

A Problem-Based Learning Approach to Incorporating Nutrition into the Medical Curriculum

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Abstract: Problem Based Learning (PBL) provides a unique opportunity for medical students to learn nutrition principles in the context of evidence-based clinical cases. At the University of Texas Medical School at Houston (UTMSH), PBL is a major component during the second year of the four year undergraduate medical curriculum. A recent review of forty-two clinical cases has shown that over half of the cases include nutrition-specific objectives related to diagnosis, therapy, prognosis, or disease prevention. Thus, these PBL cases provide students the opportunity to study a broad range of nutrition topics in a clinically relevant context. The students' nutrition knowledge is evaluated using clinically-oriented, multiple-choice questions. In order for students to develop fully their competency in clinical nutrition topics, they are also provided a foundation in basic nutrition principles. This report describes a comprehensive approach through a case-based curriculum to help prepare students in their pre-clinical years for the nutritional care of patients in their clerkships, residency, and as practicing physicians.

Keywords: medical nutrition education, nutrition in problem-based learning, evidence-based nutrition education, case-based curriculum

Numerous recommendations have been made for the inclusion of nutrition in the medical curriculum. Early leaders in the field of medical nutrition education, including Young,¹ Weinsier,² and Winick³ proposed and published core nutrition competencies for medical students, and other physicians, including Feldman⁴ and Kushner,⁵ have recognized the importance of teaching nutrition in a clinically relevant format. In the 1990s, the American Medical Student Association established the Nutrition Curriculum Project and later published a national consensus report on the essentials of nutrition education in medical schools.⁶ However, less has been written about the specific methods and strategies for incorporating nutrition into the education and training of medical students. A national survey conducted in 2004 by Adams et al⁷ indicates that most information about nutrition continues to be taught in the individual basic science courses and, therefore, is not specifically identified with the discipline of nutrition. However, with the recently created nutrition subscore for the Step 1 U.S. Medical Licensing Examination (USMLE) by the National Board of Medical Examiners (NBME),⁸ it is imperative that nutrition be recognized as a scientific discipline within the medical curriculum by both medical educators and students. As more U.S. medical schools move toward a problem-based learning, case-based

approach to preparing students for their clinical years of training, nutrition can be taught in an identifiable and clinically relevant evidence-based format.^{9,10} The purpose of this article is to provide an overview of the requirements for integration of nutrition into the pre-clinical curriculum using a problem-based learning format that enables students to incorporate nutrition into their patient care.

Background

Problem-based learning (PBL) has been widely adopted in U.S. medical schools and is believed to be highly effective for knowledge acquisition and clinical performance.¹¹⁻¹⁵ PBL is a case-based and evidence-based learning strategy that builds on linkages between basic science and clinical knowledge. Clinical cases are generally organized around organ systems. A basic premise of PBL is that it utilizes a deductive process that parallels the steps used most commonly in the evaluation and care of patients (Figure 1). This student-centered approach, in which small groups of students meet with a faculty facilitator, includes the steps of information gathering, problem identification, the judicious application of diagnostic tests, evaluation and interpretation of data, management decisions or therapy and intervention, and

Approach to the PBL Case

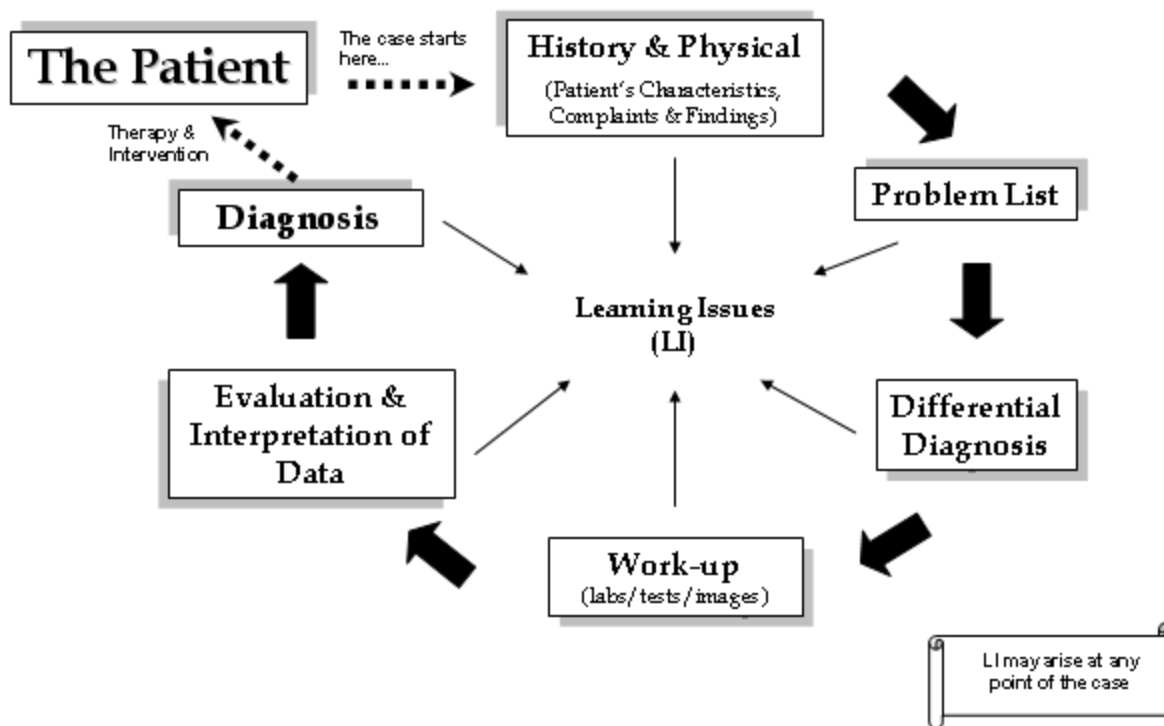


Figure 1. The PBL Process. Nutrition objectives and learning issues may arise at any point in the case.

outcomes monitoring. Students begin by developing a comprehensive written list of the patient's problems derived from a careful consideration of the medical history, physical examination, and laboratory tests. A differential diagnosis is generated by the students based on hypotheses developed from a discussion of the medical history. As laboratory data become available in the case, students can modify their hypothesis and become more focused on a specific diagnosis. Students are required to identify and complete 'learning issues' for each case that may be related to diagnosis, etiology, therapy, or prognosis. When nutrition is integrated into a PBL case, students develop an appreciation of the integral role of nutrition in the clinical management of the patient before they enter their clinical clerkships.

At the University of Texas Medical School at Houston (UTMSH), PBL was introduced into the curriculum in 1994. Over the past twelve years, more than forty PBL cases have been developed by UTMSH faculty 'working groups' composed of physicians, basic scientists, and medical educators. More than half of these cases contain nutrition issues and objectives related to the diagnosis,

treatment, or prevention of a disease. Nutrition learning issues are frequently identified as either risk factors for disease, as assessment parameters, or in many cases, as an essential part of the therapy and management of the patient. Students may choose to conduct an in-depth study of nutrition issues which are brought back to the group in written format and discussed. Groups of eight students meet with a faculty facilitator for two-hour sessions three days each week throughout the second year. The PBL curriculum has become immensely popular with both faculty and students at the UTMSH. Our medical school graduates over 200 students each year, many of whom continue their medical training in residency programs in primary care, primarily internal medicine, family medicine, and pediatrics.

Nutrition Instruction Prior to PBL

At our institution we have found it to be beneficial for the students if basic nutrition competencies are introduced during the first year pre-clinical didactic curriculum. These nutrition competencies are listed in Table 1, most of which are covered in Biochemistry or

Table 1. Nutrition Competencies Required for Successful Integration of Nutrition into PBL

- Macronutrients – daily requirements and substrate utilization
- Micronutrients – functions, food sources, deficiency and toxicity
- Energy requirements and components of caloric expenditure
- Protein requirements and nitrogen balance calculations
- RDA and DRI – rationale and application
- Criteria for a healthy diet – U.S. Dietary Guidelines
- Diet history taking
- Principles of nutrition assessment – anthropometrics, biochemical, clinical, and dietary
- Appropriate use of nutritional supplements
- Vegetarianism

Introduction to Clinical Medicine (ICM) during the first year. For example, students are taught the criteria for a healthy diet so that they understand the daily requirements of macronutrients, micronutrients, and energy. Students are expected to develop clinical skills for taking a diet history as part of the patient interviewing and medical history learned in ICM. When students master the core nutrition competencies and understand the components of a healthy diet they can move on to the application of nutrition principles in the context of a clinical case including recognition of nutritional problems that are exhibited by the patient. Nutritional assessment is another important pre-requisite for successful completion of PBL cases. These principles are learned through both a first year ICM course and a Physical Diagnosis course that is taught concurrently with PBL.

Incorporating Nutrition into PBL

Once a PBL case is developed, information concerning nutrition can be incorporated into the case's medical history, review of systems, and laboratory data. Examples of cases with nutrition content in the UTMSH curriculum are listed in Table 2. For each case, specific objectives

are developed. Examples of nutrition objectives for a patient with coronary artery disease are shown in Table 3. Students are not given the case objectives until the case review is finished. However, the faculty facilitators do use the objectives as a guide to help students complete the appropriate learning issues. It is important that each case include the patient's height and weight, BMI, history of weight gain or loss, and information about usual eating habits. In some instances, it is appropriate to include a 24-hour dietary recall or a food group analysis which could indicate deficiencies or excess of energy or certain nutrients. Relevant nutrition information provided in each PBL case should lead students to more focused learning issues on nutrition which can be completed as homework and shared with the whole group. A facilitator guide for each case contains an explanation of nutrition issues in each case.

Evaluation and Assessment of Nutrition Knowledge

In a medical curriculum where nutrition is integrated rather than taught as a separate required course, it is important to evaluate students on nutrition knowledge and clinical skills so that they recognize nutrition as an

Table 2. PBL Cases with Nutrition Content in the UTMSH Curriculum

- Cardiovascular Block – dyslipidemia, hypertension
- Endocrine Block – obesity, diabetes, thyroid disease
- Gastrointestinal Block – GERD, PUD, IBD, chronic liver disease
- Rheumatoid and Neuromuscular Disease Block
- Renal Block – CRF, ESRD dietary management
- Cancer Cases – risk factors, prevention, nutritional support during cancer therapy
- Pediatrics Cases – CF, failure to thrive, normal patterns of growth in early childhood and adolescence, nutritional anemias
- Osteoporosis Case – prevention and treatment
- HIV, AIDS Case – nutritional support

Table 3. Examples of Nutrition Objectives in a PBL Case: A Patient with Coronary Artery Disease.

- List the coronary risk factors (modifiable and fixed) and understand the effect of nutritional factors on serum cholesterol.
- Define a blood lipid profile and know the total cholesterol, LDL cholesterol, HDL cholesterol, and triglyceride levels that constitute desirable, borderline high, and high ranges for CAD risk.
- Define saturated fat, cholesterol, polyunsaturated fat, monounsaturated fat, trans fatty acids, and omega-3 fatty acids.
- List the major food sources of the different fats and know the effect of a diet containing these fats on blood cholesterol.
- Give the current recommendations of the AHA and percentages of fats in the AHA Step 1 and 2 Diets.
- Describe the effect of a high carbohydrate diet on serum triglycerides.
- Identify commonly used nutritional supplements for prevention and treatment of CAD and

important part of their medical training. A pre-test of nutrition knowledge during the first week of class was initiated as a pilot in 2000 followed by a post-test at the end of PBL in the second year. Students were informed in advance of the post-test, however, because it was not an integral component of their PBL evaluation and final grade, students did not prepare well for the exam and subsequently performed poorly on the post-test. We are currently assessing the curriculum and making plans to implement a nutrition knowledge survey and post-test in 2006-2007 that would reflect specific competencies needed prior to clinical clerkships in the third year. An exam consisting of clinical scenarios should also help students prepare for the Step 1 of the U.S. Medical Licensing Examination. It is important that both nutrition knowledge and clinical skills be reinforced during the clerkships particularly in internal medicine, family medicine, pediatrics, ob/gyn, and surgery.

The availability of the Association of American Medical Colleges' Graduation Questionnaire makes it possible to examine students' attitudes about the time devoted to nutrition in the medical curriculum in comparison to all U.S. medical schools (16). At the UTMSH, we have followed this data over the past decade and have seen a significant improvement in the percentage of students who responded that nutrition-related instruction was adequate. In 2000, only 10% of UTMSH students reported that time devoted to nutrition was appropriate compared to 24% nationally. By 2005, the percentage of UTMSH students reporting appropriate time devoted to nutrition was 46% compared to 47% nationally (**Figure 2**). The improvement in the students' perception of instruction time devoted to nutrition can be partly attributed to PBL but is also based on the addition of nutrition lectures to several basic science courses taught prior to or concurrently with PBL and in the

Internal Medicine clerkship. In addition, students have the opportunity to enroll in nutrition electives during the first, second, and fourth year of the curriculum.

Lessons Learned and Future Directions

We have learned that PBL offers several advantages for teaching nutrition in the medical curriculum. First, students are guided in the clinical application of nutrition in patient care both in the prevention and treatment of disease. Second, nutrition is taught in an evidence-based format as cases are updated to include new clinical guidelines and data from recent clinical trials. Third, students see how nutrition is integral in the overall care of the patient and identify with the role of the physician as a member of the health care team. Fourth, discussion of nutrition issues during cases reinforces students' interest in maintaining a healthy diet and in prevention of chronic disease. Fifth, discussions in the small group setting provide an opportunity for students to become comfortable in presenting nutrition information and preparing for patient interactions during clinical clerkships.

While the advantages of PBL are clear, we must also recognize that there are certain limitations of PBL with regard to developing students' competency in nutrition. These include the availability of faculty role models for nutrition in patient care, the need for encouragement by PBL facilitators for students to complete in-depth nutrition learning issues, and the institution's reinforcement of pre-testing and post-testing of nutrition knowledge. Facilitators have an opportunity to meet with case writers in the overview meetings and ask questions about particular nutrition issues in each PBL case. Depending on the dynamics of the individual PBL groups, nutrition competency may not be achieved by all students at the same level. However, the exposure

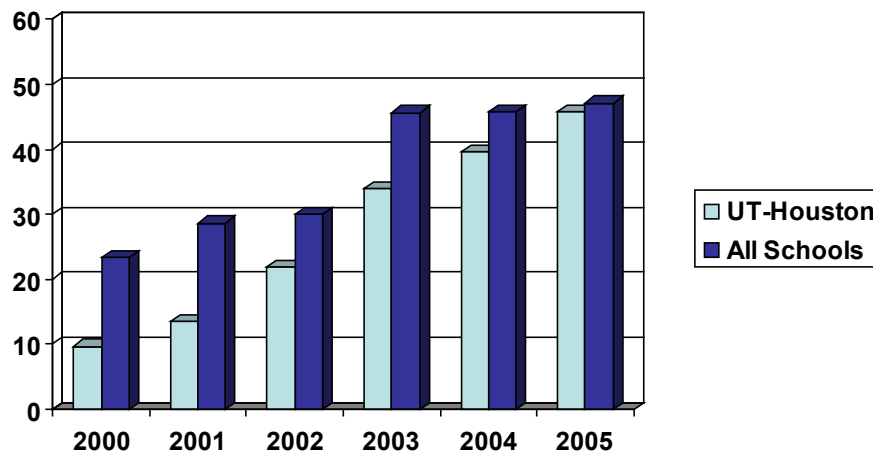


Figure 2. Association of American Medical Colleges Graduation Questionnaire Percentage of Students at UT-Houston compared to all U.S. medical schools who responded that curriculum time devoted to nutrition was appropriate from 2000 to 2005.

to nutrition in a case-based format should enable all students to develop basic proficiency in this area as they continue in their medical training.

Conclusion

Nutrition knowledge and clinical skills are important components of medical education and clinical practice. Using a problem-based learning approach for integration of nutrition can have a positive outcome for the students and reinforces the need to include nutrition in the management and care of patients. At the UTMSH students are introduced to core nutrition competencies and clinical skills in the first year didactic courses which allow them to apply nutrition in a clinically relevant format for the PBL cases. Nutrition assessment and clinical nutrition guidelines are reviewed during the Internal Medicine clerkship in the third year. Evaluation of students' nutrition knowledge and clinical skills remains a challenging area and one that deserves careful consideration and planning.

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