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Nutrition in Medicine: Nutrition Education for Medical Students and Residents

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Abstract

Proper nutrition plays a key role in disease prevention and treatment. Many patients understand this link and look to physicians for guidance diet and physical activity. Actual physician practice, however, is often inadequate in addressing the nutrition aspects of diseases such as cancer, obesity, and diabetes. Physicians do not feel comfortable, confident, or adequately prepared to provide nutrition counseling, which may be related to suboptimal knowledge of basic nutrition science facts and understanding of potential nutrition interventions. Historically, nutrition education has been underrepresented at many medical schools and residency programs. Our surveys over a decade show that most medical schools in the United States are still not ensuring adequate nutrition education, and they are not producing graduates with the nutrition competencies required in medical practice. Physicians, residents, and medical students clearly need more training in nutrition assessment and intervention.

The Nutrition in Medicine (NIM) project, established to develop and distribute a core nutrition curriculum for medical students, offers a comprehensive online set of courses free of charge to medical schools. The NIM medical school curriculum is widely used in the United States and abroad. A new initiative, Nutrition Education for Practicing Physicians, offers an innovative online medical nutrition education program for residents and other physicians-in-training, but with targeted, practice-based educational units designed to be completed in 15 minutes or less. The NIM project is strengthening medical nutrition practice by providing a free, comprehensive, online nutrition curriculum with clinically relevant, evidence-based medical education for undergraduate and postgraduate learners.

Keywords

education, medical; education, distance; nutritional sciences

The Nutrition in Medicine (NIM) project at the University of North Carolina at Chapel Hill (www.nutritioninmedicine.org) has a long history of curriculum development for medical schools. Since its inception, the mission of the NIM project has been to improve the nutrition knowledge and skill base for future physicians by creating and distributing the

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tools needed to bring nutrition education to this important audience. To guide our curriculum development and dissemination, we periodically survey instructors about the nutrition instruction their medical students receive. Since 1995, the NIM project has offered a comprehensive curriculum free of charge to medical schools. The curriculum is now entirely web based, which also includes our recent initiative of bringing nutrition education to practicing physicians as well.

Physician Nutrition Knowledge and Practice Behaviors

Despite the widespread appreciation of the relationship between diet, disease prevention, and treatment, physicians often fall short in addressing the nutrition aspects of diseases such as cancer, obesity, and diabetes in their patients. Several surveys have examined the practice behaviors of physicians. Overall, these surveys have found that physicians agree on the importance of nutrition in their medical practice but do not feel comfortable and adequately prepared to provide nutrition counseling to their patients.[1–4] In one examination of current practice behaviors, doctors engaged overweight adult patients in weight-loss counseling in only 11% of encounters.[5] Most would agree that the delivery of nutrition counseling by physicians is not optimal.

Part of the problem seems to relate to inadequate nutrition knowledge. Patients rely on their doctors as a source of nutrition information[6]; however, one analysis reported that physician nutrition knowledge may even be less than that of the patient on some topics.[7] Surveys of residents, fellows, and practicing physicians probing specific nutrition knowledge have found mean correct responses ranging from ~50%–66%.[8–12] Physicians in many practice areas report that they desire additional information and training on a wide range of nutrition topics.[13–15]

Another issue relates to physician self-efficacy. If a physician does not feel competent to address nutrition-related concerns and effect behavior change in patients, it is unlikely that patients will receive thorough nutrition assessments and interventions from that provider. Surveys have shown that low physician self-reported competency exists with regard to providing nutrition counseling to their patients.[4,11,16]

With the growing importance of nutrition in preventing the spread of the obesity and diabetes epidemics, it is alarming that many physicians still lack the knowledge base, confidence, and clinical skills needed to identify the nutrition issues present in their patients and to prescribe effective nutrition interventions. It is clear that there are deficiencies in physician training. What is currently happening in medical school and residency training programs can shed some light on possible solutions to ensuring nutrition competency among physicians.

Nutrition Instruction in Medical School and Residency Programs

Undergraduate medical education is the foundation for later physician practice. Historically, nutrition has been underrepresented in the curriculum at many medical schools. In 1985, the National Academy of Sciences (NAS) published its landmark report *Nutrition Education in U.S. Medical Schools*.[17] The NAS survey found that on average, required undergraduate

medical education included only 21 hours of nutrition instruction across all 4 years. They concluded that medical students need a minimum of 25 hours of nutrition instruction to be adequately prepared to address the nutrition concerns of their patients. This finding prompted an outpouring of professional group statements, publications, analyses, and even a congressional mandate calling for improved nutrition training for future physicians.[17–20]

A quarter of a century later, the overall status of nutrition education at most medical schools in the United States (U.S.) still has not improved enough. Across several surveys conducted by the authors between 1999–2009 examining the quantity and type of required nutrition education at U.S. medical schools,[21–23] we found that most medical schools (62%–73%, depending on the survey year) are not meeting the minimum standard of 25 hours suggested by the NAS. Our most recent survey (2008–2009) found that U.S. medical students received only an average of 19.6 contact hours of required nutrition instruction over all 4 years of medical school. Most of this instruction occurred during the preclinical years, as part of basic science education, in biochemistry, physiology, or pathophysiology courses. Although some medical schools provided a substantial amount of nutrition teaching, with 9 schools requiring 40 hours or more, most did not. With less than 25 hours of required nutrition behind them, graduating medical students cannot expect to be competent in handling nutrition care in their patients—the time simply is not adequate to cover what needs to be covered.

We have noticed a downward trend in the number of medical schools requiring a separate, obligatory course in nutrition, from 35% of respondents in our 2000–2001 survey to 25% of respondents in 2008–2009. Many medical schools have moved to an integrated curriculum or a problem-based learning approach, reducing structured learning time in traditional formats. Anecdotally, we have heard reports from medical instructors that this transition takes away many of the gains that nutrition hours in medical schools captured in the 1990s. On the other hand, at least 1 school has reported that an integrated nutrition curriculum greatly increased the total hours of instruction and improved Objective Structured Clinical Examination (OSCE) nutrition scores and student satisfaction with nutrition instruction.[24]

Barriers to improving the nutrition training of future physicians include the competition for time in the curriculum and the resistance to adding new courses or lectures, the emphasis on disease treatment instead of disease prevention, and the gaps in faculty preceptor understanding and use of expert nutrition guidelines related to cancer and other chronic diseases, and applied nutrition in general.[18,25–28] Lack of physician nutrition specialists or other nutrition educators on faculty is another obstacle, as these professionals serve as role models to both medical students and residents for addressing nutrition in patient interactions.[29]

Even if an institution meets the minimum 25 hours of required nutrition instruction, and most do not, there is no clear consensus on the best way to implement the topics and objectives that a medical nutrition curriculum should cover. Several publications by nutrition educators and medical students have suggested core content for an undergraduate medical curriculum (Table 1),[30–32] but there is great variability in the instruction between institutions.

The result is that many graduating medical students still lack a solid understanding of nutrition science and therefore are unable to apply the skills needed to provide nutrition education in their current medical practice. Residency programs report similar difficulties with including nutrition in their training programs. One evaluation of the nutrition education in U.S. family practice residency programs found a wide distribution of hours devoted to nutrition instruction (0–40 hours); the main barrier reported was competing demands and the lack of curriculum time.[33]

Altogether, this information highlights the need for medical students, residents, and fellows to receive skill-centered nutrition training—nutrition assessment, counseling, and intervention—in addition to the science behind best nutrition practice. A comprehensive curriculum that provides clinically relevant, evidence-based undergraduate and postgraduate medical education online can successfully bridge the gap and strengthen current medical nutrition practice.

The NIM Medical Student Curriculum

The American Society for Clinical Nutrition consensus guidelines and other published recommendations guided the content development for the NIM medical student curriculum,[34–36] which includes 29 units, with instruction spanning the preclinical and clinical years of medical school (Table 2). The scope of the curriculum is very broad and meets all of the expected competencies in nutrition for medical students (Table 1). The basic content covers nutrient metabolism, sources, and function, including biochemistry and physiology, weaving in clinical nutrition applications as a way to capture the user's interest while exposing the student to diagnostic and treatment concepts. Nutrition assessment and appropriate interventions are presented in many of the modules. In this way, both the preventive and therapeutic aspects of nutrition are covered throughout the entire curriculum.

The presentation of material is layered and interactive, with basic nutrition science teaching being woven within a patient video case presentation (Figure 1). This case-based approach allows students to gain confidence by interacting with simulated patients as their practical skills grow. The NIM presentation is not simply a flat sequence of slides containing knowledge items. Interactive exercises, including additional cases, animations, pop quizzes, and board-type examinations, make this a dynamic and engaging presentation. Throughout the various modules, interactive exercises illustrate how the teachings apply to practice and give the user the opportunity to apply new knowledge and skills. A full resources section, complete with dietary reference intake values, a dietary supplements index, and glossary, are available at any time. Students have access to printed versions of the objectives, key concepts, and detailed summaries; a "user notes" feature allows the student to take notes from within the program and either print or e-mail them. Although the curriculum is not designed to translate to paper instruction, users have the option of printing out any screen to review the details at a later time. Instructors can obtain their students' final exam scores from a central database; many instructors use these data to assign course credit. Students take an average of between 30–60 minutes to complete each unit, depending on the topic.

The NIM medical school curriculum allows placement of current, evidence-based nutrition information into the curriculum. The presence of a nutrition expert on faculty is always a benefit, but not an absolute requirement. These materials use an approach that requires minimal investment of faculty time and also limits added contact hours, because instructors can choose the topics that are most pertinent for their students. Another advantage is that the standardized content creates a consistency in nutrition teaching across different institutions.

Our content delivery system has many strengths. The online setup allows us to monitor which topics students are studying. We collect data on which modules are being used and how students are performing on the examination questions. We can continually improve, update, and correct our instruction based on user feedback from diverse institutions.

We have made a concerted effort to contact every U.S. medical and osteopathic school and inform them about the availability of our programs. Our periodic surveys of medical nutrition educators at all U.S. medical schools (not just those already familiar with the NIM medical school program) allow us to keep our database of nutrition educators current, as we have found that there is frequent turnover of teaching assignments, and modifications made to the curricula at many medical schools is ongoing. Once or twice per year, we notify instructors in our database about our resources and any new offerings.

The Nutrition Education for Practicing Physicians Curriculum

The newest initiative of the NIM team is developing a distinct online education program for residents, fellows, and other practicing physicians. New content for this audience uses the same delivery system as the medical student modules.

Although medical students early in their training may need broad instruction that explains the mechanisms and theory behind nutrition recommendations, this is much less the case at the residency level. Postgraduate learners may be adept at medical diagnosis and management, but they may still lack the specific skills needed to assess a patient’s nutrition status and prescribe appropriate treatment. Their biochemistry and physiology education often does not provide a solid foundation in nutrition science. What is lacking even more is the application of specific clinical nutrition skills that bring the benefits of nutrition knowledge to the bedside. The new Nutrition Education for Practicing Physicians (NEPP) curriculum addresses both.

Basic nutrition science information is accessible through a series of foundation modules, which present some of the core nutrition information that many did not learn in medical school. Foundation modules have a fairly broad scope, giving physicians an opportunity to review or update background nutrition information, and take between 30–60 minutes to complete. For example, one foundation topic relates to pregnancy. It reviews the impact of maternal nutrition on fetal development, describes the role of the placenta in fetal nourishment and transfer of nutrients across the placenta, discusses how pregnancy changes nutrient requirements, and summarizes the current recommendations and how to assess and advise women on issues such as energy intake, heartburn, constipation, and so on.

The scope and approach of the new modules developed for the NEPP curriculum are unique. Our aim is to give physicians the critical knowledge and practice skills that they require to improve the nutrition care they give to patients, and ultimately improve patient outcomes for diseases and conditions that respond to dietary interventions. Each independent unit is designed to be completed in 15 minutes or less, allowing learning to take place within the extremely busy schedule of a typical practitioner. The content is concise and targeted to present specific practice-based nutrition recommendations. The modules describe nutrition assessment and appropriate therapy in detail, at a level that the physician can apply the newly learned skills with their patients right away. Once a module is finished, it will be clear to the user how to translate a broad guideline (eg, to prevent refeeding syndrome, start low and go slow with calories) into actionable practice (eg, to prevent refeeding syndrome, begin feeding at 20% of basal energy expenditure calculated using actual weight).

The look and feel of the new NEPP modules will at a glance seem very similar to the medical student curriculum, but a closer look reveals the greater level of clinical detail and the practical applications provided. Even more so than the undergraduate series, the NEPP instructional design relies very heavily on interactive case studies and other skill-building exercises to reinforce the instruction (Figure 2). Embedded interactions serve the dual purpose of reinforcing learning for the user and assessing competency, replacing traditional examination-style questions as much as possible. We are developing new tools, such as a DRI navigator, that can be accessed by portable devices for use during clinical work. This tool allows the physician to choose the age and gender of the patient and get a complete list of nutrient recommendations. This list can also be printed and given to the patient as a handout.

Content coverage for NEPP is driven by several publications defining the scope and competencies required by residents and fellows, notably the Nutrition Academic Award's *Nutrition Curriculum Guide For Training Physicians*,[36] the American Board of Physician Nutrition Specialists *Curriculum Guide*,[37] and the *Physician's Curriculum in Clinical Nutrition: Primary Care* published by the Society for Teachers of Family Medicine.[38] When completed, there will be over 50 modules covering a wide scope of content and organized by topic area (Table 3). Each broad topic area will contain several brief, targeted instructional units. Examples of the breakdown using 2 topic areas (oncology and diabetes) are shown in the Appendix.

To our knowledge, NEPP is the only widely available, integrated, fully featured, free, online nutrition education program for residents and fellows. Although there are thoroughly detailed review articles on some topics available at resource sites such as UpToDate, NEPP is the only online nutrition education curriculum for residents and fellows that distills down the critical practice-oriented knowledge into an instructional format that can be completed in 15 minutes or less.

Many of the instructors teaching nutrition to medical students are also responsible for residents and fellows, so we notify our database contacts directly about the availability of NEPP and new offerings. We also reach out to residency directors, and present at national meetings such as the American Dietetic Association's Food and Nutrition Conference and

Exhibition and the American Society of Nutrition at Experimental Biology. We are exploring the development of YouTube pieces and other means to reach our intended audience.

Nutrition In Medicine Medical School Curriculum Usage

The NIM online curriculum has helped nutrition educators to hold ground as nutrition courses are being shortened or eliminated and nutrition often loses its distinct identity as some content is assimilated into other courses. Nutrition In Medicine is widely and actively used at many medical schools in the U.S. and around the globe. Our latest information shows that 90 out of 156 U.S. medical and osteopathic schools actively use the NIM curriculum. Many international schools use the curriculum as well.

The NIM system has been well received by both medical student users and their instructors. Over 70% of students using the programs in 2009 agreed or strongly agreed with the statement: “I would recommend this module for future students to use.” Less than 8% disagreed or strongly disagreed with this statement. Usage data show that over 6000 medical students per year, representing about a quarter of annual U.S. medical school matriculants, use the online nutrition instruction, with more users signing up every month. Efficacy evaluations for several of the covered topics have been published elsewhere.[39–41]

There is great diversity in the type and format of nutrition instruction at medical schools. According to our survey information, most of the nutrition instruction occurs during the first 2 years. A significant benefit of the NIM curriculum is its flexibility in implementation; the modules can be incorporated into a curriculum in a variety of ways. They can be used as a stand-alone course, with the entire online curriculum making up the course syllabus. Individual modules can be integrated into different courses (eg, nutritional anemias modules assigned during a hematology course). Several medical schools have integrated the entire curriculum this way, either during the first 2 years of medical school or as students are in clerkship rotations. Some topics, such as nutrition in pregnancy and nutrition during lactation, are more likely to be used as students begin their clinical rotations. The typical medical school instructor will choose a few of the modules that fit into a specific content area, rather than assign all the modules at once. Other instructors will allow students to freely choose the topics that are personally relevant and assign credit based on a minimum number of modules completed, rather than requiring the same titles for everyone. The modules also are used in small groups or as a resource in schools using problem-based learning. The broad scope of content coverage is a useful foundation to prepare students for case presentations.

Nutrition Education for Practicing Physicians Usage

Some residency programs have already adapted NEPP as a required curriculum component. A number of others are making the curriculum known to their residents as more topics become available. A great benefit of the NEPP system is that it can be readily integrated into different rotations, and directors can adapt the program to the needs of their residents.

Conclusion

The NIM medical school curriculum and the new NEPP initiative are strengthening medical nutrition practice by providing clinically relevant, evidence-based undergraduate and postgraduate medical education online, at no charge to the user. Anyone interested in using the curriculum with medical students, residents, or fellows should visit the NIM Web site (www.nutritioninmedicine.org) or contact nimprof@unc.edu.

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Appendix

Example Showing How Broad Topic Areas Will Contain Several Brief, Targeted Learning Units

Oncology

Units in this topic area will present clinically relevant findings and recommendations of the World Cancer Research Fund report and other authoritative guidelines. Topics and possible case studies include:

Primary nutrition cancer prevention: Assess nutrient intake of a young patient with a family history of breast cancer.

Secondary nutrition cancer prevention: Offer dietary advice to a patient with polyps found on colonoscopy.

Nutrition support in cancer patients: Prescribe nutrition support for a patient undergoing treatment for GI cancer.

Cancer cachexia: Intervene to halt weight loss in a patient with cancer cachexia.

Complementary and alternative therapies: Answer a patient’s questions about the efficacy of alternative therapies.

Managing side effects of treatment: Offer dietary treatments for common side effects of cancer treatment.

Drug-nutrient interactions: Advise a patient on potential drug-nutrient interactions associated with their cancer chemotherapy.

Diabetes mellitus

Units in this topic area will present nutrition therapy based on current nutrition recommendations and interventions as defined by the American Diabetes Association and the American Dietetic Association. Topics and possible case studies include:

Diabetes prevention strategies: Intervene to address weight status and physical activity patterns in children, adolescents, or adults with strong family history of diabetes.

Nutrition therapy: Provide guidance on total calorie requirements, appropriate macronutrient distribution, and meal planning and timing for a patient newly diagnosed with type 2 diabetes.

Energy balance: Calculate energy requirements and counsel an obese patient with type 2 diabetes on how to balance energy intake and expenditure.

Drug therapy: Integrate insulin therapy into the dietary and physical activity patterns of a child with type 1 diabetes.

Diabetes care in institutional settings: Prescribe nutrition support for a cancer patient with diabetes.

References

1. Levine BS, Wigren MM, Chapman DS, Kerner JF, Bergman RL, Rivlin RS. A national survey of attitudes and practices of primary-care physicians relating to nutrition: strategies for enhancing the use of clinical nutrition in medical practice. Am J Clin Nutr. 1993; 57:115–119. [PubMed: 8424377]
2. Soltesz KS, Price JH, Johnson LW, Tellijohann SK. Family physicians' views of the preventive services task force recommendations regarding nutritional counseling. Arch Fam Med. 1995; 4:589–593. [PubMed: 7606295]
3. Cimino JA. Why can't we educate doctors to practice preventive medicine? Prev Med. 1996; 25:63–65. [PubMed: 8778769]
4. Kushner RF. Barriers to providing nutrition counseling by physicians: a survey of primary care practitioners. Prev Med. 1995; 24:546–552. [PubMed: 8610076]
5. Scott JG, Cohen D, DiCicco-Bloom B, et al. Speaking of weight: how patients and primary care clinicians initiate weight loss counseling. Prev Med. 2004; 38:819–827. [PubMed: 15193904]
6. American Dietetic Association. Summary of findings: American Dietetic Association's public opinion survey nutrition and you: trends 2008. http://www.eatright.org/WorkArea/DownloadAsset.aspx?id=6442451351.
7. Lazarus K. Nutrition practices of family physicians after education by a physician nutrition specialist. Am J Clin Nutr. 1997; 65(6 Suppl):2007S–2009S. [PubMed: 9174511]
8. Kirby RK, Chauncey KB, Jones BG. The effectiveness of a nutrition education program for family practice residents conducted by a family practice resident-dietitian. Fam Med. 1995; 27:576–580. [PubMed: 8829982]
9. Temple NJ. Survey of nutrition knowledge of Canadian physicians. J Am Coll Nutr. 1999; 18:26–29. [PubMed: 10067655]
10. Raman M, Violato C, Coderre S. How much do gastroenterology fellows know about nutrition? J Clin Gastroenterol. 2009; 43:559–564. [PubMed: 19384248]
11. Vetter ML, Herring SJ, Sood M, Shah NR, Kalet AL. What do resident physicians know about nutrition? An evaluation of attitudes, self-perceived proficiency and knowledge. J Am Coll Nutr. 2008; 27:287–298. [PubMed: 18689561]
12. Flynn M, Sciamanna C, Vigilante K. Inadequate physician knowledge of the effects of diet on blood lipids and lipoproteins. Nutr J. 2003; 2:19. [PubMed: 14641920]
13. Coleman VH, Laube DW, Hale RW, Williams SB, Power ML, Schulkin J. Obstetrician-gynecologists and primary care: training during obstetrics-gynecology residency and current practice patterns. Acad Med. 2007; 82:602–607. [PubMed: 17525551]
14. Mihalynuk TV, Knopp RH, Scott CS, Coombs JB. Physician informational needs in providing nutritional guidance to patients. Fam Med. 2004; 36:722–726. [PubMed: 15531987]

15. Roberts KB, Starr S, DeWitt TG. The University of Massachusetts Medical Center office-based continuity experience: are we preparing pediatrics residents for primary care practice? Pediatrics. 1997; 100:E2. [PubMed: 9310535]
16. Jay M, Gillespie C, Ark T, et al. Do internists, pediatricians, and psychiatrists feel competent in obesity care? Using a needs assessment to drive curriculum design. J Gen Intern Med. 2008; 23:1066–1070. [PubMed: 18612746]
17. National Research Council (U.S.). Nutrition Education in U.S. Medical Schools. Washington, DC: National Academy Press; 1985. Committee on Nutrition in Medical Education.
18. Bruer, RA.; Schmidt, RE.; Chapel, T. Bethesda, MD: Schmidt (Richard) Associates, Ltd.; 1993. Nutrition Education for Physicians: Alternative Federal Roles for Creating an Improved System. Available at ntis.gov. [Accessed May 10, 2010]
19. Davis CH. The report to Congress on the appropriate federal role in assuring access by medical students, residents, and practicing physicians to adequate training in nutrition. Public Health Rep. 1994; 109:824–826. [PubMed: 7800795]
20. National Nutrition Monitoring and Related Research Act of 1990. 1990 Public law 1101-445/ HR1608. Section 302.
21. Torti F, Adams K, Edwards L, Lindell K, Zeisel S. Survey of nutrition education in U.S. medical schools—an instructor-based analysis. Med Educ Online. 2001; 6 (serial online). http://www.Med-Ed-Online.org.
22. Adams KM, Lindell KC, Kohlmeier M, Zeisel SH. Status of nutrition education in medical schools. Am J Clin Nutr. 2006; 83:941S–944S. [PubMed: 16600952]
23. Adams KM, Kohlmeier M, Zeisel SH. Nutrition education in U.S. medical schools: update of a national survey. Acad Med. In press.
24. Taren DL, Thomson CA, Koff NA, et al. Effect of an integrated nutrition curriculum on medical education, student clinical performance, and student perception of medical-nutrition training. Am J Clin Nutr. 2001; 73:1107–1112. [PubMed: 11382667]
25. Walker WA. Innovative teaching strategies for training physicians in clinical nutrition: an overview. J Nutr. 2003; 133:541S–543S. [PubMed: 12566498]
26. Makowske M, Feinman RD. Nutrition education: a questionnaire for assessment and teaching. Nutr J. 2005; 4:2. [PubMed: 15649324]
27. Touger-Decker R. Nutrition education of medical and dental students: innovation through curriculum integration. Am J Clin Nutr. 2004; 79:198–203. [PubMed: 14749223]
28. Wong V, Millen BE, Geller AC, Rogers AE, Maury JJ, Prout MN. What's in store for medical students? Awareness and utilization of expert nutrition guidelines among medical school preceptors. Prev Med. 2004; 39:753–759. [PubMed: 15351542]
29. Bringing physician nutrition specialists into the mainstream: rationale for the Intersociety Professional Nutrition Education Consortium. Am J Clin Nutr. 1998; 68:894–898. [PubMed: 9771868]
30. American Medical Student Association's Nutrition Curriculum Project. Report of the American Medical Student Association's Nutrition Curriculum Project. Essentials of nutrition education in medical schools: a national consensus. Am J Clin Nutr. 1997; 65:1559–1561. [PubMed: 9157789]
31. Warden RA, Lettoof AL, Wallis BJ, Porteous JE. Feed us nutrition: final year medical students' perceptions of nutrition medical education. Aust N Z J Med. 1996; 26:640–645. [PubMed: 8958358]
32. Kohlmeier, M.; Zeisel, SH. Teaching preventive nutrition in medical schools. In: Bendich, A.; Deckelbaum, RJ., editors. Preventive Nutrition: The Comprehensive Guide for Health Professionals. 3rd ed.. Totowa, NJ: Humana Press, Inc.; 2005.
33. Deen D, Spencer E, Kolasa K. Nutrition education in family practice residency programs. Fam Med. 2003; 35:105–111. [PubMed: 12607807]
34. Weinsier RL, Boker JR, Brooks CM, et al. Priorities for nutrition content in a medical school curriculum: a national consensus of medical educators. Am J Clin Nutr. 1989; 50:707–712. [PubMed: 2801575]

35. Essentials of nutrition education in medical schools: a national consensus. American Medical Student Association's Nutrition Curriculum Project. Acad Med. 1996; 71:969–971. [PubMed: 9125984]

36. Pearson TA, Stone EJ, Grundy SM, McBride PE, Van Horn L, Tobin BW. Translation of nutritional sciences into medical education: the Nutrition Academic Award Program. Am J Clin Nutr. 2001; 74:164–170. [PubMed: 11470716]

37. Heimburger DC. Training and certifying Physician Nutrition Specialists: the American Board of Physician Nutrition Specialists (ABPNS). Am J Clin Nutr. 2006; 83:985S–987S. [PubMed: 16600961]

38. Deen, D.; Kolasa, KM.; DeLessio, D., editors. Physician's Curriculum in Clinical Nutrition: Primary Care. 3rd ed.. Overland Park, KS: Society of Teachers of Family Medicine, Group on Nutriton; 2001. (updated 2007).

39. Buchowski MS, Plaisted C, Fort J, Zeisel SH. Computer-assisted teaching of nutritional anemias and diabetes to first-year medical students. Am J Clin Nutr. 2002; 75:154–161. [PubMed: 11756073]

40. Kohlmeier M, Althouse L, Stritter F, Zeisel SH. Introducing cancer nutrition to medical students: effectiveness of computer-based instruction. Am J Clin Nutr. 2000; 71:873–877. [PubMed: 10731491]

41. Kohlmeier M, McConathy WJ, Cooksey Lindell K, Zeisel SH. Adapting the contents of computer-based instruction based on knowledge tests maintains effectiveness of nutrition education. Am J Clin Nutr. 2003; 77(4 Suppl):1025S–1027S. [PubMed: 12663312]

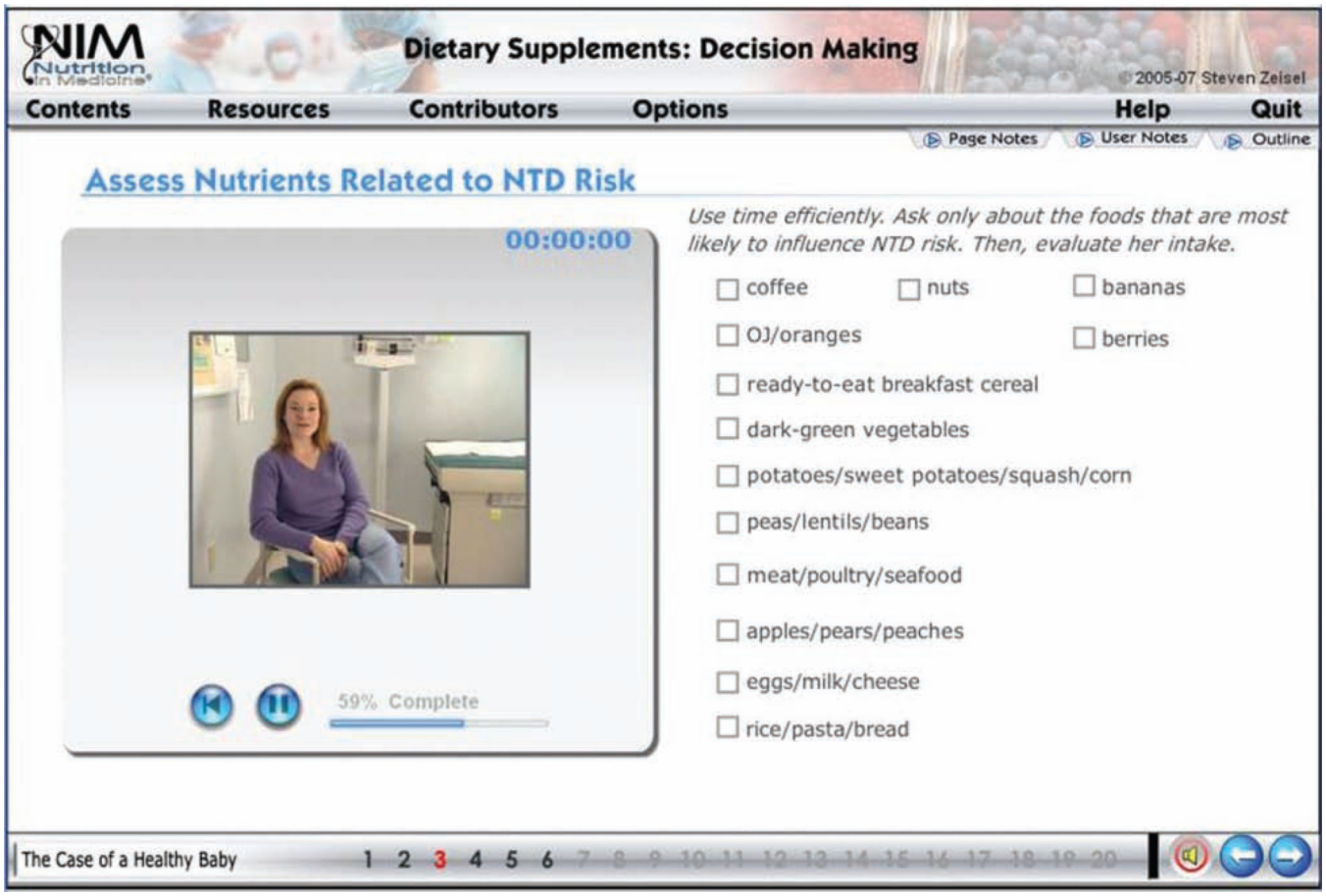

Figure 1.

Sample screen from the module on dietary supplements in the Nutrition in Medicine (NIM) medical school curriculum. A video-based case study addressing dietary factors that influence neural tube defect risk has the student use time wisely while assessing the patient's intake.

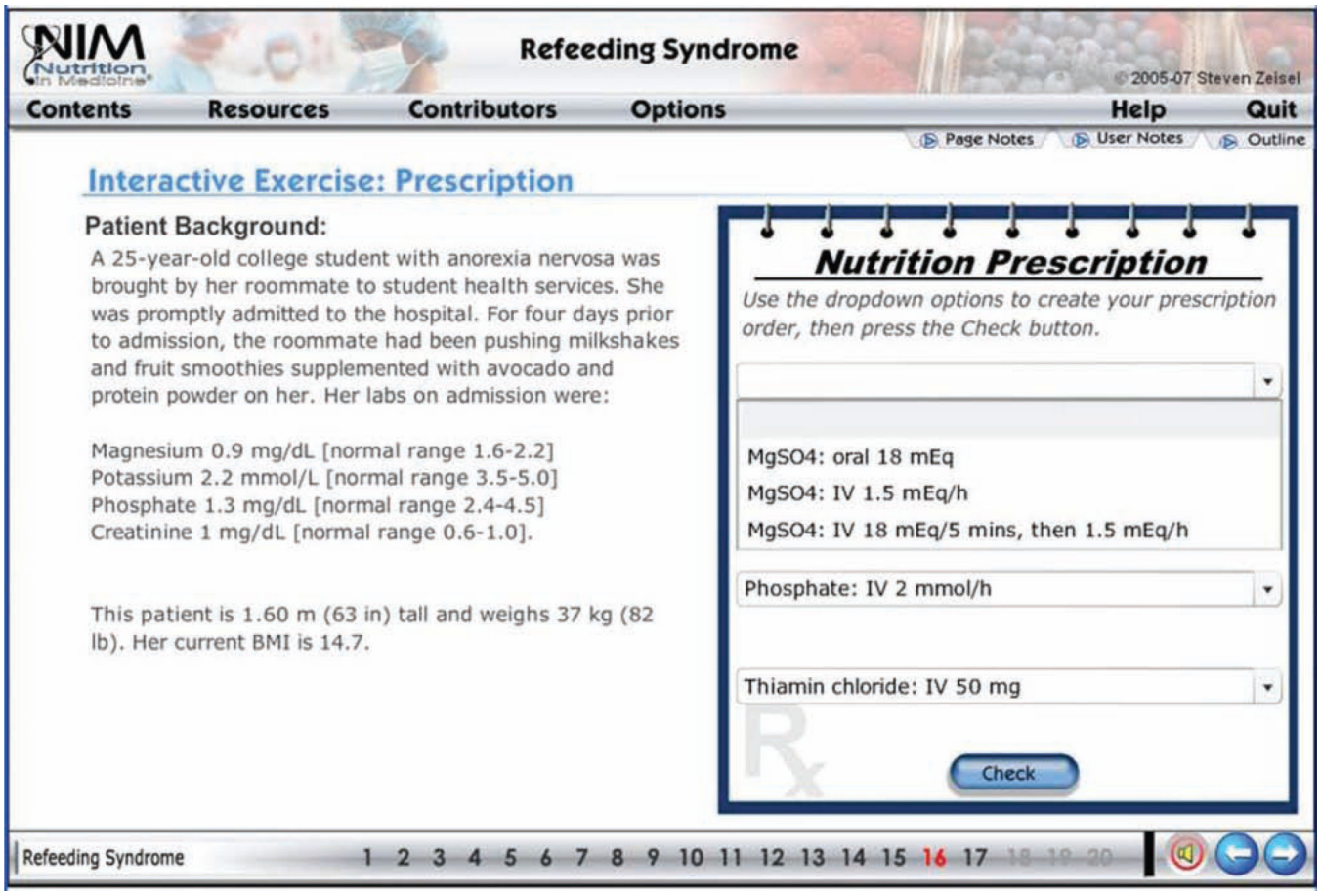

Figure 2.

Sample screen from the unit on refeeding syndrome in the Nutrition Education for Practicing Physicians curriculum for residents and physicians-in-training. An interactive exercise allows the physician to make a nutrition prescription and get immediate feedback.

Table 1

Nutrition Competencies for Graduating Medical Students

Foundation in nutrition science
Energy (deficiency, excess, metabolism, food sources, requirements)
Macronutrients
Protein (deficiency, metabolism, bioavailability, food sources, requirements)
Carbohydrates (food sources, requirements)
Fats (saturated, trans, ω-3, ω-6, cholesterol, food sources, requirements)
Dietary fiber (types, sources, requirements, effects)
Sources, bioavailability, action, deficiency, excess of micronutrients (vitamins A, C, D, E, K, B_{12}, B_6, thiamin, riboflavin, niacin, folate, calcium, phosphate, magnesium, iron, zinc, iodine, copper, chromium, manganese, molybdenum, selenium)
Antioxidants (types, sources, effects)
Water and electrolytes (sodium, potassium, chloride)
Physiology related to thirst, hunger, satiety
Function of the gastrointestinal (GI) tract
Hormonal control of nutrient metabolism
Nutrition and immunity
Nutrition assessment
Energy balance
Protein, carbohydrate, fat, fiber intake
Vitamin, mineral, trace element, antioxidant, electrolyte intake
Diet history
Nutrition physical examination (anthropometrics, body composition, skin)
Laboratory evaluation
Growth
Nutrient intake recommendations
Prevention
Pre-conception, conception, pregnancy, lactation
Growth and development
Aging
Cognitive decline
Osteoporosis
Oral health
Cancer
Cardiovascular disease
Obesity
Hypertension
Characteristics of an adequate diet
Veganism/vegetarianism
National nutrition programs
Disease treatment
Chronic diseases (cancer, cardiovascular disease, hyperlipidemia, hypertension, osteoporosis)
Nutritional anemias

Failure to thrive
Eating disorders
Kidney stones, renal failure
Diarrhea, water, electrolytes, acid-base balance
Liver disease, alcohol abuse
Disorders of the GI tract (celiac disease, gastroesophageal reflux, peptic ulcer disease)
Tests of digestive function
Hyperuricemia, gout
Malnutrition
Surgery, trauma, infection, wound healing
Food-borne illness
Drug-nutrient interactions, supplement-nutrient interactions
Food allergies
Inborn errors of metabolism
HIV/AIDS
Cystic fibrosis
Rheumatoid disease
Depression, schizophrenia
Nutrition therapy
Nutrition prescriptions and referrals
Behavior change counseling
The “Physician Registered Dietitian” team
Enteral and parenteral nutrition support
Nutrition supplements
Cultural issues in counseling
Digestive enzyme therapy

Table 2

Titles in the Nutrition in Medicine Medical Student Curriculum

Category	Titles
Disease-based	Nutritional Anemias Part 1
	Nutritional Anemias Part 2
	Metabolic Stress and Starvation
	Nutrition Support
	Cancer Nutrition: Molecular Mechanisms
	Cancer Nutrition: Prevention and Treatment
	CVD: Hypertension and Other Risk Factors
	CVD: Lipoproteins
	Diabetes: Nutritional Mechanisms
	Diabetes: Dietary Management
	Obesity: Basic and Clinical
	Pediatric Overweight: Etiology and Screening
	Pediatric Overweight: Assessment and Intervention
Life cycle-based	Nutrition for Young Children
	Nutrition for School-Aged Children
	Nutrition in Pregnancy
	Nutrition during Infancy
	Infants with Special Needs
	Nutrition during Lactation
	Nutrition and Aging: Body and Mind
	Nutrition and Aging: Chronic Disease
	Nutrition and Aging: Special Needs
Special topics	Micronutrients Review
	Dietary Supplements: Decision Making
	Dietary Supplements: Reality Check
	Dietary Supplements: Use in Practice
	Sports Nutrition: Health Effects
	Sports Nutrition: Fuel Metabolism
	Sports Nutrition: Hydration and Supplements

CVD, cardiovascular disease

Table 3

Anticipated Content Areas for the Entire Nutrition Education for Practicing Physicians Curriculum

Category	Topic Areas	
Disease-based	Oncology	Diabetes Mellitus
	Obesity	Cardiovascular Disease
	Hypertension	Hematology
	Food Allergy	Rheumatology
	Heart Failure and Cardiomyopathy	Pulmonary
	Eating Disorders	Renal
	Metabolic Syndrome	Metabolic Bone Disease
	Gastrointestinal Disease	Nutrition Support
	Metabolic Stress	Drug-Nutrient Interactions
	Nutrition and HIV Infection	Malnutrition
	Eye Diseases	
Skill-Based	Nutrition Assessment	
	Behavior Change and Counseling Techniques	
Lifecycle-Based	Geriatrics	
	Pediatrics	Women’s Health
Special Topics	Health Promotion	Popular Trends
	Dietary Supplements	Micronutrients