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Impact of drug nutrient interaction on chronic disease: Roles of pharmacy, nursing, nutrition

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***Abstract*---**A drug-nutrient interaction occurs when a drug is taken with food and/or dietary supplements, potentially altering the absorption, distribution, metabolism, or excretion of the drug. These interactions may result in increased side effects or toxicity of the drug, decreased therapeutic efficacy, nutrient imbalances or depletion, or changes in the pharmacokinetics or pharmacodynamics of the drug being used. It is estimated that more than 20% of adults take at least one dietary supplement daily, highlighting the importance of patients taking their medications, diet, and supplements together. The management of chronic diseases, many of which are treated with drugs known to cause interactions, typically spans many years. This underscores the importance and requirement of collaboration between pharmacy, nursing, and dietitians to manage patient care.

***Keywords*---**nutrient, disease, pharmacy, nursing, nutrition.

1. Introduction

A drug-nutrient interaction occurs when a medication is taken with food and/or a supplement, potentially altering drug absorption, distribution, metabolism, or excretion. These interactions may result in increased side effects or toxicity of the drug, reduced therapeutic efficacy, nutrient imbalances or depletion, or changes in the pharmacokinetics or pharmacodynamics of the medication used. It is estimated that more than 20% of adults take at least one supplement a day, highlighting the importance of patient medications, diets, and supplements being addressed together. The management of chronic diseases, many of which are managed with medications that are known to cause interactions, generally spans many years. This emphasizes the importance of, and the requirement for, cooperation among pharmacy, nursing, and nutrition professionals to manage patient care. For example, it would be beneficial for a patient to hear consistent, up-to-date information from the pharmacist, nurse, and dietitian regarding a phenytoin-Vitamin D interaction.

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When healthcare professionals work together effectively, patients are more likely to follow advice, outcomes are improved, and patient safety is better protected. In this paper, we will describe the roles of pharmacy, nursing, and nutrition professionals in identifying and resolving drug-nutrient interactions for improved patient care. However, if a healthcare professional does not provide advice about drug-nutrient interactions or does not refer a patient to an appropriate healthcare professional that can provide such advice, the nutritional status of the patient may not be addressed. If the health professional is unable to address the patient's concerns, they should refer to an appropriate health professional such as a dietitian, pharmacist, or other healthcare professional that is knowledgeable about drug-nutrient interactions.

1.1. Overview of Drug Nutrient Interactions

Diet can affect drug metabolism by altering levels of nutritional substrates and nutrients, enzymatic activity, transport proteins, and the remodeling of lipid compartments. Drug-nutrient interactions define events in which a diet is able to modulate or be modulated by circulating drugs, resulting in a distinctly altered pharmacokinetic, pharmacodynamic, or toxicological profile. In the vast majority of cases, nutripathy is defined by the modification of drug pharmacokinetics during diet implementation. Alterations in drug pharmacokinetics generally occur through changes in drug absorption (most common), drug metabolism (mainly affecting liver metabolism), or metabolism in other tissues or those subject to absorption, drug distribution (whole-body or within organs), or drug excretion.

Clinical in vivo reports are demonstrated for virtually all pharmaceutical agents being able to alter some aspect of nutrient absorption, metabolism, or excretion to date. The majority of reports outline nutrients being less bioavailable or reduced in supply as a result of a drug. For example, for an ACE inhibitor or potassium-sparing diuretic, hyperkalemia may occur, or for a loop diuretic, hypokalemia, hypomagnesemia, and hypophosphatemia. However, reports exist in which nutrient levels may be increased in circulation, thus potentially placing a plethora of nutrients at risk of high-dose overdose. This event is less frequent but has been described, particularly with water-soluble vitamins, lipophilic xenobiotics, and genotype-unifying effects. Unmodified concentration–effect relationships have been proposed such that in some cases, a continuous supply of nutrient may be considered more therapeutic than small, infrequent, high, or possibly toxic doses. For example, long-term, large-dose pyridoxine supplements have been associated with neuropathy, not toxicity, while the continuous presence of dietary pyridoxine does not produce such neuropathy.

2. Understanding Chronic Diseases and their Management

Chronic diseases, also called noncommunicable diseases, are present in human health care when medication regimens are involved and sometimes have major ramifications. Chronic diseases can severely diminish the quality of life of those who have them and can lead to loss of life. We are only recently beginning to dedicate enough attention to address their harmful health effects on a broader scale. For disease management, a multi-sectoral management approach to these noninfectious diseases is generally implemented, including medical and/or

pharmaceutical, natural remedies, and surgical treatments. A fourth domain of care from hospitals and clinics, notably behavioral health, is the administration of nonpharmacological and pharmacological interventions. Unlike acute illnesses, the therapies used to alleviate the symptoms and disease development of chronic diseases are generally long-term medication regimens. As most patients in Westernized cultures consume a diet that is either low or high in energy, consumption and removal of energy contend with the abundance of chronic comorbidities crucial to conventional medical care of chronic illness for individuals who are in a low or small number can become obese with no comorbidities, living sick and depending on the level of polypharmacy, changing the bioavailability for good or bad of all these drugs and conditions. (Liu et al., 2020)(Ping et al.2020)(Tran et al.2020)

2.1. Common Chronic Diseases

There are several chronic diseases that impact populations across the globe. These include diabetes, hypertension, dyslipidemia, asthma, and chronic obstructive pulmonary disease. The management of these diseases is ongoing and encompasses not only drug therapy but often lifestyle changes such as nutrition and exercise. Many of these diseases are primary risk factors for the incidence of cardiovascular disease. Four of these chronic diseases are the focus of this project. Someone with one of these chronic diseases may also be taking medication for another chronic disease. For example, a patient may have a diagnosis of diabetes but also of hypertension and thus be prescribed medication for both, as well as other medications. However, a person with diabetes could also be using insulin replacement or incretin mimetic agents, resulting in a drug-nutrient interaction with the amino acid tryptophan. These chronic diseases can manifest regardless of factors such as gender, race, or age.

In 2, 9.3% of Canada’s entire population (age 20 and older) reported a diagnosis of diabetes, with an estimated 4.8% unaware of their condition or yet to be diagnosed. As of 2018, 13% of Canada’s population (age 12 and older) had been diagnosed with hypertension. Rates of hypertension increase with age such that 85% of Canadians over the age of 20 years have a diagnosis of hypertension. Hypertension was diagnosed in a higher proportion of males than females. Globally, about 1.13 and 0.97 billion people live with hypertension and dyslipidemia, respectively. In 2017, 1.25 million Canadians were diagnosed with chronic obstructive pulmonary disease, accounting for 3.4% of the nation's population.

3. Pharmacy's Role in Drug Nutrient Interaction Management

In clinical pharmacy, pharmacists are expected to provide medication therapy management, including drug-nutrient interactions. They are in a prime position to provide education about potential drug-nutrient interactions. Additionally, pharmacists are to discourage patients from including nonessential minerals and vitamins that may increase the probability of a drug interaction. The responsibility of the pharmacist is to perform a comprehensive medication review and identify patients at risk of a drug-nutrient interaction. It is recommended that pharmacists educate patients on issues such as the timing of the

administration of the medication in relation to meals. The pharmacist is then to refer a patient at risk of a drug-nutrient interaction to a registered dietitian. Pharmacists are recognized as being the first health care providers in contact with many of these patients and are in an ideal position to prevent drug-nutrient interactions. (Gröber et al.2020)(Mai et al., 2020)

Pharmacists collaborate with other health care providers to ensure that the patient's adherence is optimized with a medication regimen. They must also be vigilant in identifying, resolving, and preventing potential drug-nutrient interactions for patients. Dietitians are also in an ideal position to provide this education early on in a patient's treatment. By including pharmacists and dietitians in the disease state management, as well as other health care professionals, the chronic disease state may be managed as a multidisciplinary approach in patient-centered care. Medication adherence is a significant factor in chronic disease. The pharmacist must be the medication expert in drug-nutrient interactions to manage these issues to optimize therapeutic outcomes and prevent adverse effects. The responsibility to resolve and prevent adverse drug events involving drug-nutrient interactions is the pharmacist's role.

3.1. Medication Review and Counseling

One of the roles of a pharmacist is to conduct a systematic evaluation of a patient's medication regimen. This process, known as medication review, is conducted by a pharmacist to identify, resolve, and prevent potential and actual medication-related problems. A member of the pharmacy profession must have knowledge of the pharmacology of drugs and pharmacokinetics, as well as knowledge of clinical nutrition in order to identify potential drug-nutrient interactions before they occur. Medication review by a pharmacist on an ongoing basis for a patient may help to identify these interactions. It may occur that pharmacists could be getting a lot more information than what is mentioned in the medical record. The use of dietary supplements, such as vitamins, minerals, and herbal supplements, should be discussed with any patient. In the case of the diabetic patient, there are hyperglycemia and hypoglycemia. (Flannery et al.2020)

It may be very beneficial to the patient if the pharmacist were to receive a note from the physician regarding a low-carbohydrate diet or any supplements the physician may need the patient to take or not take before the patient consults the pharmacist. The physician may need to see the patient over a period of weeks to examine his or her blood values and medications. Nutrition in the elderly is of utmost consideration because the elderly process drugs and nutrients differently than the average population. There are a number of lifestyle, pharmaceutical, and supplement risk factors associated with drug-nutrient interactions that can then lead to chronic diseases. This is a discussion to have between the patient and the pharmacist when the pharmacist works with the patient on his or her medication regimen. Patient education is important. The pharmacist will have to counsel all patients on their use of medications according to individual assessment needs.

4. Nursing's Role in Drug Nutrient Interaction Management

Nursing's Role in Drug-Nutrient Interaction Management. The nutrition diagnosis describes the assessment of clients' drug-food interactions in diet-related complications in the nursing process. As most chronic disease patients are receiving polypharmacy and will receive diet manipulation to manage the disease state, nursing is directly responsible for managing the client being discharged. Key connections between pharmacy, nursing, and nutrition, and other professionals who can identify these issues are highlighted. Nurses at all care levels monitor and assess a patient's response to drug therapy in practice settings and provide patient education on the importance of nutrition and diet therapy in patient drug response.

Nursing care must be vigilant regarding drugs' natural properties and document patient tolerance to nursing care provided, such as therapeutic diets, therapeutic enteral formulas, and tube care, to be reported in an interprofessional health care team. In an ambulatory setting, continued nurse monitoring can be quantified by nurse-documented compliance with the therapeutic diet and therapeutic medication. Reports of poor compliance must be communicated by the nurse to the appropriate health care professional, primarily the dietitian in an outpatient chronic disease case load, for further assessment and interventions to ensure more optimal patient outcomes are obtained. Nurse scientists acknowledge that the complexity in nursing science will require interdisciplinary research to enhance patient outcomes. An ideal setting might be in the care of chronic diseases that could help prevent re-hospitalization and be cross-populated by nursing science, nutrition science, and pharmacology. In conclusion, the treatment of chronic diseases needs support from all disciplines, with nurses playing an important support role on the co-treating team. Continued education for all professional levels of practitioners on how to identify and handle chronic care food-drug interactions in a timely manner is essential for better health care outcomes.

4.1. Patient Education and Monitoring

In conjunction with appropriate patient education and monitoring, nurses must be knowledgeable about drug-nutrient interactions and the healthcare workers available to assist in addressing these issues. After education is provided to patients regarding drug-nutrient interactions, nurses can reinforce the information through counseling and educational materials. Writing educational and counseling materials in plain language is beneficial for many reasons. The patient should be given another opportunity before discharge to have drug-nutrient interactions reviewed, provide the patient with some information, and answer any further questions. Nurses should avoid "talking down" to adults or elderly patients.

Monitoring of patients' nutritional status should be done throughout their course of care. Patients should be asked directly about planned changes in their diet or lifestyle once they leave the hospital. Patients' food choices reflect their cultural and lifestyle practices. Nutritional surveillance, or continuous observation and evaluation of patient responses to nutrition-based interventions, constantly updates the care plan as assessments are completed. Education at the time of

discharge is not when the patient should hear about drug-nutritional adverse events. Periodic assessments of patient nutrition status and ongoing review of medications are necessary to minimize potential events. For patients requiring an enteral program, all involved healthcare professionals should be included in communication about diet, medication, and drug-nutrient interactions. Every effort should be made to avoid drug-dietary regimens that risk the loss of medications while the patient transitions from hospital care to home care. This type of effort requires communication with ambulatory care, nursing homes, rehabilitation centers, and other acute care hospitals.

5. Nutrition's Role in Drug Nutrient Interaction Management

Nutrition professionals evaluate the dietary intake of patients in order to help identify potential or actual deficiencies that medication use may cause due to drug-nutrient interactions. To properly interpret any patient's dietary regimen, nutritionists must know the indications and effects of each drug they may be taking. Additionally, the nutritional status of an individual can affect how effectively a medication or a particular nutrient is utilized or absorbed by the body. Another aspect of the relationship between drug-nutrient interactions and chronic disease is the possibility that the combination could ultimately increase the effectiveness of a drug. In diabetes care, the main goal for the patient is to control and lower their blood sugar levels. The effects of drug-nutrient interactions and drug-induced nutrient depletions on pre-medications or symptoms of a chronic disease have the potential to be in effect for as long as a person lives. Proper nutrition management could mean more successful outcomes for the health care profession in general and the patient in particular. To be able to elucidate the broader aspects of nutrition in the treatment of a chronic disease would be timely and a worthwhile endeavor.

Restoring a normal diet will play a crucial role in any disease management, including cancer. The consumption of a normal diet can help the body replenish the nutrients that were overtaxed as a result of a medication regimen. However, caution should be taken to prevent consuming too many of any one macro- or micro-nutrient, such as fat. For this reason, the nutritionist will be instrumental in guiding a patient's food choices, which will ultimately impact disease management. The way patients can eat directly influences how well and often they may consume their medication counterparts. Counseling patients on how to care for various foods may help prevent a known nutrient-drug interaction from occurring and sustain the overall plan of treatment. In treating chronic diseases, lifestyle and eating regimens will be personalized. Those plans should be delivered in a manner that is specific to each patient's way of life, with a focus on the disease and the medication regimen. Coordination of services between health care professions is essential in order to provide individualized care to achieve a favorable health result for any patient. These health care professions may include pharmacists, nurses, nurse practitioners, dietitians, and nutritionists. Within the various educational centers of pharmacy, nursing, and nutrition, student education will increase the awareness of drug-nutrient interactions in future practice settings. The ultimate result is the optimal outcome for the patient in the counseling and care delivered. (Gröber et al.2020)(Litchford2020)(Lafferty2020)

5.1. Dietary Assessment and Counseling

Assessment. Periodically reassess the patient by repeating or utilizing an assessment method relevant for your patient, disease state, and treatment. Repeat subjective questions addressing dietary intake, weight, energy, and protein needs. Repeat objective assessment of body composition considerations and recommended calculators. Goal evaluation should be adjusted based on individual patient progress. Assess for changes in quality of life parameters including physical function, role function, emotional status, social function, and other physical symptoms. Nutrition Care Process. Careful dietary assessment is integral to nutrition recommendations and shifts the focus to include more intensive dietary recommendations.

Record different methods of dietary assessment including food frequency questionnaires, three-day verbal record, or lab-based testing which may include nutrient analysis, three-day food record, dietary recall, lifestyle questionnaire, and fasting nutritional analysis. Education/Counseling. Dietitians and nutritionists take a systematic approach to diet assessment and nutritional counseling. The interview should be structured and phases include the initial nutritional counseling session, the early interventional counseling session, and referral for long-term follow-up. Medication-induced metabolic or nutritional disorders can occur with several drug classes. Long-term management of chronic disease is limited by failure to partake in lifestyle modification. Educating and counseling patients about potential food-drug interactions enhances patient engagement in all areas for negligible expenses related to implementation. Nutrient and lifestyle counseling including dietary management, education, and assessment should involve parameters to be met at baseline and ongoing throughout drug therapy.

Counseling Strategies. Patients should also have access to a nutritionist or dietitian for counseling services so that they are empowered to make dietary modifications based on their individual needs. The pharmacist or dietitian should utilize information including food sources of nutrients, reasons for consumption, dietary interactions, pharmacokinetics, and pharmacodynamics of drug uses for specific nutrients, and how dietary supplements and botanicals can impact drug-nutrient interactions. Education about common high-risk herbals for renal transplant includes those for which drug-serum levels of medications may be impacted. It is vital to reinforce these risks at each teaching opportunity with communication between the healthcare team including dietitian, pharmacist, physician, and nurse in order to provide consistent messages to the patient. The nurse, pharmacist, and nutritionist need to be diligent in monitoring the patient for improvements in symptoms, complementary and alternative adjunct therapies, increasing clinical markers of renal and hepatic function, and adherence to drug therapy that may cause drug and nutrient interactions.

6. Interprofessional Collaboration in Managing Drug Nutrient Interactions

Interprofessional collaboration in managing drug-nutrient interactions is essential for patient safety and quality outcomes. Multidisciplinary teamwork consisting of pharmacy, nursing, and nutrition professionals is not only a valid model utilized

in services for accreditation compliance, but also an evidence-based best practice that spans the continuum of care. Each discipline has a unique collaborative role that impacts patient safety for drug-nutrient interactions individually, but as a team, they will maximize the potential for detecting and preventing drug-nutrient interactions in order to enhance patient care. By working together, the team is able to complete the necessary technology portion of the assessment.

A comprehensive assessment can only be accomplished when all three disciplines contribute their expertise. To address these changing competencies, the team's communication model is based on a shared team approach in order to manage interactions most effectively. These changes in technology and information have created interprofessional implications; numerous groups across the country are grappling with these implications through their work in civic groups and teaching circles. Presenters at the Model Interdisciplinary Program to Improve Quality of Care for the Elderly have offered insight into potential best practices related to drug-nutrient interactions by prohibiting added salt, resulting in a decrease in potential medication-nutrient concerns. In summary, the major benefit of a coordinated effort in identifying and managing drug-nutrient interactions is to provide patients with the most thorough and informative information regarding their food and medication needs and their safety. Continuing education and awareness of this issue among colleagues is vital to long-term success, and many professionals are working in this area every day to develop resources and new methods.

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تأثير التفاعل بين الأدوية والمغذيات على الأمراض المزمنة: أدوار الصيدلة والتمريض والتغذية

1. مقدمة

يحدث التفاعل بين الأدوية والمغذيات عندما يتم تناول دواء مع الطعام و/أو المكملات الغذائية، مما قد يؤدي إلى تغيير امتصاص الدواء أو توزيعه أو استقلابه أو إفرازه. قد تؤدي هذه التفاعلات إلى زيادة الآثار الجانبية أو سُمّية الدواء، أو تقليل الفعالية العلاجية، أو اختلالات أو استنزاف المغذيات، أو تغيرات في الحركية الدوائية أو الديناميكية الدوائية للدواء المستخدم. تشير التقديرات إلى أن أكثر من 20٪ من البالغين يتناولون مُكمِّلاً غذائياً واحداً على الأقل يومياً، مما يبرز أهمية تناول أدوية المرضى ونظامهم الغذائي ومُكمِّلاتهم الغذائية معاً. إن إدارة الأمراض المزمنة، التي يتم علاج العديد منها بأدوية معروفة بأنها تسبب تفاعلات، تمتد بشكل عام لسنوات عديدة. وهذا يؤكد على أهمية ومتطلبات التعاون بين الصيدلة والتمريض واختصاصيي التغذية لإدارة رعاية المرضى.

على سبيل المثال، سيكون من المفيد للمريض سماع معلومات متسقة وحديثة من الصيدلي والممرضة وأخصائي التغذية فيما يتعلق بتفاعل الفينيتوين وفيتامين د.

عندما يعمل متخصصو الرعاية الصحية معاً بشكل فعال، يزداد احتمال اتباع المرضى للنصائح، وتتحسن النتائج، وتتحسن حماية سلامة المرضى. سنقوم في هذه الورقة بوصف أدوار الصيدلة والتمريض واختصاصيي التغذية في تحديد وحل التفاعلات بين الأدوية والمغذيات لتحسين رعاية المرضى. ومع ذلك، إذا لم يقدم أخصائي الرعاية الصحية المشورة بشأن التفاعلات بين الأدوية والمغذيات أو لم يُحِل المريض إلى أخصائي رعاية صحية مناسب يمكنه تقديم هذه المشورة، فقد لا تتم معالجة الحالة التغذوية للمريض. إذا لم يتمكن أخصائي الصحة من معالجة مخاوف المريض، فيجب عليه إحالته إلى أخصائي صحي مناسب مثل أخصائي تغذية أو صيدلي أو أي أخصائي رعاية صحية آخر على دراية بالتفاعلات بين الأدوية والمغذيات.