Self-reported nutrition proficiency is positively correlated with the perceived quality of nutrition training of family physicians in Washington State[1–3]

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ABSTRACT

Background: Despite concerted scientific, educational, and congressional calls to increase nutrition coverage in medicine for more than half a century, most graduating medical students report an inadequate quality and quantity of nutrition training. Furthermore, practicing physicians report a lack of confidence and related proficiency in nutrition counseling skills because of inadequate training. Assessment of nutrition proficiency and related training of practicing physicians may support the prioritization of nutrition topics to be included in medical education.

Objective: We tested the hypothesis that the perceived adequacy of nutrition training (quality and quantity) of family physicians in Washington State is positively correlated with self-reported nutrition proficiency in 5 nutrition factors determined after confirmatory factor analysis.

Design: A randomized mail survey method ($n = 778$ possible respondents), which involved one mass-mailing follow-up, was used.

Results: A 39.3% response rate was achieved ($n = 306$ respondents). The 31-item questionnaire was reduced to 5 factors, explaining 48.5% of the total variance ($\alpha = 0.916$). Perceived quality (poor to excellent) of nutrition training was positively correlated with self-reported nutrition proficiency scores for all 5 factors ($P < 0.01$). No significant differences were noted between zip code or sex and mean nutrition proficiency scores for all 5 factors.

Conclusion: The examination of correlations between perceived quality of education and self-reported proficiency may be a useful gauge of effectiveness of nutrition training in medicine. Prioritization of nutrition information based on proficiency levels, including information on complementary and alternative medicines and nutritional management of disease, merits further investigation. *Am J Clin Nutr* 2003;77:1330–6.

KEY WORDS Nutrition proficiency, medical-nutrition training, medical students, family physicians, Washington Academy of Family Physicians

INTRODUCTION

For more than half a century, concerted scientific, educational, and congressional efforts have been made to increase the nutrition training and skills of medical students and practicing physicians with limited success and have been outlined extensively in several medical-nutrition education articles (1–7). Despite these efforts, ≥ 50% of graduating US medical students continue to report that the time and content devoted to nutrition education in medical school are inadequate (8). This observation, however, is not limited to medical students. Primary-care physicians surveyed often avoid nutrition counseling because of their lack of training, confidence, and perceived proficiency in this area (9–11). This poses public health concerns because physicians are positioned to provide nutrition counseling and related diagnoses to many segments of the population, and their nutrition advice is regarded as both valid and reliable by the population at large (12). Furthermore, physician nutrition education has historically not been adequate to support national objectives for health promotion and disease prevention, such as the *Healthy People 2000* objective of reducing the prevalence of overweight persons (13). It is speculated that the achievement of one of the *Healthy People 2010* objectives, that 75% of physician visits related to cardiovascular disease and associated comorbidities include nutrition counseling (14), will require further attention to the content of nutrition information in medical school, residency, and continuing medial education (CME).

Research considering the nutrition proficiency or competence derived from nutrition training and practice of physicians should be a central consideration in medical-nutrition curriculum reform. Although performance-based clinical examinations and observation of physician-patient encounters may be the ideal model for assessing nutrition proficiency, this method can be costly in both time and resources and involves ethical concerns regarding human subjects approval. The alternative study design involves the use of self-reported measures of nutrition proficiency, which could serve as a proxy for actual proficiency. In a study of concurrent and predictive validity of self-reports of performance of college-bound students, Baird (15) indicated that self-reports are often as valid as are more extensive and expensive tests in similar areas, concluding that "one can believe and make decisions based on self-report

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TABLE 1
Priority nutrition topics to consider in developing a nutrition course for medical students[1]

Rank	Topic
1	Obesity
	Diet, hyperlipidemia, and atherosclerosis
	Lipids
	Diet and diabetes
	Pregnancy and lactation
	Water, electrolytes, and acid-base balance
	Major minerals
2	Carbohydrates and fiber
	Vitamins
	Proteins and amino acids
	Cell growth, infancy, and adolescence
	Nutrition and immunity
3	Nutritional assessment and support
	Nutrition in surgery, trauma, and infection
	Diet and hypertension
	Body weight, body composition, and energy balance
	Geriatrics
	Nutrition and cancer
	Function of the gastrointestinal tract
	Criteria of an adequate diet
	Nutrition in diseases of the gastrointestinal tract
	Hormonal control of nutrient metabolism
4	Nutritional anemias
	Drug-nutrient interactions
	Trace minerals
	Nutrition and alcohol and other substance abuse

[1] Topics are listed in descending order of importance within each priority level and were derived from the list of 42 topics outlined by The American Society for Clinical Nutrition's Committee on Medical/Dental School and Residency Nutrition Education (21).

information in a wide variety of areas just as much as one can believe and use test information."

We tested the hypothesis that perceived adequacy of nutrition training (quality and quantity) of family physicians is positively correlated with self-reported nutrition proficiency. At the national level, quality indicators of nutrition training may be of particular import because only 26% of US medical schools have a separate, required nutrition course (16). Furthermore, there is currently no systematic method for measuring the adequacy of nutrition education and related nutrition proficiency in medical school curricula. Although several published studies have focused on the association between nutrition knowledge and related training, recent literature suggests that there is a stronger relation between measures of perceived proficiency and prospective patient counseling (17), which is at the heart of health care education reform.

SUBJECTS AND METHODS

A mail survey of members of the Washington Academy of Family Physicians (WAFP) was developed, administered, and analyzed in accordance with Human Subjects Exemption procedures. Face validity—or the examination of whether the survey instrument in question appears to measure the variable of interest, in this case, nutrition proficiency (18)—was determined by a group of nutrition experts that were either affiliates or members of the National Heart, Lung, and Blood Institute's Nutrition Academic Award Program at the University of Washington (19). In 1997, the National Heart, Lung, and Blood Institute developed the Nutrition Academic Award Program with the main objective to design and implement effective nutrition curricula for physician-education and -training programs (20).

A randomized survey mailing to 50% (n = 803) of the active WAFP members, which was sufficient to achieve adequate study power and remain within budgetary constraints, took place in mid-May of 2000. Randomization was carried out via the Excel database (Microsoft Corp, Redmond, WA). The original mailing included a postcard to be filled out by subjects not wishing to respond and included basic demographic information, a personalized cover letter, the 2-page nutrition proficiency and needs survey, return envelopes, and a quarterly, 1-y newsletter entitled *MD-RD Quarterly*. The newsletter was used to provide optional CME opportunities (one CME credit per newsletter) and as a strategy to increase survey response rates. The initial mailing was followed by a second mass-mailing follow-up to all potential respondents in early July 2000.

The survey consisted of 31 questions about self-reported nutrition proficiency based on 26 core nutrition areas outlined by Roland Weinsier in his National Dairy Council Award for Excellence in Medical/Dental Nutrition Education lecture (21; **Table 1** and Appendix A). The 31 nutrition proficiency items also included questions related to proficiency in counseling on complementary and alternative medicine (CAM) in view of an estimated 1 in 3 Americans that use unconventional therapies annually (22) and on food safety, in consideration of the most recently published *Dietary Guidelines for Americans* (23).

Self-reported nutrition proficiency scores of 31 nutrition items were determined by using a modified Likert rating scale. The question was worded as follows: "Do you feel comfortable in terms of your level of nutrition knowledge or patient counseling skills in the following areas...", where Y indicates "yes, totally proficient;" S indicates "somewhat proficient;" N indicates "no, not proficient;" and NA indicates "not applicable to my practice." To further assess potential deficits in nutrition information, an open-ended question regarding the 3 most common nutrition questions encountered in medical practice was included.

Other survey questions included a simple attribute rating scale of the quality of nutrition training (poor to excellent) in medical school, residency, and CME and quantity (presence or absence) of nutrition training in medical school and residency, referrals to registered dietitians, importance of applied nutrition information in medical practice, use of nutrition resources and basic demographic information (including sex, age, and years practicing since residency), and zip code. Data were analyzed by using SPSS 10 for WINDOWS software (24).

Factor analysis

In a detailed overview of factor analysis, Gorsuch comments that "all scientists are united in the common goal: they seek to summarize data so that the empirical relationships can be grasped by the human mind" (25). In factor analysis, statistical methods are used that allow the researcher to reduce data and, by doing so, make the data more manageable and the related findings more meaningful. In our study, confirmatory factor analysis was used, which tests specific hypotheses regarding the nature of the factors (26)—in this case, whether a relation exists between self-reported nutrition proficiency and perceived adequacy of nutrition training (quality and quantity) in 5 proposed factors. This statistical procedure allowed us to reduce the 31 items in the nutrition proficiency survey to 5 subscales or factors. Principal component analysis was used to extract the factors, and Varimax was used to rotate the factors. Essentially, these procedures allow each factor

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TABLE 2
Ranked proficiency factors, α values, and narrative of loaded nutrition items

Factor 1:	Nutrition and prevention/wellness (α = 0.678): benefits of aerobic exercise and osteoporosis prevention and treatment, significance of modest weight loss in type 2 diabetes, moderate alcohol consumption in health and disease,[1] and role of water and hydration in health
Factor 2:	Macronutrients in health, including food safety (α = 0.697): dietary cholesterol and saturated fat, assessment of total calories and saturated fat with the food label; calories per gram of macronutrients and their basic metabolic roles, avoidance of cross-contamination, and serving sizes of meat and dairy from the food guide pyramid
Factor 3:	Women, infants, and children (α = 0.787): breast-feeding and maternal and infant benefits and challenges, use of growth-chart tables and interpretation, advice on feeding infants with colic, common nutrient deficiencies of adolescent women, calculation of BMI and waist-to-hip ratio based on sex,[1] and role of genetics, diet, and pharmacology in weight loss[1]
Factor 4:	Micronutrients in health, including herbal supplements (α = 0.809):[2] use of vitamins, minerals and herbal supplements and drug interactions; n−3 and n−6 fatty acids in heart health; probiotics; antioxidant-rich produce; food constituents, including phytonutrients and soy; (gastrointestinal intolerances, maldigestion, and malabsorption); and (reported health risks of high-protein, high-fat diets)
Factor 5:	Nutrition and disease management (α = 0.715): recommended dietary patterns for type 2 diabetes, recognizing warning signs and symptoms of eating disorders, nutritional risks of the elderly, nutrition for weight loss and cachexia, indications and contraindications of enteral and parenteral nutrition,[3] and nutrition education for patients with a recent diagnosis of HIV infection[3]

[1] Moderate-factor loading items (0.334–0.387).
[2] Items in parentheses are nonintuitive items loading on the factor.
[3] ≥5% of respondents indicated "not applicable to practice."

to be as mathematically independent from each other as possible. To measure reliability or internal consistency of the 5 factors or how well the variables in each factor relate as a group, Cronbach's coefficient α was tabulated—the closer the values are to 1, the greater the reliability. Factor loadings were also tabulated, which are basically the degree of generalizability (correlation coefficient) between each variable and the factor it loads onto—the farther the factor loading is from 0, the more one can generalize from the factor to the variable of interest.

Development of composite scores for nutrition proficiency factors

Mean nutrition proficiency composite scores were calculated for each factor by summing the proficiency scores (totally proficient, partially proficient, and not proficient) of the 31 items and dividing the sum by the number of items in each factor. Division by the number of items in each factor was necessary because factors varied in the number of items loading in each. To treat the proficiency score as a continuous variable, all proficiency items considered "not applicable to practice" by respondents were eliminated from the analyses.

Development of composite scores for nutrition training

Composite scores for quality of nutrition training were developed by adding quality of training scores in medical school, residency, and CME together (poor, fair, good, very good, or excellent) to develop a single variable or measure for each subject. Point biserial correlations were also assessed between quantity of nutrition training in medical school and residency (presence or absence) and nutrition proficiency scores in the 5 factors.

RESULTS

Characteristics of respondents

Of a total of 803 mailings, there were 778 possible respondents [25 (3.1%) of the mailings were returned undelivered or were unusable for other reasons]. A 39.3% response rate was achieved (306 survey respondents). The respondents had a mean and median age of 44 y, and 54.2% were female (n = 166). Urban zip codes were provided by 39.9% of respondents (n = 122), and 60.8% of respondents (n = 186) had been practicing medicine for > 10 y. Compared with the entire WAFP population, the respondents were nearly identical in terms of the years practicing medicine (60% had been practicing medicine for > 10 y) and mean age (45 y), but were overrepresented in having urban zip codes (20% of the total WAFP had an urban zip code) and in the number of female responders (33.7% of the total WAFP population was female). No significant differences were noted in sex or zip code and mean self-reported nutrition proficiency scores in all 5 factors.

Factor analysis

The 5 subscales or factors explained 48.5% of the total variance. The α of the 31-item nutrition proficiency instrument was 0.916 (n = 295). After confirmatory factor analyses were used, the 5 factors were named, and α values for each factor and factor loadings for each item were determined (**Table 2**). The percentages of subjects reporting nutrition proficiency items as "not applicable to practice" that were removed from analyses when developing composite scores were all from the "Nutrition and Disease Management" factor and included proficiency in *1*) nutrition education for recently diagnosed HIV infection (19%; n = 59) and *2*) indications and contraindications of enteral and parenteral nutrition (5.3%; n = 16). In all other items, ≤ 2.5% of subjects responded "not applicable to practice."

Ranking

The 31 nutrition items and corresponding factors were ranked according to mean nutrition proficiency scores. A rank of 1 is considered the highest ranking factor (most proficient) and a rank of 5 is the lowest ranking factor (least proficient) (Table 2). All factor loadings were found to be positive. Only 3 nutrition proficiency items had factor loadings < 0.4 and included *1*) measuring body mass indexes and waist circumference based on sex; *2*) the role of genetics, diet, and pharmacology in weight loss; and *3*) definition of moderate alcohol consumption and its role in health and disease. When moderate loading items and items considered not applicable to practice were removed from the factor analysis, factor loadings and α values generally decreased for all factors.

Nutrition training

Quantity of nutrition training

Of the 59.2% of respondents reporting that they received nutrition training in medical school (n = 181), 22.1% reported that their training was adequate (40/181). In factors (F) 3 and 5, significant positive correlations (P < 0.01) were observed between self-

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TABLE 3
Quality of nutrition training in medical school, residency, and continuing medical education (CME)

Nutrition training	Respondents	Response				
		Poor	Fair	Good	Very good	Excellent
	% [n]			*% [n]*		
Medical school	84.3 [258]	48.8 [126]	26.4 [68]	15.1 [39]	8.1 [21]	1.6 [4]
Residency	83.3 [255]	44.7 [114]	28.2 [72]	20.8 [53]	5.9 [15]	0.4 [1]
CME	74.5 [228]	24.6 [56]	28.5 [65]	25.9 [59]	17.1 [39]	3.9 [9]

reported nutrition proficiency and perceived quality (presence) of nutrition information in medical school (F3 = 0.159, F5 = 0.185) and residency (F3 = 0.130, F5 = 0.281).

Quality of nutrition training

Most respondents reported nutrition training as either poor or fair in medical school, residency, and CME, with improvements in perceived quality of training increasing from medical school (**Table 3**). Furthermore, as the perceived quality of training in medical school, residency, and CME increased (poor to excellent), proficiency scores in all 5 factors increased (**Table 4**). Self-reported nutrition proficiency was positively correlated with the perceived quality of nutrition training in all 5 factors determined after confirmatory analysis ($P < 0.01$).

DISCUSSION

In this study we showed that perceived quality of nutrition training was positively correlated with the self-reported nutrition proficiency of a survey sample of practicing family physicians in Washington State. This correlation was observed in all 5 nutrition factors ($P < 0.01$). Because a large proportion of US medical schools do not have a quantified amount of nutrition information, quality indexes may serve as a more universal predictor of nutrition proficiency than do quantity indexes. Currently, the Association of American Medical College's All Schools Graduation Questionnaire places most of its emphasis on the relation between the time devoted to training and the adequacy of medical education on various topics, including nutrition. It is possible that perceived quality of training may be a more useful gauge of proficiency and related practice and merits further investigation.

In an earlier study, nutrition knowledge of a 21% sample of senior medical students at 10 southeastern medical schools was positively correlated with the student assessment of the quality (0.35) and quantity (0.28) of nutrition education (27). Moreover, most of the medical students participating in this study felt that the quality and quantity of their medical-nutrition training was inadequate. Positive correlations between perceived quantity of nutrition information in medical school and residency and self-reported nutrition proficiency were also observed in 2 factors in our study. Of particular interest, a correlation between perceived quality and quantity of nutrition training was observed in the lowest proficiency factor, nutrition and disease management, underscoring the necessity for its inclusion in medical education. Perhaps, for all 5 factors, the use of a dichotomous variable (absence or presence) as a quantitative measure of nutrition training was not sufficient to observe this association. Furthermore, most of the physicians surveyed had been practicing medicine for > 10 y and, as such, it may have been difficult for participants to accurately recall the quantity of nutrition training.

TABLE 4
Pearson's correlation coefficients between composite scores of perceived quality of nutrition training in medical school, residency, and continuing medical education and self-reported nutrition proficiency (factors 1–5)[1]

Nutrition proficiency factors	Quality of nutrition training
Factor 1: Nutrition and prevention/wellness	0.221 [274]
Factor 2: Macronutrients in health, including food safety	0.338 [270]
Factor 3: Women, infants, and children	0.265 [263]
Factor 4: Micronutrients in health, including herbal supplements	0.298 [269]
Factor 5: Nutrition and disease management	0.335 [215]

[1] Number of respondents in brackets, excluding those who indicated "not applicable to practice." All coefficients were significant, $P < 0.01$.

We developed a self-report nutrition proficiency instrument with the aim that assessing physician confidence derived from training or practice in essential nutrition topics would facilitate prioritization of nutrition content in medical education. Focusing on physician nutrition proficiency is in line with the national objectives of *Healthy People 2010* (14) and the US Preventive Services Task Force (28) to increase physician nutrition counseling. As knowledge does not always connote confidence and corresponding practice, measuring proficiency levels in nutrition areas may be a more effective modality for prioritizing nutrition information in medicine.

Although establishing construct validity of measurement instruments is a process, the positive, moderate, or high factor loadings or correlation coefficients between the variables and their respective factors—the α or the reliability of the survey instrument (0.916) and individual factors (0.678 to 0.809)—and the normal distributions of nutrition proficiency composite score histograms provide preliminary evidence that we have developed an acceptable index of nutrition proficiency and related training needs for this population. The lowest scoring proficiency items, including nutrition in disease management and micronutrients (including herbals), merits further investigation in other study populations (including medical students) to confirm their emphasis in medical education. Arguably, the less evidence-based topics—such as CAM—are the most challenging to teach. Although improvements have been made since 1999, > 50% of graduating medical students who responded to the Association of American Medical College's All Schools Graduation Questionnaire recently reported that time devoted to instruction in CAM was inadequate (8). Because of heightened consumer and patient demand for information on CAM and the obligation of physicians to be informed on this topic, medical educators should be responsible for developing innovative teaching strategies in this area. Essential topics in medical curriculum, as reported by The American Society for Clinical Nutrition (21) and more extensively by the American

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Medical Students' Association (29), overlook prioritization of CAM in medical education. Yet, information on adverse interactions of medications with botanical supplements or foods, and "red flag" supplements such as ephedra or ma huang are important considerations in patient care.

In terms of individual nutrition items, physicians reported the highest proficiency in counseling on lifestyle components other than diet, including overall benefits of aerobic exercise on health and well-being, strategies for osteoporosis prevention and treatment (presumably, they would counsel on benefits of weight-bearing exercises), definition of moderate alcohol consumption and its role in health and disease, and the significance of modest weight loss for patients with insulin resistance syndrome. Other high-proficiency items included items related to macronutrients and health, such as water and hydration, and pediatric nutrition, including the use growth-chart tables from the National Center for Health Statistics. On the basis of our current study (31 nutrition proficiency items), greater attention to nutrition in disease management—such as the management of comorbid conditions associated with obesity and high-protein, high-calorie diets for HIV, cachexia, and weight loss—is warranted in medical education. Interestingly, the items with the lowest proficiency corresponded to the most common nutrition inquiries that the respondent would like to be better equipped to answer. We plan to publish these descriptive findings elsewhere, including the observation that almost all respondents were referring to a registered dietitian.

Suboptimal reports of perceived quality of nutrition training in medical school, residency, and CME also indicate the need to consider information deemed essential by practicing physicians, because >40% of respondents indicated that their nutrition training was poor in medical school and residency; 22% of respondents reported adequate training in medical school, which is less than the national average of graduating medical students (8). Although quality reports of nutrition training improved in residency and CME compared with medical school, they merit further improvement at all levels of education. Because >60% of WAFP survey respondents had been practicing medicine for >10 y, it is possible that the survey results do not reflect the opinions of recent graduates, which will be examined at the University of Washington.

This study has several limitations. First, we studied only one population of family physicians; therefore, the generalizability of these results is questionable. Furthermore, response rates of ≥60% are suggested for findings to be generalizable to other populations (30). However, Hazard Munro (31) argues that a ratio of 10 subjects for each variable is desirable to generalize from the sample to a wider population, which was achieved in this study design (31 items; 306 respondents). Also noteworthy is the fact that compared with the entire WAFP population, survey respondents had almost identical mean ages and years of practice since residency. Second, there was an overrepresentation of urban female respondents. Yet, in our study sample, sex and zip code did not significantly affect nutrition proficiency in any of the 5 factors. Last, it is critical to determine whether self-reports are testing actual nutrition proficiency levels. We plan to further refine, administer, and analyze this survey instrument in a cross-sectional study of medical students to gain more insights into the relation between self-reported nutrition proficiency and perceived adequacy of nutrition training, including temporal relations, to further prioritize nutrition information in medical education.

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APPENDIX A

Nutrition Survey for Family Practitioners of Washington State

Please take 7 to 9 minutes of your time to fill out this brief survey. Your participation and comments are critical to the success of this project.

1a. Do you feel comfortable in terms of your level of nutrition knowledge or patient counseling skills in the following areas (check one box per item using the following scale):

Y = Yes, **Totally proficient**
S = Somewhat Proficient
N = No, Not Proficient
NA = Not Applicable to my practice

Y	S	N	NA	
				Strategies for osteoporosis prevention and treatment, including nutrition and lifestyle.
				Nutrition education for a patient recently diagnosed with HIV infection.
				Assessing the total calories and saturated fat per portion of food by using the food label.
				Significance of modest weight loss for patients with insulin resistance syndrome (diabetes).
				Calories per gram of protein, carbohydrate and fat, and their basic metabolic roles.
				Generalized mechanism for the pro-biotic use of yogurt and acidophillus.
				Means of identifying antioxidant-rich produce while grocery shopping.
				Overall benefits of aerobic exercise on health and well-being.
				Role of water and hydration in health, and fluid needs based on activity level and age.
				Calculation of body mass index (BMI) and waist-to-hip ratio based on gender.
				Scientifically confirmed benefits of St. John's Wort and Echinacea.
				Indications for the use of single vitamins (ie: B, C, E) or multivitamin-mineral supplements.
				Role of omega-3 and omega-6 fatty acids in heart health.
				Nutrition concerns of patients with GI intolerances, maldigestion or malabsorption.
				Reported health risks of high protein/high fat diets, such as the Atkins diet.
				Maternal and infant benefits and challenges anticipated with breast-feeding.
				Avoidance of cross-contamination when preparing and storing foods.
				Common nutrient deficiencies of adolescent women.
				Role of genetics, diet and pharmacology (Orlistat, Sibutramine) in weight loss regimens.
				Advice on feeding a colic infant breast milk versus soy formulas.
				Examples of a serving size of meat or dairy from the Food Guide Pyramid.
				Role of food constituents in health (phytonutrients, dietary fiber, soy, etc).
				Potentially harmful interactions of medications with herbal or botanical supplements.
				Definition of moderate alcohol consumption and its role in health and disease.
				Nutrition strategies for persons losing weight due to chronic illness or cachexia.
				Recognizing warning signs and symptoms of patients with eating disorders.
				Interpretation of growth chart tables and pertinent trends for a child with Failure to Thrive.
				Indications and contraindications for enteral and parenteral nutrition.
				Role of dietary cholesterol and saturated fat in elevating blood lipids.
				Recommended dietary patterns for non-insulin dependent (Type 2) diabetes mellitus.
				Recognition of nutritional risk in elderly patients.

1b. Mark an asterisk * beside the three above topics that your patients most often inquire about.

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