition care delivery by 21st century health systems, will reduce the health and economic burdens from atherosclerotic cardiovascular disease to a degree not previously realized.

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There is now abundant scientific evidence documenting that adherence to a healthy dietary pattern reduces the risk of atherosclerotic cardiovascular disease (ASCVD) events and can significantly advance population-wide cardiovascular health, supporting the principal objectives of the American Heart Association's (AHA's) Strategic Impact Goals for 2020 and beyond.[1] Specifically, in large prospective cohort studies and randomized trials, higher intakes of fruits, vegetables, leafy greens, whole grains, fish, nuts, seeds, and legumes and lower intakes of sugar-sweetened beverages, refined grains, and red and processed meats are associated with reduced ASCVD risk (Figure).[2–6] Moreover, the substitution of healthy dietary components for less healthy versions (eg, liquid vegetable oils for solid fats and whole grains for refined grains)[7–9] and adherence to whole patterns of healthy eating (eg, the Mediterranean diet, the Dietary Approaches to Stop Hypertension [DASH] diet, and others) also reduce the risk of cardiovascular and all-cause mortality.[10,11] These effects are now believed to occur via multiple mechanisms,[2–4] and in those with ASCVD, effect sizes are similar to some pharmacological interventions.[12–14] However, despite the robust nutrition science base and wide dissemination of evidence-based dietary guidelines from the AHA/American College of Cardiology (ACC) in 2013,[15] and regularly from the Dietary Guidelines for Americans Advisory Committee,[16–18] diet quality remains poor throughout much of the United States,[19–21] especially in ethnically diverse subgroups with low socioeconomic status and in a surprisingly large proportion of individuals with established ASCVD.[22–24] Numerous factors shape dietary behavior,[25] but a large proportion of adults reportedly lack important nutrition knowledge that could negatively impact adherence to healthy diet patterns.[26–28]

This evidence and the massive public health and economic burdens attributed to unhealthy diet behaviors[29,30] have triggered national calls to increase the delivery of diet counseling in outpatients with ASCVD or risk factors as an evidence-based strategy.[31–34] However, despite evidence that physicians are willing to undertake this task and are viewed as credible sources of diet information,[35–37] they engage patients in diet counseling at less than desirable rates and cite insufficient nutrition knowledge and training as barriers to carrying out this role,[38–40] even during their peak learning years.[41] These data align with ongoing evidence of large and persistent gaps in medical nutrition education and training in the United States, discussed in Update on Gaps in Medical Nutrition Education and Training in the United States.

Efforts to strengthen undergraduate medical education (UME) and graduate medical education (GME) in nutrition, especially by schools formerly funded by the National Institutes of Health Nutrition Academic Award,[42] have endured for decades, primarily because of the efforts of dedicated faculty. During this time, the nutrition science evidence base related to ASCVD risk reduction has grown rapidly, as have other topics justified for inclusion in medical nutrition education curricula (Table 1). Now, major reforms in UME and GME designed to incorporate advances in the science of learning and to better prepare physicians for 21st century healthcare delivery are providing a new impetus and novel opportunities to expand medical nutrition education and training nationwide, as discussed in detail herein.

This science advisory, for medical school curriculum directors, program directors, faculty, trainees, and students, reviews current gaps in medical nutrition education and training in the United States and summarizes reforms in UME and GME that support and facilitate more robust nutrition education and training efforts. It also outlines new opportunities for accomplishing this goal via new curricula, pedagogies, technologies, and competency-based assessments. Nutrition-related core competencies related to ASCVD prevention and organized across the 6 domains of the Accreditation Council for Graduate Medical Education (ACGME) framework are presented. Recommended for achievement by all residents by graduation, these competencies are especially important for those planning careers in primary care, cardiology, neurology, endocrinology, obesity treatment, gastroenterology, oncology, intensive care medicine, and some surgical subspecialties. Although expanded nutrition competencies are needed across all health professions, those presented herein are limited to medical students and trainees and form the basis of the entrustable professional activities (EPAs) related to nutrition that are also presented. Educational resources for building and enhancing medical nutrition education and training curricula, which might be of interest to nutrition educators from all health professions and to practicing clinicians, are listed at the end of this document. A recent AHA scientific statement provides broader guidance on medical education and competencies for lifestyle counseling[43] and serves as a companion to this more specific nutrition competencies science advisory. Finally, although limitations of time and resources remain important considerations, current needs and approaches for strengthening medical nutrition education and training, including via new interprofessional opportunities,[44] are now compelling, urgent, and abundant. This science advisory represents a roadmap for perpetuating progress toward this educational goal until more robust patient-centered nutrition care delivery by health systems is achieved nationwide.

UPDATE ON GAPS IN MEDICAL NUTRITION EDUCATION AND TRAINING IN THE UNITED STATES

UME in Nutrition

A 1985 survey of one third of US medical schools by the National Academy of Sciences found inadequate expo-

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	Endpoint	No. of studies	No. of subjects	No. of events	Unit	RR	Reference
Fruits	CHD	16 PCs	817,155	13,786	Each 1 serving/day (100 g)	0.94 (0.91, 0.98)	Gan Y 2015
	Stroke	8 PCs	377,159	9,706	Each 1 serving/day (100 g)	0.82 (0.75, 0.91)	Hu D 2014
	Diabetes	7 PCs	368,232	21,063	Each 1 serving/day (100 g)	0.94 (0.89, 1.00)	Li M 2014
Vegetables	CHD	14 PCs	705,316	13,135	Each 1 serving/day (100 g)	0.95 (0.92, 0.98)	Gan Y 2015
	Stroke	6 PCs	342,118	8,854	Each 1 serving/day (100 g)	0.94 (0.90, 0.99)	Hu D 2014
	Diabetes	5 PCs	173,995	18,758	Each 1 serving/day (100 g)	0.98 (0.89, 1.08)	Li M 2014
Green leafy vegetables	Diabetes	3 PCs	127,148	13,331	Each 1 serving/day (100 g)	0.76 (0.62, 0.94)	Li M 2014
Legumes	Stroke	6 PCs	254,628	6,690	Each 4 servings/wk (400 g)	0.98 (0.84, 1.14)	Afshin A 2014
	CHD	4 PCs	198,904	6,514	Each 4 servings/wk (400 g)	0.86 (0.78, 0.94)	Afshin A 2014
	Diabetes	2 PCs	100,179	2,746	Each 4 servings/wk (400 g)	0.78 (0.50, 1.14)	Afshin A 2014
Whole grains	CHD	6 PCs	--	5,383	high vs low	0.78 (0.71, 0.86)	Tang G 2015
	Stroke	4 PCs	207,984	877	2.5 vs. 0.2 servings/day	0.83 (0.68, 1.14)	Mellen P 2008
	Diabetes	10 PCs	385, 868	19,829	Each 1 serving/day (50 g)	0.81 (0.74, 0.89)	Aune D 2013
Nuts and seeds	CHD death	5 PCs, 1 RCT	206,114	6,749	Each 4 servings/week (4 oz [113 g])	0.76 (0.69, 0.84)	Afshin A 2014
	Nonfatal CHD	3 PCs, 1 RCT	141, 390	4,280	Each 4 servings/week (4 oz [113 g])	0.78 (0.67, 0.92)	Afshin A 2014
	Diabetes	5 PC, 1 RCT	230,216	13,308	Each 4 servings/week (4 oz [113 g])	0.87 (0.81, 0.94)	Afshin A 2014
Fish	CHD Death	12 PCs	282,075	4,195	2-4 servings/week vs. ≤3 servings/month	0.79 (0.67, 0.92)	Zheng J 2012
	Stroke	8 PCs	394,958	16,890	≥ 5 vs. 1 serving/week	0.88 (0.81, 0.96)	Chowdhury R 2012
	Diabetes	13 PCs	481,489	20,830	Each 1 serving/day (100 g)	1.12 (0.94, 1.34)	Wu J 2012
Unprocessed red meats	CVD death	13 PCs	1,070,215	24,241	high vs low	1.12 (0.95, 1.33)	Abete I 2014
	Stroke	5 PCs	239,251	9,593	Each 1 serving/day (100 g)	1.13 (1.03, 1.23)	Chen G 2013
	Diabetes	9 PCs	447,333	28,206	Each 1 serving/day (100 g)	1.19 (1.04, 1.37)	Pan A 2011
Processed red meats	CVD death	6 PCs	1,186,761	35,537	Each 1 serving/day (50 g)	1.24 (1.09, 1.40)	Abete I 2014
	Stroke	5 PCs	239,251	9,593	Each 1 serving/day (50 g)	1.11 (1.02, 1.20)	Chen G 2013
	Diabetes	8 PCs	372,391	26,234	Each 1 serving/day (50 g)	1.51 (1.25, 1.83)	Pan A 2011
White meat (poultry, rabbit)	CVD death	5 PCs	1,197,805	31,535	Each 1 serving/day (100 g)	1.00 (0.87, 1.15)	Abete I 2014
Total dairy	CHD	10 PCs	253,260	8,792	high vs low	0.94 (0.82, 1.07)	Qin L 2015
	Stroke	16 PCs	764,635	28,138	high vs low	0.88 (0.82, 0.94)	Hu D 2014
	Diabetes	14 PCs	459,790	35,863	Each 1 serving/day	0.98 (0.96, 1.01)	Chen M 2014
Milk	CHD	6 PCs	259,162	4,391	Each 1 serving/day (200 ml)	1.00 (0.96, 1.04)	Soedamah-Muthu S 2011
	Stroke	9 PCs	525,609	22,382	high vs low	0.91 (0.82, 1.01	Hu D 2014
	Diabetes	7 PCs	167,982	15,149	Each 1 serving/day (200 g)	0.87 (0.72, 1.04)	Aune D 2013
Cheese	CHD	7 PCs	--	--	high vs low	0.84 (0.71, 1.00)	Qin L 2015
	Stroke	5 PCs	282,439	9,919	high vs low	0.94 (0.89, 0.995)	Hu D 2014
	Diabetes	8 PCs	242,960	17,620	Each 1 serving/day (50 g)	0.92 (0.86, 0.99)	Aune D 2013
Butter	CHD	5 PCs	--	--	high vs low	1.02 (0.88, 1.20)	Qin L 2015
	Stroke	3 PCs	173,853	5,299	high vs low	0.95 (0.85, 1.07)	Hu D 2014
Yogurt	CHD	5 PCs	--	--	high vs low	1.06 (0.90, 1.34)	Qin L 2015
	Diabetes	9 PCs	408,096	32,995	Each 1 serving/day (½ cup)	0.82 (0.70, 0.96)	Chen M 2014
Eggs	CHD	7 PCs	263,938	5,847	Each 1 serving/day (1 egg)	0.99 (0.85, 1.15)	Rong Y 2013
	Stroke	6 PCs	210,404	7,579	Each 1 serving/day (1 egg)	0.91 (0.81, 1.02)	Rong Y 2013
	Diabetes	5 PCs	69,297	4,889	≥1 egg/day vs. never or <1 egg/week	1.42 (1.09, 1.86)	Shin J 2013
100% fruit juice	Diabetes	11 PCs	407,288	34,549	Each 1 serving/day (8 oz.)	1.06 (0.98, 1.14)	Imamura F 2015
Sugar-sweetend beverages	Diabetes, non-BMI adjusted	13 PCs	421,973	36,492	Each 1 serving/day (8 oz.)	1.42 (1.19, 1.69)	Imamura F 2015
	Diabetes, BMI adjusted	17 PCs	464,937	38,253	Each 1 serving/day (8 oz.)	1.27 (1.10, 1.46)	Imamura F 2015
	CHD	4 PCs	194,664	7,396	Each 1 serving/day (8 oz.)	1.17 (1.10, 1.24)	Xi B 2015
Coffee—Caffeneited	CVD	29 PCs	--	--	3 vs. 0 cups/day, nonlinear	0.89 (0.85, 0.93)	Ding M 2014
	Diabetes	11 PCs	--	--	Each 1 serving/day (1 cup)	0.91 (0.89, 0.94)	Ding M 2014
Decaffeneited	Diabetes	11 PCs	--	--	Each 1 serving/day (1 cup)	0.94 (0.91, 0.98)	Ding M 2014
Tea	CHD	7 PCs	235,368	8,328	Each 1 serving/day (1 cup)	0.90 (0.81, 0.996)	Zhang C 2015
	Diabetes	14 PCs	503,165	35,574	Each 1 serving/day (1 cup)	0.98 (0.96, 0.995)	Yang W 2014
	Stroke	8 PCs	307,968	11,329	Each 1 serving/day (1 cup)	0.94 (0.90, 0.973)	Zhang C 2015

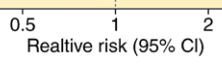

Figure. Recent meta-analysis of prospective cohort studies and randomized trials of the effects of specific foods on the risk of CHD, stroke, and diabetes mellitus.

BMI indicates body mass index; CHD, coronary heart disease; CI, confidence interval; CVD, cardiovascular disease; PC, prospective cohort; RCT, randomized clinical trial; and RR, relative risk. Reprinted from Mozaffarian et al.[2] Copyright © 2016, American Heart Association, Inc.

Table 1. Summary of the Clinical Evidence Base Linking Diet to Cardiovascular Health

Topic	Summary	Evidence
Effects of specific foods and nutrients on ASCVD risk or risk factors	Evidence of significantly reduced ASCVD risk from consumption of fruits, vegetables, whole grains, beans, legumes, nuts, seeds, low-fat dairy, phytochemicals, and PUFA-MUFA vs significantly increased ASCVD risk from sugary foods and beverages, refined carbohydrates, red and processed meats, and saturated fats	Cohort studies, RCTs, reviews, meta-analyses, statements
Effects of dietary patterns on ASCVD risk or risk factors	Evidence of significantly reduced ASCVD risk from Mediterranean, DASH, vegetarian, USDA, and AHA diet patterns vs significantly increased ASCVD risk from southern US diet pattern	RCTs, cohort studies, reviews, guidelines, DGAC reports
Effects of obesity and weight loss on ASCVD risk or risk factors; effects of dietary supplements on ASCVD risk	Evidence of significantly increased ASCVD risk from obesity; evidence of significantly reduced weight and improved ASCVD risk factors from hypocaloric diets; benefits of omega-3 fatty acid supplementation on reduced ASCVD risk in some groups	RCTs, reviews, guidelines, advisories, NIH supplement database
Effects of food environments on ASCVD-related health outcomes	Early evidence of improved health outcomes from home cooking and culinary skills vs ASCVD-related health risks from meals eaten away from home, food deserts, and food insecurity	Observational studies, reviews, USDA website
Effects of behavior modification on diet outcomes	Evidence of improved diet outcomes from diet-related cognitive-behavioral interventions	RCTs, reviews, websites

References for all evidence sources listed can be found in the Nutrition Competencies for ASCVD Prevention-Medical Knowledge section.

AHA indicates American Heart Association; ASCVD, atherosclerotic cardiovascular disease; DASH, Dietary Approaches to Stop Hypertension; DGAC, Dietary Guidelines for Americans Advisory Committee; MUFA, monounsaturated fatty acids; NIH, National Institutes of Health; PUFA, polyunsaturated fatty acids; RCTs, randomized controlled trials; and USDA, US Department of Agriculture.

sure to nutrition in health and disease, which prompted a recommendation for a minimum of 25 classroom hours.[45] Four subsequent surveys conducted between 2000 and 2013 have shown little progress in achieving this goal. The 2013 survey found that 71% of medical schools provide less than the recommended 25 hours of nutrition education, and 36% provide less than half that amount.[46] Of the 30 osteopathic schools surveyed, 85% reported providing less than the recommended 25 hours.[47] Moreover, despite the growing nutrition science evidence base, the average and median number of hours of nutrition instruction at US medical schools paradoxically declined, to 19 hours and 17 hours, respectively, in the last survey. Also, the survey showed that although some didactic nutrition education is usually provided, highly valued clinical practice exposure and training to build competencies and skills are minimal. However, the latest survey also showed that most of the US medical schools that currently exceed the minimum 25 hours of nutrition education do so by integrating nutrition education across the curriculum rather than by providing a single course.[46]

GME in Nutrition: Residency Programs

Any nutrition education gained during medical school is likely to be lost if not reinforced and translated into practical how-to knowledge during GME.[41] Unfortunately, evidence suggests that most primary care residencies are not meeting this need. The ACGME develops program requirements for primary care and specialty GME, and those for internal medicine training currently include no recommendations for either nutrition-related didactics or clinical practice exposures.[48] This training gap is aligned with survey data that have shown that only 14% of internal medicine trainee respondents are confident in their ability to counsel patients about diet.[41] In contrast, the American Academy of Family Physicians has established nutrition education guidelines for family medicine residents[49]; however, a recent survey that included family medicine trainees also documented low self-efficacy regarding nutrition knowledge and diet counseling skills,[50] which suggests that family medicine training gaps also exist. These data align with a recent survey of 495 program directors in internal medicine, family medicine, surgery, and anesthesiology that reported that only 26% offered formal GME in nutrition, and 77% believed they were not meeting requirements for GME in nutrition.[51]

GME in Nutrition: Cardiovascular Fellowship Programs

Gaps in nutrition education delivery also exist during accredited cardiovascular medicine fellowship programs. In a 2010 survey, 44% of cardiology fellowship directors reported providing a nutrition lecture, but only 27% of their chief fellows recalled a nutrition topic.[52] Cardiology program directors cited lack of time as the most significant barrier to providing more preventive cardiology training, whereas chief fellows attributed the problem to lack of a developed curriculum. In a recently updated survey, 56% of senior cardiology fellows reported receiving no nutrition education during their training, and 90% of >600 practicing cardiologists reported receiving no or minimal nutrition education during fellowship.[53] The 2015 ACC statement on core competencies for training in preventive cardiology has recommended that trainees "know the principles of nutrition and obesity assessment and management, including the roles of pharmacotherapy and bariatric surgery," and acquire "skill to implement and prescribe lifestyle approaches for the prevention and treatment of hypertension, dyslipidemia, tobacco use,

obesity, and diabetes mellitus," although specific nutrition knowledge and competencies are not listed.[54]

POPULATION HEALTH NEEDS AND HEALTH CARE AND CURRICULAR REFORMS ALIGNED WITH EXPANSION OF MEDICAL NUTRITION EDUCATION AND TRAINING

Many factors have contributed to shortcomings in medical nutrition education and training in the United States. Among these are healthcare delivery and payment models that have afforded little incentive or infrastructure for health promotion and disease prevention and management through diet and lifestyle counseling.[55] However, the national strategy to improve healthcare quality in the United States and stem its rising costs has led to new payment structures and a reorganization of care delivery that will necessitate more robust and better coordinated health promotion and disease prevention efforts by health systems. The national prevention strategy calls for these efforts to extend to entire practice-based populations, be focused on the behavioral determinants of health (including healthy eating), and be better integrated with public health sector efforts.[56] On the basis of some health risk assessment data, the largest population health needs could be in the areas of nutrition and obesity management.[57]

The need to train clinicians for this new healthcare environment and to simultaneously apply advances in the science of learning has led to recent calls to reform UME and GME in the United States. A Carnegie Foundation report has called for better integration of formal learning with early clinical experiences, including interprofessional and team-based activities; a broadening of professional identity to include, among other things, collaborative care delivery; the development of habits of inquiry and quality improvement, including population health management; and more individualization of learning processes and standardization of learning outcomes.[58] The authors recognize that all of these will require greater exposure to the social, economic, and political aspects of healthcare delivery. An international commission of medical educators also has called for transformative changes in health professions education to create a 21st century medical profession that "embraces teamwork, upholds a strong service ethic, and is centered around the interests of patients and populations."[59] A 2017 report by medical educators from Harvard Medical School echoes these earlier calls and proposes a major restructuring of UME to graduate "science-minded" and "service-minded" physicians with the capacity to advance population health, particularly in poor and underserved areas.[60] Recognizing the large impact from social and behavioral risks on individual and population health, the Association of American Medical Colleges has also called for greater incorporation of behavioral and social sciences into medical school and training curricula, as well as for competencies related to behavior counseling.[61] Finally, a conference of leaders in GME cosponsored by the Josiah Macy Jr. Foundation and the American Association of Academic Health Centers, has called for specific reforms in residency training, including better alignment with the changing healthcare needs of the public; a broadening of training to include population health, prevention topics, and interprofessional education; wider adoption of competency-based assessments; and more individualized training goals and paths.[62] Local innovations in GME as a result of these reforms have included engagement of residents in activities to improve community health, and interprofessional, team-based care focused on the social determinants of health.[62] Taken together, the national strategy to improve population health and its behavioral determinants, as well as reforms in UME and GME designed to meet these needs, support broader integration of nutrition knowledge and skill-building into medical education and training.

NEW OPPORTUNITIES FOR EXPANDING MEDICAL NUTRITION EDUCATION AND TRAINING

The reforms in UME discussed herein provide both an impetus and new opportunities to integrate and contextually embed nutrition education across all 4 years of learning. This can occur via pedagogical changes to competency-based curricula, early and longitudinal clinical experiences, and interactive, experiential, and inquiry-driven instruction and activities.[63] Similarly, reforms in GME provide abundant opportunities to expand nutrition-related education and skill building across a broad mix of didactic, clinical, experiential, and inquiry-driven scholarly activities within a growing number of educational tracks, including those dedicated to lifestyle medicine. Furthermore, during all phases of UME or GME, Internet-based nutrition instruction can now either supplement or originate nutrition education. Real-world examples of these opportunities are discussed below.

Integrating Nutrition Education and Training

During UME

As noted, most of the small number of medical schools that exceed the minimum 25 hours of nutrition education do so by horizontally and vertically integrating nutrition content across the learning continuum[46]; that is, across organ system didactics, small group sessions, skill-building clinical exposures, and electives.

For instance, at Boston University School of Medicine (through a nutrition Vertical Integration Group), the University of Texas Medical School at Houston, and others,[64–67] nutrition content is now woven into organ system didactics and case-based and problem-based group sessions to impart formal knowledge and demonstrate clinical applications. Content might highlight the role of cardioprotective diets in ASCVD risk reduction, dietary saturated fatty acid restriction in the management of blood cholesterol levels, energy balance in obesity and diabetes mellitus management, and dietary sodium restriction in heart failure and blood pressure management.[64] In this manner, nutrition becomes a theme that spans multiple organ system blocks instead of a one-time course with less clinical relevance.[63] Although this approach can make nutrition less recognizable as a distinct discipline, curriculum directors can electronically link nutrition sessions taught across organ system blocks or use nutrition-related Internet-based resources or textbooks to promote nutrition as a distinct field.[63]

New reforms also offer opportunities to develop nutrition-related skill building during early clinical experiences now common in the first year of medical school. During history-taking and physical assessment activities, students learn how to take a diet history, assess body mass index and waist circumference, recognize signs of calorie excess and other cardiometabolic risk factors, and assess diet quality and readiness for diet change.[64] In collaborative care settings that pair students with other professionals in training (registered nurses, registered dietitian nutritionists [RDNs], behaviorists, social workers), students can acquire early nutrition-related practice skills and observe the roles of other nutrition care team members, satisfying new standards and competencies for interprofessional education,[68] as outlined by the Interprofessional Education Collaborative.[69]

Applied nutrition knowledge and skill building are also being integrated into first- and second-year electives now common in UME, including those that provide experiential learning, such as the following:

- Practical nutrition electives: At Albert Einstein School of Medicine, a popular first-year nutrition elective developed in 2009 combines didactics with interactive and practical learning experiences that cover diet assessment, dieting myths, the science behind the Dietary Guidelines for Americans, motivational interviewing to effect diet behavior change, contemporary nutrition topics, and nutrition label reading, the latter via an experiential session that also builds community engagement skills.[64]
- Diet behavior electives: At Northwestern University Feinberg School of Medicine, an elective challenges students to complete a 6-week behavior change plan in which they self-select a health behavior to increase (eg, fruit and vegetable intake) or decrease (eg, soda or fried food intake), monitor baseline occurrence, set goals, and implement change,[70] a learning approach that has been shown to improve prevention care delivery to patients.[71,72] At Boston University School of Medicine, an experiential learning activity in nutrition challenges students to limit their weekly food budgets to the amount provided by the state's Supplemental Nutrition Assistance Program.[65,66]
- Culinary medicine electives: First offered >100 years ago,[73] the development of culinary skills has recently re-emerged as a way to help medical students translate healthy meal preparation skills to patients.[74,75] First taught in the United States at the State University of New York medical school in 2003 and further advanced by a 2013 partnership between Tulane University School of Medicine and the Johnson & Wales University College of Culinary Arts, culinary medicine electives are now offered at a growing number of US medical schools. At the Tulane campus, culinary skills are taught either via classes at Johnson & Wales or in student-led community cooking and nutrition classes at the Goldring Center for Culinary Medicine,[76,77] with a pilot study reporting improved blood pressure, cholesterol, and hemoglobin A_{1c} among a small group of patients with diabetes mellitus randomized to a student-led group versus usual care.[78] Similarly, at Brown University's Alpert Medical School, a "Food + Health" elective pairs second-year medical students with Johnson & Wales culinary students at the schools' Providence campuses in a twice-yearly semester-long class that combines didactics led by medical and culinary students with 5 themed culinary workshops, including cooking with less salt, healthy cooking on a budget, and Mediterranean-diet cooking.[79] In a separate RDN-designed, 6-week community health elective pilot entitled "Food Is Medicine," Brown University medical students and local nursing students lead a community nutrition cooking class that teaches plant- and olive oil–based meal preparation to low-income individuals with cardiometabolic risk factors, building culinary, interprofessional, communication, and community engagement skills. A culinary medicine experience also has been incorporated into the nutrition education curriculum at Boston University School of Medicine as part of the student-formed, faculty-supported Student Nutrition Awareness and Action Council.[65,66]

Nutrition knowledge and skill building can also be integrated into third-year clerkships in medicine, surgery, pediatrics, psychiatry, and obstetrics/gynecology, although these efforts typically require greater coordi-

nation, and into fourth-year clinical rotations and mentored inquiry-driven activities.[63,64]

During GME

Reforms in GME have resulted in a growing number of individualized internal medicine and family medicine training tracks and a broader mix of didactic, clinical, experiential, wellness, and inquiry-driven activities within which nutrition knowledge and competencies can be integrated and assessed. Traditional activities include noon lectures, conferences and journal clubs, rotations on inpatient services, and ambulatory experiences in advanced primary care and specialty practices, such as cardiology, lipid, endocrinology, and bariatric surgery clinics. More innovative activities are those that engage trainees in personal wellness and diet self-care, nutrition-related community outreach activities, and culinary skills development via hands-on food workshops and cooking demonstrations, the latter now in place at a reported 10 GME programs through partnerships with culinary institutions.[80] Together, these educational sites and activities offer numerous opportunities to develop and assess nutrition knowledge and competencies and engage residents (and often faculty) in learning related to diet and ASCVD prevention. Finally, although efforts to enhance GME in nutrition have focused traditionally on primary care residencies, nutrition educators have noted that "there is not a single medical specialty or subspecialty that would not benefit from an increased emphasis on nutrition education," which highlights the importance of improving nutrition education and training across specialties.[64] As an example, at the Montefiore Medical Center–Albert Einstein College of Medicine, residents in obstetrics and gynecology now engage in self-directed, Internet-based nutrition education focused on obesity and diet behavior change during pregnancy, demonstrating improved nutrition knowledge and practice skills, including increased referral rates to RDNs.[64]

Distinct Lifestyle Medicine Curricula for Nutrition Education and Training

During UME

A more focused strategy for incorporating nutrition into UME curricula involves integration into a lifestyle medicine (LM) thread or track, an approach aligned with calls for more individualization in medical education. Rather than offering a distinct course or integration into standard UME curricula, some medical schools, such as Northwestern University Feinberg School of Medicine and the University of South Carolina–Greenville School of Medicine, have introduced separate LM tracks that provide in-depth UME in nutrition alongside other lifestyle factors, including physical activity, substance and tobacco use, stress management, sleep hygiene, and behavioral counseling.[81] Although LM curricula are relatively new, a recent review reported that these tracks incorporated within UME improve student knowledge, skills, self-care, counseling, and patient outcomes related to lifestyle factors.[82] The Lifestyle Medicine Education Collaborative is a newly established partnership between leaders in LM and medical educators that provides leadership, guidance, and resources to advance the adoption of LM curricula in medical schools.[83] The recently published AHA statement on medical training to achieve competency in lifestyle counseling recognizes the LM education movement and outlines competencies needed to educate and train physicians for both this career track and LM topics embedded within traditional education and training programs.[43]

During GME

LM residency programs and tracks provide unique opportunities to acquire in-depth nutrition expertise and competencies during GME. The American College of Lifestyle Medicine maintains a current and growing list of GME training opportunities in nutrition within LM programs[84] and provides links to nutrition fellowship and postdoctoral fellowship programs. GME in LM also has been linked to improved physician knowledge and attitudes, practice outcomes, and patient outcomes.[82]

Web-Based Nutrition Education and Training

During UME

Medical schools that have not fully integrated nutrition science across their 4-year curricula are enhancing and even originating nutrition education via an Internet-based program that can be incorporated into any existing curriculum. The Nutrition in Medicine project at the University of North Carolina, Chapel Hill,[85,86] is an online, open-access nutrition education curriculum for medical students established in 1995 by a team of physicians, nutritionists, and computer scientists. The 50-hour core curriculum covers biochemical, epidemiological, and clinical aspects of nutrition science. Virtual case studies and translational illustrations are abundant and, although not as effective as self-directed nutrition counseling, offer even schools with no or limited quality nutrition faculty a means of expanding or establishing nutrition education at a fundamental level. Since its inception, >100 (or about one half) of US medical and osteopathic schools and dozens of international medical schools have accessed the Nutrition in Medicine project's materials to support their nutrition education efforts.[87]

During GME

In 2009, the Internet-based Nutrition in Medicine project at the University of North Carolina expanded its interactive online, open-access medical school nutrition education program to include Nutrition Education for Practicing Physicians. This comprehensive medical nutri-

tion education program for trainees and physicians in practice presents a wide range of foundational nutrition topics alongside disease-specific clinical vignettes and is designed specifically for easy incorporation into busy clinical schedules.[88]

NUTRITION COMPETENCIES FOR ASCVD PREVENTION

Assessing nutrition knowledge and skills imparted by the growing list of UME and GME activities discussed above is essential for competency-based medical education and training and is aligned with calls to better standardize learning outcomes.[58,62] Several groups have proposed content for medical nutrition education and training; however, no consensus on a unified framework has been reached.[89–92] The widely adopted ACGME framework for defining the expected outcomes of competency-based medical education and training across 6 domains,[93] with or without 2 additional domains proposed by medical educators,[94] is a suitable construct for categorizing nutrition competencies that impact ASCVD prevention and should be able to be broadly applied across countries.[94] The rationale and content for nutrition competencies within each of the 6 ACGME domains are discussed below and tabulated in Table 2.

Table 2. CVD-Related Nutrition Competencies Categorized by ACGME Domains

Domain	Competencies
Patient care: Demonstrate care that is patient centered, compassionate, appropriate, and effective	In all patients, uses most long-term care visits to inquire about diet and provide brief, focused diet recommendations and messages In patients with ASCVD or risk factors, demonstrates the ability to Assess short- and long-term ASCVD risk and criteria for metabolic syndrome via the medical history, vital signs, waist circumference and BMI, laboratory data, and an ASCVD risk calculator Take a diet history informally or via a diet assessment tool Formulate a diet-related diagnosis, intervention, and follow-up plan matched to the level of ASCVD risk and to specific risk factors Consider comorbidities and socioeconomic factors that impact diet behavior; assess readiness for diet change; use evidence-based behavior change techniques, with self-monitoring when appropriate Recognize patients who will benefit from referral to RDNs for medical nutrition therapy Record all of the above in an accurate and timely manner
Medical knowledge: Demonstrate knowledge of established and evolving biomedical, clinical, epidemiological, and social/behavioral sciences and apply this knowledge to patient care	Demonstrates knowledge and application of Basic principles of nutrition science and food sources of macronutrients and micronutrients Basic evidence linking specific foods/nutrients, dietary patterns, and food habits/environments to increased or decreased ASCVD risk Diet assessment tools and evidence-based behavior change strategies and techniques
Systems-based practice: Demonstrate awareness of the broader health system and the ability to apply its resources to individual care	Demonstrates the ability to Access national dietary guidelines and Internet-based patient education tools Refer patients appropriately to RDNs, lipid specialists, diabetes mellitus care specialists, obesity specialists, bariatric surgeons, and behaviorists and to participate in team-based nutrition care delivery Make appropriate referrals to community, state, and federal programs aimed at improving healthy food access and education
Practice-based learning and improvement: Demonstrate the ability to evaluate one's care and to continually improve it	Demonstrates the ability to Improve nutrition care delivery by incorporating new nutrition science, guidelines, assessment tools, patient education tools, and diet counseling techniques Monitor and improve patient diet behaviors and outcomes Monitor and improve one's progress in achieving nutrition competencies
Interpersonal and communication skills: Demonstrate skills that lead to effective exchange of information and collaboration to improve patient care	Demonstrates the ability to Communicate diet and nutrition information to patients based on education and health literacy levels Communicate effectively with dietitians, behaviorists, lipid specialists, and other team members in a manner that supports a team approach to health promotion and treatment of disease
Professionalism: Demonstrate the ability to carry out professional activities and to adhere to ethical principles	Demonstrates Empathy when counseling patients with alcoholism, obesity, eating disorders, dietary nonadherence, and culturally based dietary habits Professionalism in communications with all care team members and the ability to serve as a role model to those with less nutrition and medical knowledge Integrity in the delivery of evidence-based diet information (and avoids financial or other conflicts related to industry or business entities) Recognition of personal deficiencies in nutrition competency and the ability to work to rectify these

ACGME indicates Accreditation Council for Graduate Medical Education; ASCVD, atherosclerotic cardiovascular disease; BMI, body mass index; CVD, cardiovascular disease; and RDNs, registered dietitian nutritionists.

Patient Care

The ACGME defines competency in patient care as "the ability to demonstrate care that is patient-centered, compassionate, appropriate and effective."[93] Applied to diet-related patient care for ASCVD prevention, students and trainees should demonstrate the ability to inquire and provide brief messages about diet at most chronic care visits, because there is evidence that this can favorably impact diet outcomes.[95] For those with ASCVD or risk factors, they should demonstrate the competencies below, summarized in Table 2, including the ability to accomplish the following:

- Assess short- and long-term ASCVD risk[96,97] and criteria for metabolic syndrome,[98] via the medical history, vital signs (including blood pressure, waist circumference, body mass index, or other assessments of adiposity),[99,100] and laboratory data, including fasting blood glucose and blood lipids.
- Take a diet history informally or via a diet assessment tool.[101]
- Formulate a diet-related diagnosis, intervention, and follow-up plan that matches short- and long-term ASCVD risk; criteria for metabolic syndrome, overweight, or obesity; and the presence of hyperlipidemia, hypertension, or diabetes mellitus.
- Consider comorbidities and socioeconomic factors that impact diet behavior,[25] assess readiness for diet change,[102] and use evidence-based behavior change techniques to guide diet change,[103–106] encouraging diet self-monitoring via e-tools,[108,109] when appropriate.
- Recognize significant nutrition-related diagnoses to identify patients who will benefit from referral to RDNs for in-depth counseling and medical nutrition therapy based on the Nutrition Care Process Model.[110]
- Record all of the above in an accurate and timely manner.

Medical Knowledge

The ACGME defines competency in medical knowledge as "the ability to demonstrate knowledge of established and evolving biomedical, clinical, epidemiological, and social-behavioral sciences, and to apply this to patient care."[93] Relative to diet and cardiometabolic health, medical knowledge and its applications can be viewed as existing within 3 broad areas, including (1) basic nutrition principles and food sources of nutrients, (2) evidence linking foods/nutrients, diet patterns, and food environments to changes in ASCVD risk, and (3) diet assessment tools and behavior change interventions.

1. Basic nutrition principles and food sources of nutrients
   - Knowledge of basic nutrition principles provides learners with the foundation needed to diagnose and treat diet-related disorders. Students and trainees should demonstrate basic knowledge of the following, summarized by the Institute of Medicine and National Academy of Sciences in an easily searchable online reference[111]:
     - Macronutrients, their recommended intake ranges, and diet composition
     - Calorie requirements and energy balance
     - Fatty acids and sterols; carbohydrates and fiber; amino acids and proteins
     - Vitamins, minerals, trace elements, and electrolytes
     - The basic roles of all of these in human metabolism and homeostasis
   - Knowledge of food sources of nutrients provides learners with the foundation needed to translate nutrition knowledge into practical guidance. For the purposes of ASCVD risk reduction, students and trainees should particularly demonstrate knowledge of the following:
     - Food sources of healthy fats, whole grains, lean animal and plant proteins, sterols, and flavonoid-rich fruits, green leafy and other vegetables, including those with roles in regulating oxidative stress,[112] as tabulated in the US Department of Agriculture's food composition database[113]
     - Food sources of nutrients to be limited based on the Dietary Guidelines for Americans Advisory Committee,[16] including added sugars, sodium, and saturated and *trans* fats in processed foods and beverages, including those often mistakenly viewed as "heart healthy" (ie, sugar-laden cereals, yogurts, and fruit juices; salt-laden vegetable juices; and coconut oil), as well as food sources of nutrients that are underconsumed based on the Dietary Guidelines for Americans Advisory Committee,[16] such as calcium, potassium, fiber, and vitamin D, and their roles in disease, particularly in the elderly
     - The federally mandated nutrition facts label and its application and planned updates[114]
     - The evidence for or against dietary supplements as outlined by the National Institutes of Health,[115] specifically as related to omega-3-fatty acid supplementation, as recently reviewed[116]
2. Evidence linking foods/nutrients, diet patterns, and food environments to ASCVD risk
   - Knowledge of foods and nutrients associated with changes in ASCVD risk or risk factors,

identified consistently in well-conducted cohort studies and clinical trials, is essential for translating nutrition science to patients and for recognizing diet myths and controversies often abundant in popular media.[117] Trainees should demonstrate knowledge of the following:

- Specific foods associated with increased or decreased ASCVD risk based on prospective studies,[2–5] as illustrated in the Figure
- Individual nutrients associated with increased or decreased ASCVD risk, including:
  - Fats, specifically saturated fatty acids and *trans* fatty acids, which are associated with an increase in serum low-density lipoprotein cholesterol and the risk of coronary heart disease or all-cause mortality, versus monounsaturated and poly-unsaturated fatty acids, which reduce serum low-density lipoprotein cholesterol and the risk of coronary heart disease and total mortality when substituted for saturated fatty acids,[7,8,118,119] and which also reduce elevated triglycerides, hyperglycemia, or ASCVD risk when substituted for refined carbohydrates (up to a total fat intake of 35% of calories),[120] evidence of which has led to calls for policy shifts away from low-fat diets[121]
  - Carbohydrates in the form of refined grains and added sugars, especially from sugary beverages, which are associated with obesity, dyslipidemia, insulin resistance, and ASCVD risk,[9,122] especially when glycemic load is increased,[123] versus carbohydrates as whole grains, which are associated with reductions in obesity, insulin resistance, ASCVD risk, and total mortality when substituted for refined carbohydrates,[9] and which also reduce coronary risk when substituted for total fat in diets that are plant-based, fiber-rich, and high in fruits, vegetables, beans, and legumes, as well as whole grains[124]
  - Proteins from plant sources (beans, legumes, nuts, and seeds) and fish, which are associated with reduced ASCVD risk,[2–5] versus from processed meats (eg, delicatessen meats, bacon, sausage, hot dogs), which are associated with increased ASCVD risk[2–5]
  - Sterols from plant sources, which are associated with reductions in serum low-density lipoprotein cholesterol, versus some animal sterols (eg, cholesterol in eggs) that raise low-density lipoprotein cholesterol and are associated with increased ASCVD risk in diabetic patients[125]
- Knowledge of diet patterns associated with changes in ASCVD risk, and evidence-based guidelines derived from them, is essential for and can facilitate diet counseling of patients. Trainees should demonstrate knowledge of the following:
  - Healthy dietary patterns and their evidence bases, including the AHA Dietary Pattern[15] and the Healthy US Style,[16] Mediterranean,[10,13] Dietary Approaches to Stop Hypertension (DASH),[126] and vegetarian/vegan diet patterns, all reviewed recently[127]
  - Dietary guidelines and recommendations, including the "2013 AHA/ACC Guideline on Lifestyle Management to Reduce Cardiovascular Risk,"[15] the 2015 to 2020 Dietary Guidelines for Americans,[16] and dietary recommendations for treating complex dyslipidemias[128]
  - The basic process by which diet evidence is systematically reviewed, ranked, and incorporated into these guidelines and recommendations[129]
  - The commonalities among current dietary guidelines (including an emphasis on whole foods, nutrient density, and energy balance, as well as restriction of added sugars, sodium, and solid fats) that facilitate patient adherence and coordinated treatment, the latter essential because many cardiometabolic risk factors overlap and require simultaneous management
- Knowledge of weight loss principles that impact ASCVD risk factors is essential for treating the large numbers of patients with overweight or obesity encountered in practice.[130] Trainees should demonstrate knowledge of the following:
  - The association between obesity and ASCVD risk factors and total mortality[131,132] and the favorable effects of weight loss on most of these risks[133]
  - The evidence that popular hypocaloric diets appear to induce similar weight loss,[134] but those that allow moderate fat are associated with greater reductions in triglycerides and increases in high-density lipoprotein cholesterol and possibly better adherence than those low in fat[135]
  - Evidence-based guidelines for obesity treatment[136,137]
- Knowledge of the effects of food habits and environments on diet quality and ASCVD risk is essential when engaging patients in diet counseling, especially those with lower socioeconomic status. Trainees should demonstrate knowledge of the prevalence and negative effects on ASCVD risk factors of:

- Food eaten away from home[138–140] and, conversely, of the potentially positive health effects of culinary skills development and home cooking[141,142]
- Food deserts, defined by the US Department of Agriculture as "parts of the country vapid of fresh fruit, vegetables and other healthful whole foods, usually found in impoverished areas"[143–146]
- Food insecurity in the United States[147]

3. Diet assessment tools and behavior change theories as applied to diet
   - Knowledge of formal diet assessment and tracking tools that provide an approximation of dietary intakes is valuable when assessing diet quality, the need for diet behavior change, and the achievement of diet goals. Trainees should demonstrate familiarity with the following:
     - Rapid Eating and Activity Assessment for Patients (REAP), a brief, validated food questionnaire linked to an accompanying physician guide to counseling[148,149]
     - Weight, Activity, Variety and Excess (WAVE), a diet and lifestyle instrument that addresses calorie balance and healthy eating and incorporates practical tools[149–151]
     - Food Behavior Checklist, a picture-based food survey for those with low health literacy[152]
     - New commercial mobile e-health tools for diet self-monitoring and tracking, for example, MyFitnessPal,[108] Lose It,[109] and others, and emerging digital platforms with the capability of connecting patient-generated diet data to electronic health records[153]
   - Knowledge of the many factors that affect diet behavior and the evidence supporting specific diet behavior change interventions is essential for guiding patients to successful diet change. Trainees should specifically demonstrate knowledge of the following:
     - The social-ecological model of diet behavior, which recognizes that diet behavior is shaped by individual, social, cultural, and economic influences; the settings in which foods and beverages are consumed; and system, organizational, and industry factors[25]
     - The trans-theoretical model, which emphasizes the need to tailor behavior change strategies to the stage of readiness (ie, precontemplation, contemplation, preparation, action, maintenance, or relapse), and of the 5A's steps for applying the trans-theoretical model to diet behavior change[102] (ie, assess diet and readiness to change, advise diet changes, agree on diet change goals, assist to change diet practices or address barriers, and arrange follow-up and support, including referrals to RDNs when needed)
     - Evidence-based behavior modification techniques such as motivational interviewing, goal setting, and regular feedback, which are now Class IA recommendations for diet counseling,[103] and particularly the 4 basic skills used in motivational interviewing[154] (ie, open questions, affirmations, reflective listening, and summarizing [OARS])

Systems-Based Practice

Competency in systems-based practice is defined by the ACGME as "the ability to demonstrate awareness of the broader health system and apply its resources to individual care."[93] As related to nutrition, trainees should demonstrate the ability to make appropriate referrals to RDNs, diabetes mellitus educators, clinical lipid specialists, and obesity treatment experts; to local and web-based programs that promote cooking skills, weight loss, diabetes mellitus prevention, and wellness; and to federal nutrition assistance programs, including the Women, Infants and Children program, Meals on Wheels, and Supplemental Nutrition Assistance Program–Ed.

Practice-Based Learning and Improvement

The ACGME defines competency in practice-based learning and improvement as the "ability to demonstrate evaluation of one's care and to continually improve it."[93] Specific to nutrition, competency in practice-based learning and improvement includes the ability to monitor and improve diet-related behaviors and outcomes in patients and to hone these skills within complex patient care environments with ever-changing standards, guidelines, and policies. Therefore, trainees should demonstrate the ability to access and incorporate into practice new dietary guidelines, counseling techniques, and diet assessment and education tools. Finally, competency in practice-based improvement includes the ability to self-monitor and improve one's own progress in achieving nutrition competencies.

Interpersonal Skills and Communication

Competency in interpersonal skills and communication is defined by the ACGME as the "ability to demonstrate skills that lead to effective exchange of information with patients and other providers, and collaboration to improve patient care."[93] The latter is especially vital given the increasing need for physicians to work within interdisciplinary teams. Trainees should be proficient in communicating

nutrition guidance across all levels of patient education and health literacy, in documenting nutrition assessment, and in establishing a legal record of nutrition care.

Professionalism

The ACGME defines competency in professionalism as the "ability to carry out professional activities and to adhere to ethical principles."[93] Compassion, respect for others, honesty, and integrity are the foundations of professionalism. In relation to nutrition care delivery, trainees should demonstrate professionalism when counseling patients with eating disorders, alcoholism, obesity, dietary nonadherence, and culturally specific dietary habits, as well as when interacting with care team members who might have less medical knowledge. They should demonstrate avoidance of personal and financial conflicts related to the promotion of diet plans, foods, supplements, or other products. Finally, they should recognize deficiencies in their nutrition competencies and work to remedy these.

EPAs FOR NUTRITION COMPETENCY

Recently the Association of American Medical Colleges developed and defined 13 categories of integrated, observable, and measurable clinical work activities that each graduating medical student should be able to perform in basic fashion without direct supervision on the first day of internship and with increasing skill, performance, and independence (or "entrustment") as he or she progresses along the learning continuum to graduating senior resident.[155–157] As such, EPAs provide a clinical context for (and are mapped to one or more of) the ACGME/Association of American Medical Colleges competency domains and are achieved when milestones or "entrustable behaviors" that integrate patient care, medical knowledge, practice skills, and professional attitudes for that particular activity are skillfully demonstrated. As EPAs become adopted, medical schools must demonstrate their achievement and determine how, when, where, and by whom the EPA is to be taught, as well as its method of measurement and assessment. The 13 core EPAs being advanced by the Association of American Medical Colleges and the suggested entrustable behaviors relevant to nutrition care competencies are presented in Table 3.

RESOURCES FOR IMPROVING MEDICAL NUTRITION EDUCATION AND TRAINING CURRICULA

Faculty

Relatively few medical school faculty with training and expertise in nutrition and the general lack of institutional support and academic "homes" for those who do possess these qualifications have contributed to inadequate UME and GME in nutrition.[158–160] However, multidimensional nutrition curricula that integrate the expertise of RDNs in particular,[44] as well as nurses, behaviorists, and culinary experts, can greatly enhance the efforts of even a single faculty member or champion. Nutrition curriculum organizers might also find that medical nutrition education efforts by other faculty, RDNs, behaviorists, trainees, and students are already in place in other local programs, departments, or practices and can be tapped to help create broader and more integrated multidisciplinary nutrition education and training efforts. The resources discussed above and listed below can provide faculty with significant support.

Curricula Building Guidance

Faculty and curriculum developers seeking to expand their medical nutrition education and training efforts can find valuable information in the following publications, which provide both general guidance and descriptions of the steps and elements helpful for planning, implementing, evaluating, and sustaining an integrated nutrition education curriculum:

- "A Novel Method of Increasing Medical Student Nutrition Awareness and Education"[66]
- "A Novel Nutrition Medicine Education Model: The Boston University Experience"[65]
- "Development of Case-Based Integrated Nutrition Curriculum for Medical Students"[161]
- "Position of the Academy of Nutrition and Dietetics: Interprofessional Education in Nutrition as an Essential Component of Medical Education"[44]
- "Lessons Learned From Nutrition Curricular Enhancements"[162]
- "Nutrition Education in Medical School: A Time of Opportunity"[63]
- "Comprehensive Integration of Nutrition Into Medical Training"[163]
- The Nutrition Academic Award, funded by the National Heart, Lung, and Blood Institute between 1998 and 2005 at 21 medical schools in the United States, produced a curriculum guidance document, instructional materials, practice tools, and publications, available at https://www.nhlbi.nih.gov/sites/default/files/media/docs/NAA%20Nutrition%20Curriculum%20Guide.pdf.[164]

Educational Content Resources

Key nutrition science sources and reviews useful for curriculum developers, faculty, students, trainees, and practicing providers are listed in the publications and websites listed below.

- Institute of Medicine Dietary Reference Intakes[111]

Table 3. EPAs Relevant to Nutrition Competencies

EPA	Entrustable Behaviors
1. Gather a history and perform a physical examination	Gathers all information related to diet and CVD risk from Personal and family history, diet/lifestyle history, and basic laboratory data Formal diet assessment, when appropriate Evaluation of social, cultural, and economic factors that influence diet habits Physical examination findings, including BMI, waist circumference, and other physical findings of CVD risk Does all of the above in a complete manner and with sensitivity and cultural awareness
2. Prioritize a differential diagnosis after a clinical encounter	Synthesizes all diet-related information and draws on knowledge and experience to recognize Relationships between dietary history and CVD risk or risk factors, including acute CVD events Social, cultural, and economic factors that impact diet habits Openly discusses conclusions with supervisors and patients
3. Recommend and interpret common diagnostic screening tests	Performs diet-related screening and testing based on Standards of care National guidelines Cost awareness Patient preferences Performs test interpretation that Is accurate Recognizes urgency when present Discusses test results with supervisors and patients
4. Enter and discuss orders and tests	Prescribes diet orders and recommendations that Match the patient's clinical diagnosis, CVD risk, or acute CVD event/illness Account for other clinical factors Recognize social, cultural, and economic factors Use health information technology and tools Include RDN referral when needed Discusses diet recommendations with patients in a nonjudgmental manner, as well as with other team members
5. Document a clinical encounter in the patient's record	Documents diet-related histories, examination findings, assessments, and plans that are Systematic, complete, timely, and legible Tailored to inpatient and outpatient care settings Inclusive of patient factors and preferences
6. Provide an oral presentation of a clinical encounter	Orally presents diet-related information tailored for the care setting (ie, that is relevant to active problems in the inpatient setting and to chronic disease management in the outpatient setting) Maintains patient privacy and displays respect when presenting diet histories and behaviors
7. Form clinical questions and retrieve evidence to advance patient care	Accesses nutrition science (in guidelines, studies, review articles, and databases) to research and deliver nutrition care Recognizes areas of controversy or non–evidence-based diet information Listens to and learns from the nutrition care experiences of other professionals and team members
8. Give or receive a patient handover to transition care responsibility	NA
9. Collaborate as a member of an interprofessional team	Understands the roles of the healthcare team in nutrition care delivery Makes timely and appropriate referrals to RDNs, RNs, PAs, lipid specialists, hypertension specialists, preventive cardiologists, obesity experts, and behaviorists Demonstrates mutual respect in interactions with team members
10. Recognize patients in need of urgent care and initiate evaluation and management	Recognizes the possibility of acute illness requiring care escalation in patients with physical symptoms or severely abnormal findings related to ASCVD risk factors
11. Obtain informed consent for tests and procedures	NA
12. Perform the general duties of a physician	NA
13. Identify system failures and contribute to a culture of safety and improvement	Identifies gaps in patient diet knowledge and self-efficacy and works to close these gaps via diet counseling and educational tools Identifies gaps in hospital diet and nutrition care delivery and works through appropriate channels to close these gaps

ASCVD, atherosclerotic cardiovascular disease; BMI, body mass index; CVD, cardiovascular disease; EPAs, entrustable professional activities; NA, not applicable; PAs, physician assistants; RDNs, registered dietitian nutritionists; and RNs, registered nurses.

- US Department of Agriculture Food Composition Database[113]
- US Food and Drug Administration Food Label Program[114]
- National Institutes of Health Food Supplement Database[115]
- "Components of a Cardioprotective Diet: New Insights"[3]
- "Dietary and Policy Priorities for Cardiovascular Disease, Diabetes, and Obesity: A Comprehensive Review."[2]
- "Trending Cardiovascular Nutrition Controversies"[117]
- "Dietary Fats and Cardiovascular Disease: A Presidential Advisory From the American Heart Association"[8]
- "Omega 3 Polyunsaturated Fatty Acid (Fish Oil) Supplementation and the Prevention of Clinical Cardiovascular Disease: A Science Advisory From the American Heart Association"[116]
- "Dietary Sugars Intake and Cardiovascular Health: A Scientific Statement From the American Heart Association"[123]
- "Sodium, Blood Pressure, and Cardiovascular disease: Further Evidence Supporting the American Heart Association Sodium Reduction Recommendations"[165]
- "2013 AHA/ACC Guideline on Lifestyle Management to Reduce Cardiovascular Risk: A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines"[15]
- Dietary Guidelines for Americans, 2015–2020[16]
- "Recommended Dietary Pattern to Achieve Adherence to the American Heart Association/American College of Cardiology Guidelines: A Scientific Statement From the American Heart Association"[127]
- "Behavior Change Counseling Curricula for Medical Trainees: A Systematic Review"[106]
- "Dietary Applications of the Stages of Change Model"[102]
- "Interventions to Promote Physical Activity and Dietary Lifestyle Changes for Cardiovascular Risk Factor Reduction in Adults: A Scientific Statement From the American Heart Association"[103]
- "State of the Evidence Regarding Behavior Change Theories and Strategies in Nutrition Counseling to Facilitate Health and Food Behavior Change"[104]

CME Resources

Like most fields of medicine, nutrition science is rapidly evolving. Engaging in continuing medical education (CME) activities can help nutrition educators and faculty partners incorporate new, evidence-based nutrition science and educational tools into existing curricula and competency frameworks. Advertised to local practitioners, CME activities in nutrition also expand nutrition knowledge and the delivery of nutrition counseling by local primary care providers, advanced practice providers, hospitalists, specialists, medical students, trainees, and other clinician team members. The organizations listed below offer multiday or online CME activities focused on medical nutrition primarily for the prevention of ASCVD and other chronic diseases.

Live CME

- AHA Epidemiology/Lifestyle Scientific Sessions: An annual 4-day AHA scientific session devoted to the development and application of translational and population science related to heart disease and stroke prevention and the advancement of cardiovascular health, with a major focus on the role of diet and lifestyle.[166]
- Healthy Kitchens, Healthy Lives: A 4-day course organized by the Harvard School of Public Health and the Culinary Institute of America, held in Napa, CA, that bridges nutrition science, health care, and the culinary arts.[167]
- International Conference on Nutrition in Medicine: A 2-day course organized by the George Washington School of Medicine and the Physicians Committee for Responsible Medicine, held annually in Washington, DC, that updates the science linking nutrition to cardiometabolic and other disorders.[168]
- International Plant-Based Nutrition Conference: An annual 4-day course hosted by the Plantrician Project, that presents the latest science on the health benefits of plant-based eating.[169]
- Lifestyle Medicine: A 2-day course organized by the Institute for Lifestyle Medicine at Spaulding Rehabilitation Hospital and Harvard Medical School that integrates formal learning about advances in diet and lifestyle with practical skills such as counseling techniques and practice-based culinary education tools and strategies.[170]
- Mayo Clinic Nutrition and Wellness in Health and Disease: A 2-day CME course organized by the Mayo Clinic Office of Continuous Professional Development that covers ambulatory topics in nutrition, LM, and wellness.[171]
- Nutrition & Health Conference: A 3-day course organized by the University of Arizona that reviews the latest information on nutrition and health presented by scientific researchers, clinicians, and food policy and culinary experts.[172]

Online CME

- Nutrition Science for Health and Longevity: What Every Health Professional Needs to Know: A 3-hour, self-paced, interactive nutrition course from the nonprofit Gaples Institute that emphasizes clinically relevant nutrition science, counseling strategies, and practical tips for making nutritional interventions in a busy clinical setting. $50; qualifies for CME and American Board of Internal Medicine maintenance of certification.[173]
- Introduction to Food and Health: A 2.5-hour, multimodule CME activity from Stanford University Center for Continuing Medical Education that also features speakers from Harvard School of Public Health and that covers basic principles of nutrition, the use of motivational interviewing and nutritional assessment using evidence-based techniques and tools, and the process of guiding patients through diet behavior change. Uses didactic videos, animated cases, and interactive and experiential activities.[174]
- Medscape Nutrition CME Learning Center[175]
- AHA Healthy Living Continuing Education series: A series of free 1- to 1.5-hour science-based slide and video presentations with continuing education credits created by the AHA for health professionals and their patients, including The Facts on Fats, Living Healthy With Less Added Sugar, Smart Food Shopping, and Simple Cooking.[176]

CONCLUSIONS

Despite robust evidence that diet quality significantly impacts ASCVD risk, unhealthy dietary patterns remain a major contributor to the massive public health and economic burdens from ASCVD in the United States. Guideline-based diet behavior counseling initiated by physicians on the frontlines of primary and specialty care can improve diet and health outcomes in individuals and, coupled with 21st century disease prevention and health promotion strategies, hold immense potential for improving population-wide cardiovascular health. However, to meet this societal need and realize this potential, more robust medical nutrition education and training are needed. Because nutrition is a dynamic science with a rapidly evolving evidence base that requires continual updating and renewed translational efforts, the competencies outlined in this science advisory provide a foundation and flexible options for advancing nutrition knowledge and skills across the learning continuum. The real-world experiences of dedicated nutrition educators and innovators suggest that this is best achieved by integrating formal learning in nutrition across organ systems and within practical, experiential, inquiry-driven, and interprofessional clinical activities. Many of these activities are also aligned with 21st century reforms in UME and GME and will help prepare physicians for team-based care with RDNs and other qualified professionals who can sustain their diet education and population health management efforts. As for other chronic diseases, such a model of collaborative nutrition care, delivered systematically by health systems and aligned with population-based diet improvement strategies, will reduce the public health and economic burdens from ASCVD to a degree not previously realized in the United States.

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The American Heart Association makes every effort to avoid any actual or potential conflicts of interest that may arise as a result of an outside relationship or a personal, professional, or business interest of a member of the writing panel. Specifically, all members of the writing group are required to complete and submit a Disclosure Questionnaire showing all such relationships that might be perceived as real or potential conflicts of interest.

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This table represents the relationships of writing group members that may be perceived as actual or reasonably perceived conflicts of interest as reported on the Disclosure Questionnaire, which all members of the writing group are required to complete and submit. A relationship is considered to be "significant" if (a) the person receives $10 000 or more during any 12-month period, or 5% or more of the person's gross income; or (b) the person owns 5% or more of the voting stock or share of the entity, or owns $10 000 or more of the fair market value of the entity. A relationship is considered to be "modest" if it is less than "significant" under the preceding definition.

*Modest.

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Reviewer	Employment	Research Grant	Other Research Support	Speakers' Bureau/ Honoraria	Expert Witness	Ownership Interest	Consultant/ Advisory Board	Other
Amrita Ahluwalia	Queen Mary University of London, Barts and The London School of Medicine and Dentistry (United Kingdom)	None	None	None	None	Heartbeet Ltd*	None	None
David J. Maron	Stanford University	None	None	None	None	None	None	None
Paul Poirier	Université Laval (Canada)	None	None	None	None	None	None	None

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*Modest.

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