Nutrition–drug interactions: A Web-based approach to pharmaceutical care in Greece

Maria Skouroliakou, Maria-Nikoleta Thanopoulos, Giorgos Maravelias, Panos Papandreou, Dimitrios Ntountaniotis, Efi Daskalou, and Thomai Karagiozoglou-Lampoudi

Abstract

Objectives: To evaluate Greek pharmacists' willingness to use a new Web-based software program to detect drug–food interactions, to assess the experience of those pharmacists opting to use the program, and to estimate the public benefit associated with use of the program.

Practice innovation and results: The Nutrition-Drug Interaction program was developed to enable Greek pharmacists to access an online database of medication-related information, including detailed drug and pharmaceutical company listings, nutritional guidelines for patients, potential drug–food and drug–drug interactions, and reaction alerts. More than 50% of the community pharmacists agreeing to use the program found it "quite useful" or "very useful," with more than 62% saying they were "very satisfied" or "quite satisfied" with the quality of information provided through the program.

Conclusion: A significant proportion of Greek pharmacists, especially those 50 years of age or younger, found a new Web-based drug–food interaction software program to be both informative and useful. Participating pharmacists reported that use of the new program enhanced their role as health consultants and helped improve the quality of the patient services they provide.

Keywords: Drug–food interactions, pharmacotherapy, personalized medicine, Internet.

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Maria Skouroliakou, PhD, is Assistant Professor, Enteral and Parenteral Nutrition, Department of Nutrition and Dietetics, Harokopio University of Athens, Athens, Greece. **Maria-Nikoleta Thanopoulos, MSc,** is Dietitian–Nutritionist and Collaborator, IASO Clinic, Athens, Greece. **Giorgos Maravelias** is R&D Technical Director, Netmechanics LLC, Heraklion, Crete, Greece. **Panos Papandreou** is PharmD candidate, School of Pharmacy, Northeastern University, Boston, MA. **Dimitrios Ntountaniotis, PhD,** is postdoctoral researcher, Department of Chemistry, National and Kapodistrian University of Athens, Athens, Greece. **Efi Daskalou, MSc,** is Dietitian–Nutritionist and PhD candidate, Department of Nutrition and Dietetics, Clinical Nutrition Laboratory, **Thomai Karagiozoglou–Lampoudi, MD, PhD,** is Professor of Clinical Nutrition, Department of Nutrition and Dietetics, Alexander Technological Education Institute of Thessaloniki, Greece.

Correspondence: Maria Skouroliakou, PhD, Department of Nutrition and Dietetics, Harokopio University of Athens, 70, L. Venizelou, Kallithea, 17671, Greece. E-mail: mskour@hua.gr

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Drug–food interactions are responsible for a variety of adverse medical consequences, nutrient depletion, and possible malabsorption.[1] Poor nutritional status, food intake, and nutrient composition all can affect how drugs are metabolized and absorbed. Drugs may interfere with the availability and utilization of certain nutrients (e.g., vitamins, electrolytes, or trace elements). Patients with diseases are among those most at risk for drug–food interactions. The potential effects of drugs on health and nutritional status include anorexia, weight changes, malnutrition, and gastrointestinal abnormalities. However, such effects are easily avoided by adhering to specific nutritional guidelines or medication regimens.[2]

The Joint Commission emphasizes the need for pharmacists to provide counseling to patients[1] and to inform them about health-related nutritional matters.[3] An educational tool that provides detailed information on drug–food/nutrient interactions has the potential to help pharmacists amplify their advisory role and to improve public health.

Patients need access to both medications and pharmacist-delivered patient care services to achieve optimal health outcomes. Currently, in most U.S. and European countries, pharmacists and practitioners are actively involved in the appropriate use of pharmaceutical agents, the provision of adequate drug information, and monitoring for positive outcomes and safety of their patients during pharmacotherapy treatments. Pharmacist counseling and other patient care services targeted for disease prevention decreases the numbers of medicine-related adverse reactions and improves public health.

Greek pharmacists are generally well-educated scientists, but pharmacy practice in Greece has not reached an advanced stage. The country currently lacks a dedicated drug information center. Most community pharmacists in Greece stay behind the counter and do not counsel patients about prescriptions. The absence of appropriate tools (e.g., software providing detailed information about drug–food interactions or frequently updated national guidance on medication use) contributes to the restrained role of Greek pharmacists. To date, there is no evidence in international literature of research exploring the role of the community pharmacist in Greece.

At a Glance

Synopsis: While well educated, most community pharmacists in Greece primarily work behind the counter and offer limited patient consultation. This is due in part to the absence of appropriate informational support systems. This interview-based survey assessed the willingness of 106 pharmacists from pharmacies located throughout Athens to use a new Web-based software program to detect food–drug interactions as well as the experiences of those opting to use the program and the public benefit associated with program use. Of the 37 pharmacists ultimately participating in field-testing, more than 50% found it useful and more than 62% expressed satisfaction with the information provided.

Analysis: *The study authors found that pharmacists aged 50 years and younger and those with the greatest number of patients per week were most open to the concept of the new software program. Of those opting to use the program, 73% provided patient consultation based on nutritional information obtained from it, with 44% receiving positive patient feedback. The authors concluded that new software programs such as this one can play an important role in helping pharmacists detect food–drug interactions while enhancing their role as health consultants.*

Objectives

The goals of this survey are to evaluate Greek pharmacists' willingness to use a new Web-based software program to detect drug–food interactions, to assess the experience of those pharmacists opting to use the program, and to estimate the public benefit associated with use of the program.

Methods

The Nutrition–Drug Interactions program

While many websites currently provide information on drug–drug or substance–substance interactions (e.g., www.drugs.com, reference.medscape.com, www.healthline.com), none includes specific reference to medications marketed in Greece. This new Web-based software program designed specifically for Greek pharmacists provides information on the interactions between locally available drugs and foods/nutrients. While the first version of the program was written in Greek, a second version was translated into English for use worldwide.

The Nutrition–Drug Interactions program lists more than 400 pharmaceutical companies, approximately 1,800 generic substances, and 10,500 medicinal products and their code numbers. The program also describes general product characteristics, including dosage form, barcode, package size/type, and drugs' classification under Greece's proprietary ranking system, which is based on the World Health Organization's (WHO) Anatomical Therapeutic Chemical (ATC) classification system. An additional sub-tab provides general nutritional guidelines for children and adults with and without diseases who are taking prescription medication, herbal products, or supplements.

Additional information incorporated into the software includes potential drug–drug interactions; reaction alerts; oral and gastrointestinal effects; proper med-

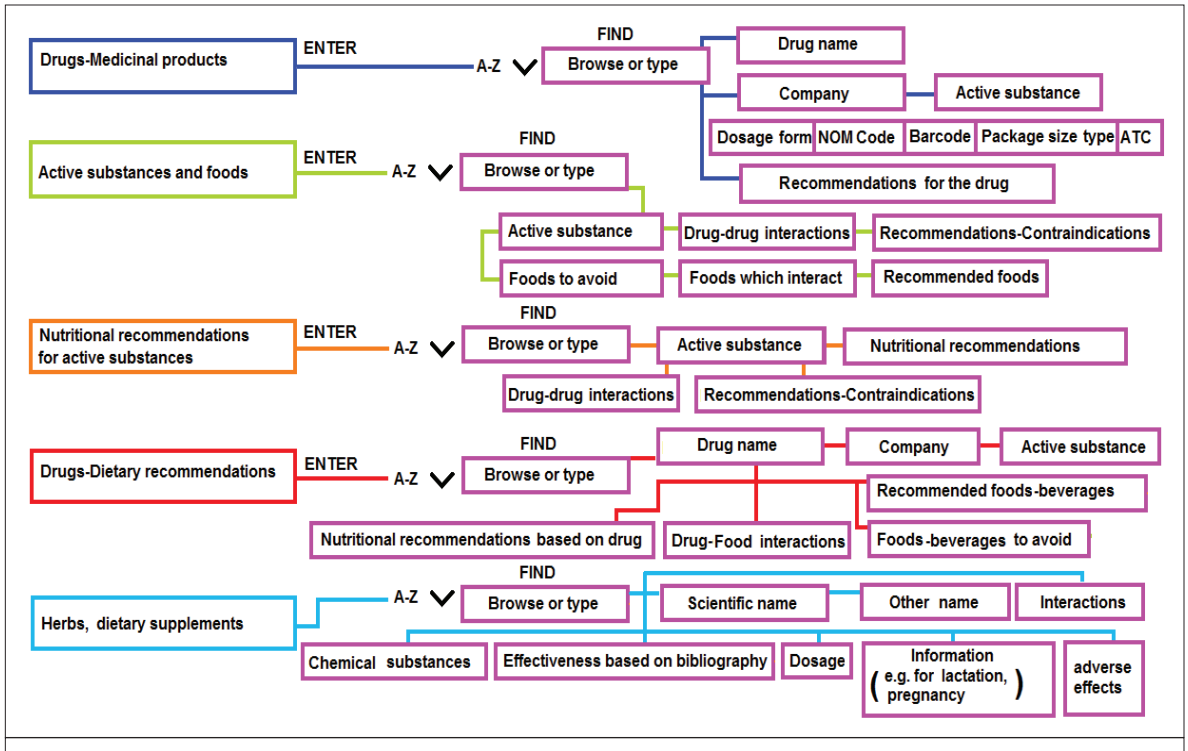

Figure 1. Schematic representation of the elements of the Nutrition–Drug Interaction program

ication administration; clinically important food/fluid intake recommendations related to particular medications; manufacturer's official recommendations on the use of specific drugs while lactating or pregnant; commonly published recommendations for specific monitoring of patients; reported alterations in laboratory values or condition; interactive effects of food, vitamins, minerals, and/or other supplements; nutritionally interactive excipients under each brand name; and specific dietary recommendations, contraindications, and precautions (Figure 1).

The software also includes nutritional facts on macronutrients and micronutrients (e.g., calcium), as well nutrition information related to specific conditions (e.g., nausea).

Study design

Quantitative research was designed based on personal interviews with 106 pharmacists from randomly selected pharmacies located throughout Athens, Greece (19 in the north, 25 in the south, 12 in the east, 11 in the west, 23 in downtown Athens, and 16 in the port city of Piraeus). Of the pharmacies represented in the survey, 32 were local neighborhood pharmacies, 26 were close to hospitals, 20 were close to social security organizations, and 28 were in center points in the region of Attica.

Two structured questionnaires with a combined total of 81 closed and open questions (see Appendices, available under Supplemental Content on JAPhA.org) were used to assess the thoughts and experiences of participating pharmacists, with the first administered prior to use of the new program, and the second administered afterward.

The first phase of research comprised interviews with the 48-item questionnaire A (see Appendix A, available under Supplemental Content on JAPhA.org). Conducted in person by authorized personnel (Medi-Mark Ltd., Athens), these interviews were designed to assess pharmacists' attitudes and opinions about their perceived role and the value of providing consulting services.

After the interviews, those pharmacists opting to use the program participated in a three-month trial of the new software. Each pharmacist was e-mailed a user name and password along with an instructional form describing the program and how to install it. Participants were also provided with the contact information for a specialized nutritionist and the program developer, both of whom were available to offer further instruction or training via video conferencing. To verify use of the program, follow-up phone calls were made 15 days after providing the passwords and other information.

The second phase of research involved participants' self-completion of the 33-item questionnaire B (see Appendix B, available under Supplemental Content on JAPhA.org). This set of questions was designed to assess

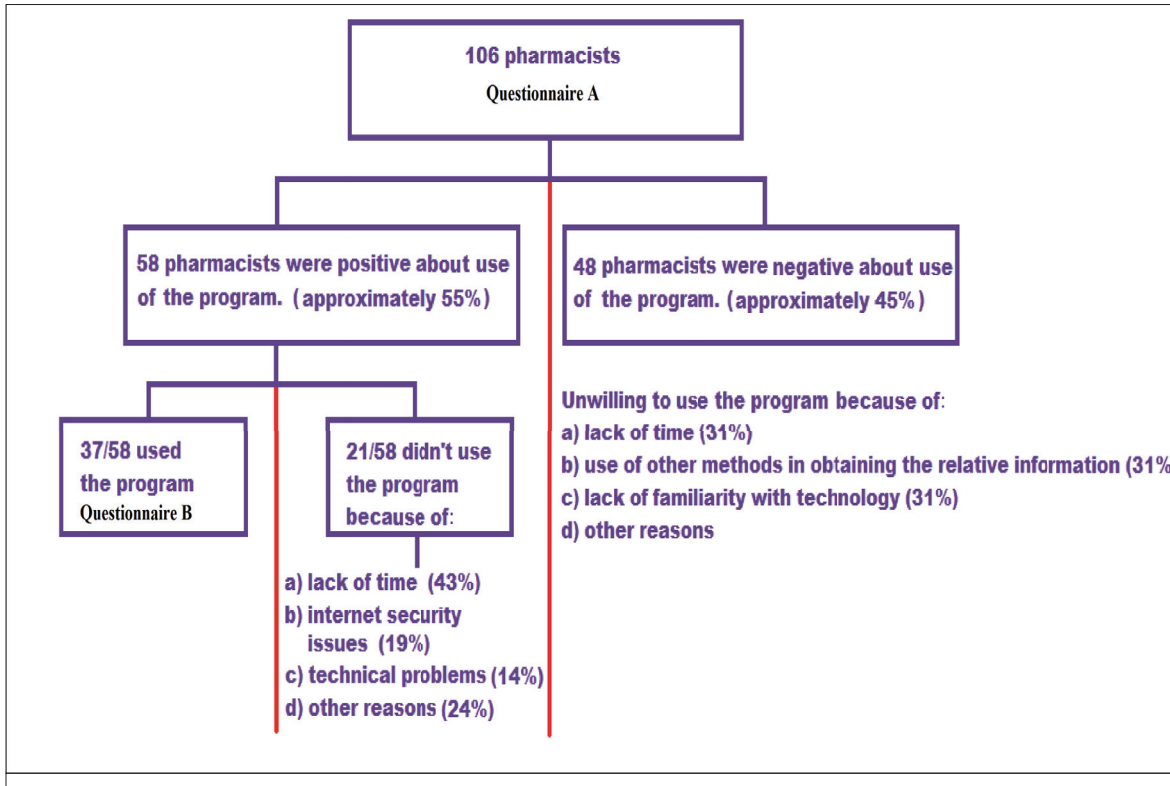

Figure 2. Study design

pharmacists' hands-on experience with the Web-based program in terms of such parameters as ease of use, degree of utility, and satisfaction with the information included. Participants were also asked to suggest any changes or improvements to the program, as well as about their plans for future use of the software.

Inclusion criteria for study participation were Internet access, valid e-mail address, and location in the Attica region. The sole exclusion criteria was lack of Internet access.

Of the 106 pharmacists interviewed in the first phase of research, 37 ultimately field-tested the program. Those testing the software were separated into groups based on pharmacist age and the number of clients served at their pharmacy on a weekly basis.

QPSMR software was used for data entry and SPSS version 20 was used for analysis. Descriptive statistics, Pearson's correlation coefficient, logistic regression, and principal component analysis (PCA) were performed. To explore whether there was an underlying factor structure of the pharmacists' opinion and attitudes toward their role, the importance of advice, and attitudes toward use of the Web-based program, a factor analysis was performed.

Results

Of the 106 pharmacists interviewed with questionnaire A, 58 (55%) agreed to use the new program. The other 48 pharmacists (45%) declined to participate further because of lack of free time (31%), use of other methods to obtain similar information (31%), lack of familiarity with technology (31%), and other reasons (7%). Ultimately, 37 pharmacists participated in the actual field-test, with the remaining 21 citing lack of time (43%), Internet security issues (19%), and/or technical problems (14%) as primary reasons for opting out (Figure 2).

First phase

Based on the findings of the first-phase interview (questionnaire A), pharmacists regarded themselves more as health consultants than as business owners. When asked about the extent of their knowledge on nutritional issues, 17% characterized it as "very satisfactory" and 58% said it was "quite satisfactory." Comparatively, 42% of those pharmacists interviewed said their knowledge on health matters was "very satisfactory." In relation to both health and nutritional issues, 31% of pharmacists said they offer advice to patients on their own initiative "very often" and 44% said they do so "quite often" Interviewees also noted that nutrition is one of the most common issues for which they provide advice.

Table 1. Pharmacists' evaluation of new Web-based software program

	No. clients served/week (% total)			Pharmacist age (years) (% total)		
Statements	**≤50 (31%)**	**51–80 (46%)**	**≥81 (23%)**	**≤40 (24%)**	**41–50 (32%)**	**≥51 (44%)**
Find the idea useful			+		+	
Find the idea feasible			+		+	
The program would improve sales			+		+	
The program would improve the pharmacy's image			+	+		
Initially in favor of trial use			+	+		
Initially unfavorable to trial use	+					+
Actually used program		+	+	+		

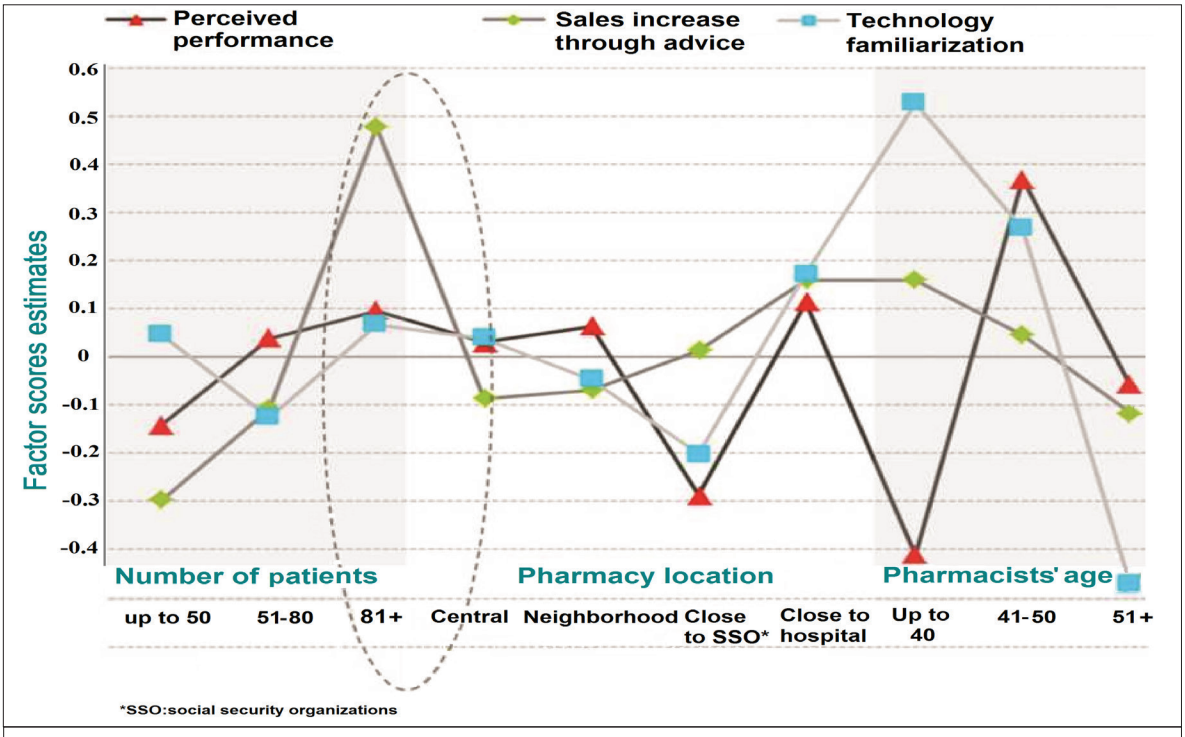

Figure 3. Pharmacists' intention to test the program according to components 1, 2, and 3

Based on demographic analysis, pharmacists who had 81 or more clients per week (n = 24, 23%) and were aged 41–50 years old (n = 35, 32%) assessed the concept of the new program as more useful and feasible and more strongly believed the software would help increase their sales, as compared with pharmacists in other client and age groups (Table 1).

Generally, pharmacists aged 50 years or younger and those with the greatest number of patients per week (≥81) were more favorable to the idea of using the new program. Those pharmacists who were negative to the idea of the program from the start had the smallest number of weekly patients (≤50) and were older than 50 years.

Second phase (questionnaire B)

At the conclusion of the trial period, 7 (19%) of the 37 participating pharmacists said they used the new program for almost all prescriptions. The other 30 (81%) primarily cited time constraints as their reason for not using the software more often. Only 5 (17%) cited non-frequent use because of insufficient information.

Another aim of the research was to evaluate pharmacists' perception of the importance of providing nutritional advice. The study found that 27 (73%) of the pharmacists using the program provided patient consultation based on nutritional information obtained from the program, with 44% of them receiving positive feedback from their patients.

In assessing the utility of the program, 19 (52%) of the pharmacists found it "quite useful" to "very useful."

Table 2. Principal components analysis and resulting components and items

Factors	Components (variance explained) 1: Perceived performance (28%)	2: Sales increase through advice (21%)	3: Technology familiarization (20%)
Satisfaction from efficacy in sales	0.856	0.175	-
Satisfaction from knowledge in sales	0.843	0.165	-
Satisfaction from knowledge of health-related issues	0.696	-	0.227
Satisfaction from knowledge of dietary advice	0.683	–0.104	0.137
Sales increase induced by advice	-	0.775	–0.153
Sales increase induced by program use	0.136	0.748	0.365
Active participation in sales	0.378	0.664	–0.125
Image as advisor induced by program use	–0.418	0.623	0.229
Familiarization with personal computer use	-	-	0.930
Familiarization with Internet use	0.198	-	0.925

The two program features cited as most useful were the combination of food with drugs (42%) and the provision of nutritional guidelines based on the disease condition (32%). When participants were asked how useful they found each of a predefined set of program features on a 5-point scale (1 = not useful at all; 5 = extremely useful), 62% rated "searching information about dietary advice based on disease condition" as "extremely useful" or "quite useful."

During the first phase of research, pharmacists predicted that use of a new Web-based program designed to support the provision of nutrition advice would most likely improve their consultation role and the quality of patient services. After use of the program, participating pharmacists confirmed that these were the two greatest benefits, with 11 of the 37 (30%) field-testing the new software spontaneously stating that it would strengthen their advisory role and 10 (27%) saying it would help them offer improved patient services. In regard to the effect of the software on pharmacy sales, 32% of pharmacists predicted during first-phase interviews that the program would "definitely" increase sales and 30% said it would "probably" do so, compared with 5% and 35% of pharmacists, respectively, after use of the program.

Regarding overall use of the program, 38% of pharmacists said they were "quite satisfied" to "very satisfied" with their experience. More specifically, 68% said they were "quite satisfied" to "very satisfied" with validity of the program's information, 62% were similarly satisfied with the program's combination of drug and nutritional information, and 30% had some degree of satisfaction with the adequacy of information provided.

Factor analysis

For the factor analysis of the full data set of 106 pharmacists, a correlation matrix confirming suitability of the data was prepared before deciding which items to include in this analysis. Using PCA with varimax rotation, a number of different item combinations were checked.

The suitability of the data for factor analysis was also assessed by inspecting the Kaiser-Meyer-Olkin (KMO) value (0.661>0.600) and Bartlett's test of sphericity, which reached statistical significance (P <0.001).

PCA revealed the presence of three components with eigenvalues greater than 1. To better interpret the components, varimax rotation was performed. The three (orthogonal) component solutions explained a total of 68.6% of the total variance, with component 1 (perceived performance) contributing 27.8%, component 2 (sales increase through advice) contributing 20.6%, and component 3 (technology familiarization) contributing 20.1% (Table 2).

A three-predictor logistic regression model was fitted to the data to test the research hypothesis regarding the relationship between the performance of each pharmacist on the three components and the likelihood of agreeing to test the program. The outcome variable was pharmacists' intention to test the program (1 = yes, 0 = no), and the three predictors were the scores of the pharmacists on the three components produced by the previous procedure of PCA. All three components were found to affect the intention of pharmacists to test the program (Figure 3).

More specifically, the higher the score in component 1, the less likely pharmacists were to test the program (b = –0.538, P = 0.042<0.05, Wald = 4.137). Conversely, the higher the score in components 2 and 3, the more likely pharmacists were to test the program (b = 1.4, P = 0.000<0.05, Wald = 19.080 and b = 0.839, P = 0.001<0.05, Wald = 10.592, respectively).

Discussion

According to the findings of the present study, pharmacists older than 40 years are more likely to embrace use of the new software program based on their perception

of the link between offering improved advice and increasing sales, while those 40 years of age or younger are more familiar with and open to using new technology and more interested in improving their business image.

The research also demonstrated that pharmacists believe they are better educated on general health and drug interactions than on nutritional issues. A study by Allen et al. on student pharmacists' knowledge of Canada's Food Guide found that their general knowledge was poor, despite the fact that the majority of the study sample was aware of the guide and most considered it a useful tool for communicating with their patients. Fewer than 50% of the student pharmacists were able to identify the recommended daily servings for adults in most food group categories. The researchers concluded that a greater focus must be placed on general nutritional knowledge for both personal and professional reasons.[4]

To better promote public health, patients should have increased access to education and advice about nutritional guidelines.[5] The present study found that pharmacists' use of new Web-based software with detailed nutritional information could prove very useful, as nutrition-related issues frequently come up in discussion with patients. The majority of the pharmacists used the program in offering advice on nutritional matters and received positive feedback from their patients. We conclude that use of such software would likely improve the communication between pharmacists and patients, as well as the quality of patient services; patient-centric care is a prominent feature of health and pharmacy policy.[6]

Of the 106 pharmacists initially participating in the study, 27 believed that the new program would strengthen their advisory role, 23 believed it would improve their patient service, and 7 predicted it would help increase pharmacy sales. Considering these figures and the high prevalence of chronic diseases around the world that are influenced by poor nutrition, basic dietary consultation would likely be a useful tool for pharmacists.[4] Further, since drug therapy may have an impact on the nutritional status of patients, nutritional assessment should be part of the review of patients' drug medication treatment.[2]

A previous study by Bertsche et al. evaluated the impact of a computerized decision-support system for allergic rhinoconjunctivitis counseling in community pharmacies on the treatment recommended by pharmacists. The researchers found that pharmacists who used the program achieved better counseling and drug prescription for their patients.[7]

It is also widely acknowledged that many people in developing countries go directly to a pharmacy for medication to avoid the costs of a doctor. Thus, pharmacy staff is often required to fulfill a health need for population groups that cannot afford proper health care and nutritional guidance.[6]

Research also shows that the more pharmacists are familiar with technology, the more likely they are to use new software programs like the one at the center of the present study. In general, technology has great potential to reduce medication errors in hospitals, clinical centers, and, by extension, pharmacies.[8]

Limitations

This study took place solely in Greece. Results could be different in other countries, where Web-based programs such as the type used here are more common. It should also be noted that Greek pharmacists evaluated the Greek version of the software. The English version or a version translated into another language would probably yield different information.

Conclusion

A similar study based on drug–drug interactions verified that a computerized program would benefit pharmacists and enrich their education levels on such matters.[9] This research underscores the essential role of new software programs in detecting drug–drug and drug–food interactions,[9,10] and further demonstrates that pharmacists play an important role in protecting the public from possible risks by potential interactions.[11,12]

Our study provides clear evidence that the Nutrition–Drug Interactions program facilitates and supports the work of pharmacists in terms of counseling and patient service. It is well understood through this and other research that nutritional support and advice from pharmacists helps maintain and improve public health,[13–15] while a focus on nutrition and the use of nutrient manipulation can enhance clinical responses to disease.[16]

The role of pharmacists is to improve patient health, patient safety, and drug therapy management.[15] However, additional research is needed to verify the necessity of integrating new Web-based nutritional information programs into pharmacies—despite the fact that the joint International Pharmaceutical Federation (FIP)/WHO guidelines on good pharmacy practice contend that "a system should exist that enables pharmacists to report and to obtain feedback about adverse events and medicine-related problems."[16]

A future research suggestion is to customize English versions of the Nutrition–Drug Interactions program for other countries and to design new pilot studies with a greater number of pharmacists. Another challenge is to translate new versions of the software into many other languages.

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