International Journal of Nursing
June 2015, Vol. 2, No. 1, pp. 1-9
ISSN 2373-7662 (Print) 2373-7670 (Online)

Published by American Research Institute for Policy Development
DOI: 10.15640/ijn.v2n1a1
URL: http://dx.doi.org/DOI: 10.15640/ijn.v2n1a1

Knowledge, Attitudes and Awareness of Food and Drug Interactions among Nurses with Different Levels of Experience

Nkechi. M. Enwerem[1] & Priscilla Okunji[2]

Abstract

Aim: To examine the knowledge, attitudes and awareness of food and drug interactions (FDI) among nurses with different levels of experience in their day to day practices. **Background:** The 2004 Institute of Medicine report (IOM), "Keeping Patients Safe," recognized the nursing profession as playing a critical role in patient safety (Dunton, 2007; McHugh & Lake, 2010). Although new nurses possess a strong theoretical knowledge of nursing, experience from practice is important in providing a safer level of practice (Hill, 2010).The retention of experienced nurses in practice, would require a continuous, career-long learning (Hill, 2010).Medical errors resulting in Adverse Drug Reactions (ADRs), pose a significant public health problem. Studies on the knowledge, attitudes and awareness of FDI among nurses with different levels of experience are lacking. **Methods:** This was a cross sectional study which included a structured questionnaire. The study included a convenience sample of 278 nurses divided into 5 groups with different levels of experience: 0-4 years (66); 5-9 years (75); 10-14 years (45); 15-19 years (41); and ≥ 20 years. **Results:** There was statistical difference in knowledge and attitude to FDI among the 5 groups. 72.3 % of nurses had not observed food and drug interaction during their practice. **Conclusion:** The five groups all scored low in their knowledge of FDI. Most of the participants recommended in-house training on FDI every six (6) months.There is a significant difference in the knowledge of FDI among the five groups with different levels of nursing experience.

Keywords: Knowledge, attitudes, awareness , food and drug interactions (FDI), Nurses with different levels of experience- 0-4, 5-9, 10-14, 15-19 and ≥ 20 years – convenience sampling

1. Background and Significance

Food and drug interactions (FDI) occur when specific nutrients in foods interact with drugs when ingested concomitantly. FDI can result in changes in the bioavailability, pharmacokinetics, pharmacodynamics and therapeutic efficacy of the medication. Dietary sources of vitamin K, such as spinach or broccoli, have been shown to cause a pharmacodynamic antagonism of warfarin thereby causing a need to increase the dosage requirement for warfarin. Grapefruit juice contains a bioflavonoid that inhibits CYP3A (define), an enzyme that is involved in the metabolism of many drugs (Andrade, 2014; Hanley, et al., 2011). Such interaction can cause a 5-fold increase in the bioavailability of some drugs (Mason, 2010).Especially, orally-administered drugs such as felodipine that are metabolized by CYP3A enzymes (Hanley et al., 2011). Patients at high risk for FDI include elderly patients taking three or more medications (polypharmacy) for chronic conditions such as diabetes, hypertension, depression, high blood cholesterol, or congestive heart failure. Such patients should be assessed regularly for food and drug interactions (Moulyet al., 2015).
In 1999, the Institute of Medicine reported that as many as 98,000 deaths occur annually from medical errors (Committee on Quality of Health Care in America, IOM, 1999).

[1] Department of Nursing, Howard University, Washington, DC. USA. Email: Nkechi.enwerem@howard.edu
[2] Department of Nursing, Howard University, Washington, DC. USA.

In the United States, the cost of managing drug-related morbidity and mortality is about $37.6 billion annually (IOM, 2010). About half of the cost, is associated to preventable errors (AHRQ, 2010). FDI (Food and Drug Interaction), is one of the sources of Medication errors(Bushra et al., 2011). Adverse Drug Reactions (ADRs), pose a significant public health problem. Several studies confirm that Registered Nurses, play an important role in patient safety (IOM,2004, 2010).The Joint Commission on the Accreditation of Healthcare Organizations (JCAHO) requires that a thorough drug history be taken during hospital admission and adequate drug reconciliation during discharge (Unroe et al., 2010). Nurses should be watchful in monitoring for possible FDI and in counseling patients on food and beverages to avoid when taking certain medications. It is imperative that nurses be current on potential FDI of medications to ensure that they function properly as patient advocates.The nursing profession plays a critical role in patient safety (Dunton, 2007). The 2004 Institute of Medicine report (IOM), "Keeping Patients Safe," recognized the nursing profession as playing a critical role in patient safety (Dunton, 2007; McHugh & Lake, 2010). Although new nurses possess a strong theoretical knowledge of nursing, experience from practice is important in providing a safer level of practice (Hill, 2010). Research studies, suggest that a better patient outcome is linked to nursing experience (Aiken, Havens, & Sloane, 2009). The retention of experienced nurses in practice, would require a continuous, career-long learning (Hill, 2010). Nursing experience is defined as the time in practice and ability to self-reflect on encountered circumstances in taking decisions (Simmons, Lanua, Fonteyn, Hicks & Holm, 2003). Experience does not confer expertise (Ericsson, Whyte, & Ward, 2007). Another study, suggests that experience confers expertise (Bobay, Gentile, and Hagle, 2009). Fewer medication errors and lower patient fall rates were observed in a large proportion of nurses with $\geq$5 years of experience (Blegen, Vaughn, & Goode, 2001). This study examined the differences, in the knowledge, attitude, and awareness of food-drug interaction amongst nurses with different levels of experience (0-4, 5-9; 10-14; 15-19 and $\geq$20 years of experience).

2. Methods

2.1 Design

This was a cross-sectional descriptive survey using the validated, structured questionnaire of Jyoti et al. (2012). The questionnaire is focused on common FDI.

2.2 Selection of Participants

The survey included a convenience sample of 278 nurses, divided into 5 groups (0-4 years, 5-9 years, 10-14 years 15-19 years and $\geq$20 years of nursing experience) from health care facilities in the District of Columbia metropolitan (DC-MD-VA) area. The study was carried out during the period of March – December 2014.

2.3 Ethical Considerations

Informed consent was obtained from all the participants before distribution of the Food and Drug Interaction questionnaire (FDIQ). Personal identifiers were excluded in the questionnaire. Institutional Review Board of Howard University, USA, approved this study.

2.4. Data Collection

The Jyoti et al. (2012) FDIQ was adopted for this study. There were 40 questions which included dichotomous, multiple choice and open-ended questions. Of the 40 questions, 35 tested participants' knowledge (Appendix I) and 4 tested participants' attitude to prevent FDI in their health care delivery (Appendix II). The FDIQ included questions regarding food interactions with antihypertensive, antithyroids, antidepressants, anticoagulants, antiretrovirals, peptic ulcer drugs and analgesics. The FDIQ also measured if the participant had noticed any food and drug interaction during their practice. One open-ended question was incorporated to get participants suggestions on the steps to take to increase the nurse's knowledge, awareness and practice of FDI. On average it took 30 minutes for participants to complete the questionnaire.

2.5. Data Analysis

Statistical analysis was carried out using the Statistical Package for the Social Sciences Statistics (SPSS) Version 22 (IBM-SPSS Inc., Chicago, Illinois). Results were expressed as mean±SD. Questions scored correct, were given one point while incorrect answers, were given a zero point. The maximum score for knowledge questions on FDI was 35 while the maximum score for practice questions was 4. The Pearson's chi-square test followed by the Mann-Whitney U test, were used to evaluate homogeneity of the data across the groups. One-way Analysis of Variance (ANOVA) was used to compare the total score among the different groups. The level of significance was set at $p<0.05$.

3. Results

The survey was completed within nine months of the start of the study. The response rate was 100%, and all participants completed the FDIQ within 30 minutes.

3.1. Knowledge

The overall knowledge of the study participants was assessed based on their responses to the questionnaire (Appendix I). Table 1 shows the knowledge and comparison of the FDIQ among nurses with different levels of experience. The values reported for each question represent the percentage of the correct answers in each of the groups. With respect to timings of food and drug intake, most of the participants, were conversant with proton pump inhibitors (PPI e.g. omeprazole), non-steroidal anti-inflammatory drugs (NSAIDs) and thyroid hormones (levothyroxine), but were not aware of the antidiabetic drugs such as acarbose, glipizide, antacids and drug for tuberculosis (isoniazid) (Qs15 & 16). For these drugs, participants with 0-4 years of experience, scored better than nurses with 10-14, 15-19 and ≥20 years of nursing experience. For the question on the interaction of Coumadin with ginger or garlic (Q5), all of the participants scored low. All groups scored high on the interaction of theophylline with large amounts of tea, coffee and chocolates (Q1). Nurses with 10-14 years of nursing experience, scored low regarding common food and drug interactions such as consumption of cheese, processed meats, legumes, wine, beer, fava beans and fermented products with MAO inhibitors (Q3). All the groups scored low on the interaction ofgriseofulvin, ketoconazole and albendazole with fatty diets (Q7). Nurses with ≥20 years of nursing experience, scored better than other groups on the pharmacokinetic process where FDI occurs most (Q14). All groups scored low on the interaction of thyroid supplements with foods such as Brussels sprouts, cauliflower, millet and cabbage (Q11), and also on the interaction of digoxin with foods such as wheat bran, rolled oats and sunflower seeds (Q8). Compared to other groups, nurses with 15-19 years of nursing experience, scored high on the FDI of amiodaronewith grapefruit juice. There were no significant differences amongnurses with 5-9 and 10-14 years of nursing experience on their knowledge of FDI between diltiazem and grapefruit juice (Q24). The groups scored high on their knowledge of FDI between alcohol and metronidazole (Q20) and alcohol with cimetidine (Q22). The total scores on the knowledge test as displayed in Table 2 were as follows: 0-4 years (21.32±4.10), 5-9 years (23.01±3.84), 10-14 years (21.27±4.85), 15-19 years (23.61±4.13) and ≥20years (21.25±4.41). Significant differences in knowledge were found among the five groups.

Q #	GP I 0-4 (%) N = 66	GP II 5-9 (%) N=75	GP III 10-14(%) N=45	GP IV 15-19 (%) N =41	GP V ≥20 (%) N =51	Pair wise comparison (p value)									
						GP I-II	GP I-III	GP I-IV	GP 1-V	GP II-III	GP II-1V	GP II-V	GP III-IV	GP III-V	GP IV-V
1	78.8	88.0	84.4	92.7	76.5										.037
2	53	50.7	55.6	56.1	33.3				.034					.029	.029
3	84.8	84.0	77.8	85.4	78.4										
4	83.3	80	88.9	87.8	86.3										
5	53	46.7	44.4	61.0	27.5				.006			.031			.001
6	43.9	45.3	44.4	61	60.8										
7	28.8	34.7	40	43.9	27.5										
8	30.3	30.7	28.9	24.4	27.5										
9	33.3	40	40	48.8	47.1										
10	56.1	58.7	53.3	73.2	47.1										.012
11	18.2	34.7	33.3	17.1	29.4	0.028					.046				
12	39.4	53.3	42.2	31.7	45.1						.026				
13	78.8	84.0	82.2	95.1	82.4			.022	.021						
14	54.5	58.7	53.3	48.8	72.5									.025	.009
15	56.1	60	73.3	85.4	70.6			.002			.005				
16	39.4	41.3	35.6	24.4	13.7				.002			.001		.013	
17	39.4	57.3	33.3	24.4	43.1	0.034				.011	.001				
18	53	76	62.2	75.6	70.6	0.004		.020							
19	60.6	56	55.6	39	64.7			.031							.015
20	89.4	92.0	84.4	92.7	86.3										
21	30.3	30.7	22.2	24.4	33.3										
22	93.9	86.7	88.9	97.6	94.1										
23	78.8	80	77.8	80.5	72.5										
24	74.2	65.3	62.2	85.4	58.8						.022		.016		.006
25	51.5	58.7	57.8	61.0	47.1										
26	71.2	78.7	64.4	87.8	64.7			.046					.012		.011
27	83.3	86.7	68.9	85.4	66.7				.037	.019		.007			.041
28	97.0	93.3	91.1	97.6	96.1										
29	81.8	89.3	77.8	92.7	80.4										
30	68.2	82.7	64.4	85.4	76.5	0.046		.048		.025			.027		
31	69.7	88.0	71.1	87.8	74.5	0.008		.032		.021					
32	43.9	58.7	60	56.1	66.7				.015						
33	68.2	68	66.7	70.7	54.9										
34	71.2	62.7	66.7	80.5	58.8						.048				.027
35	66.7	89.3	73.3	92.7	78.4	0.001		.002		.023			.019		

Table 1: Comparison of the knowledge of FDIQ in five groups (0-4; 5-9; 10-14; 15-19 and ≥20 years): Expressed as Percentage of Respondents with Correct Answers for each Questions

Total score	0-4 (n = 66)	5-9 (n =75)	10-14 (n =45)	15-19 (n=41)	≥20 (n= 51)
Mean ± SD	21.32±4.37	23.01±3.84	21.27±4.85	23.61±4.13	21.25±4.41
Mean difference	-1.6951	-1.7467	-0.0515	-2.2916	-0.0633
Mean score percentage	60.91 %	65.75 %	60.76 %	67.46 %	60.73 %
p value	0.007	0.007	0.007	0.007	0.007

Table 2: Total Score, Mean Difference and the Mean Score Percentage of Knowledge on FDI among the Five Groups

3.2. Awareness

Most of the participants (72.3 %) had not observed adverse reactions due to FDI during their clinical practice with significant differences for 0-4 years (83.3%; $p < .05$), 5-9 years (68.0%; $p < 0.001$) , 10-14 years (77.8 %), 15-19 (75.6 %) and ≥20 years of nursing experience (56.9%; $p = 0.004$). Nurses with ≥20 years of nursing experience had more frequently observed FDI compared to other groups.

This is followed by nurses with 5-9 years of nursing experience. From the open-ended question on how knowledge and awareness of FDI may be improved, most of the participants felt it is important to update FDI every six months through nursing in-service training.

3.3. Attitude

Table 3 revealed that the nurses in the five groups took steps to prevent FDI. The participants agreed that before a drug is dispensed: the label on the container should be read, the package inserts listing the direction of use, warnings, interactions and precautions should be read in order to avoid FDI. Furthermore, the participants believe that drug capsules should not be taken separately unless as directed by the physician, and that medications should not be taken with alcohol. With respect to practice, nurses with 15-19 years of experience, more frequently took steps to prevent FDI while dispensing or giving medications.

Table 3: Comparison of the Attitude to FDI in Five Groups (0-4; 5-9; 10-14; 15-19 and ≥20 Years): Expressed as Percentage of Respondents with Correct Answers for Each Question

Q #	GP 1 0-4 (%) N = 66	GP II 5-9 (%) N=75	GP III 10-14(%) N=45	GP IV 15-19 (%) N =41	GP V ≥20 (%) N =51	Pair wise comparison (p value)									
						GP I-II	GP I-III	GP I-IV	GP 1-V	GP II-III	GP II-1V	GP II-V	GP III-IV	GP III-V	GP IV-V
1	84.8	92.0	93.3	100.0	94.1			0.009							
2	92.4	96.0	95.6	100.0	96.1										
3	78.8	86.7	84.4	97.6	86.3			0.007					0.038		
4	81.8	90.7	86.7	100.0	88.2			0.004			0.450		0.016		0.024

4. Discussion

The present study was successful in evaluating the knowledge, awareness and attitude of FDI among nurses with varying levels of experience. With respect to knowledge of FDI, there were some significant differences among nurses with different levels of experience. Significant differences were noted on some individual questions such as interaction of Coumadin with garlic (Q5), timing of food with glipizide(Q16), and with actos (Q17). The result of this study, did not show that nurses with more years of experience scored better than nurses with less years in all FDI questions.This observation supports the strategy of retaining experienced nurses in the workforce for a longer period through cultivating a climate of continuous, career-long learning (Hill, 2010).There was no significant differences among the five groups with respect to practice to prevent FDI. This means that the six rights of medication administration was observed by the five groups. Nurses with ≥20 years of experience more frequently observed FDI compared to the other groups. These differences could be that experienced nurses, integrate skill, cues, knowledge and intuition in patient care more than the less experienced nurses (Hill, 2010). The results of this study with respect to the awareness of FDI, are in line with other studies that have shown that nursing experience is strongly correlated to patient outcomes and a higher levels of clinical performance (Dunton2007; Burritt & Steckel, 2009; Hill 2010). Hill (2010) recommended that one of the strategies to prevent the threat of losing experienced nurses is cultivate a climate of continuous, career-long learning. Drug interaction does not only occur between two drugs. They can occur between drugs and between any kind of foreign substance (xenobiotica), food (e.g. grapefruit juice, broccoli, barbecue) as well as caffeine and alcohol (Haen, 2014). Warfarin interacts with many foods (Nutescu et al., 2011). Vegetables, such as broccoli, kale, spinach, rich in vitamin K, when consumed in large quantity, will interfere with the effectiveness and safety of warfarin (Bushra, 2011). FDI occur when the presence of a food changes the bioavailability of a drug co-administered together. This variation can result in therapeutic failure especially with orally administered drugs (Mouly et al., 2015). Foods can change drug bioavailability through various mechanisms which include change in gastric emptying, and changes in the activity of drug metabolizing enzymes (Kersemaekers et al., 2015). Improper timing of foods and drugs are contributors to treatment failure (Jyoti et al., 2012).

The participants from the five groups scored very low in some questions on the FDIQ such as the timing of foods and drugs such as propranolol, ACE inhibitors, glipizide, isoniazid, antacids, acarbose, voglibose. To enhance therapeutic effects, drugs such as glipizide, atenolol, captopril, isoniazid, and rifampicin that interact with foods should be taken on an empty stomach (Manrique et al., 2014; Winstanley et al., 1989). A study showed that the administration of captopril on an empty stomach will decrease its absorption significantly (Nazari et al., 2011). The five groups scored low on their knowledge of alcohol interaction with foods such as milk. Acute ethanol absorption, inhibits drug metabolism. Chronic alcohol consumption had been shown to affect the bioavailability of drugs consumed orally or by the parenteral route (McCance-Katz et al., 2013). The five studied groups especially nurses with 0-4 and ≥20 years of nursing experience, scored poorly on the interaction of griseofulvin, ketoconazole and albendazole with fatty diets. These drugs have antifungal and anthelmintic properties. Earlier studies have shown that these drugs are poorly absorbed when administered orally. A high systemic concentration is observed when these drugs are coadministered with a fatty food (Omotoso et al., 2013). The maximum plasma concentration of griseofulvin increased by 80% in the presence of high fat content meals. This increase is a result of enhanced solubilization of griseofulvin by fat (Palma et al., 1986). Drugs with a large therapeutic index, produce a harmless effect when they interact with food (Mason, 2010). Griseofulvin has a wide therapeutic index. However, at a high concentration, toxicity is observed because of concentration-dependent liver enzyme induction. Albendazole exhibits similar characteristics to griseofulvin in the presence of a fatty meal. Unlike griseofulvin, a high carbohydrate, low fat meal significantly reduces the plasma concentration of ketoconazole and albendazole(Mannisto et al., 1982).

Drugs with low therapeutic index are more likely to produce a significant harmful effect when they interact with food (Mason 2010). The five groups of participants, scored low in the interaction of digoxin with foods such as wheat bran, rolled oats and sunflower seeds. Digoxin is a drug that is commonly used in the management of atrial arrhythmias and congestive heart failure. Agents that affect intestinal motility have been shown to affect the rate and extent of absorption of orally administered digoxin (Hussain 2011). Johnson et al. (1987) showed in sixteen healthy volunteers, concurrent administration of digoxin tablets with a meal high in fiber content decreased the extent of absorption of digoxin. Digoxin has a narrow therapeutic index. Therefore, changes in the bioavailability of digoxin will have a significant therapeutic effect. The consequence of a decrease in the plasma concentration of digoxin will lead to therapy failure.Drugs with low therapeutic indices such as phenytoin should be taken at set times with relation to meals (Mason, 2010; de Lima Toccafondo & Huang 2012; Carrillo, 2012). The groups did poorly on the interaction of levodopa with a meal rich in protein. Levodopa is used in the management of Parkinson's disease. Its absorption from the small intestine is mediated through an unknown large neutral amino acids transport pump (Carmago et al., 2014). The coadministration of Levodopa with dietary amino acids causes an increase in the competition for transport in the small intestine and at the blood-brain barrier, thus decreasing the bioavailability of Levodopa (Carmago et. al., 2014). Question 14 tested participants on the pharmacokinetic process where interactions occur most. Nurses with ≥20 years of nursing experience, scored higher on this question than other groups. Similar scores were noticed on the effect of food on levothyroxine.

4. Conclusions

Our studies are in agreement with previous studies (Jyoti et al., 2012) that have shown that health care professionals lack knowledge about FDI. The study also reveal that experience does not confer expertise in the knowledge of food and drug interactions. Our study also supports research that has shown that experienced nurses possess more tactic knowledge than theoretical knowledge (Evans et al., 2006). The study revealed that the level of awareness of FDI is directly related to the level of nurses' years of experience. About 28% of the study participants had recorded FDI during their clinical practice. Nurses ≥20 years of experience, had witnessed more FDI than nurses with 0-4, 5-9, 10-14, 15-19 years of experience. The present study showed that there is a significant difference in the knowledge of FDI among nurses with 0-4, 5-9, 10-14, 15-19 and ≥20 years of experience.However, no statistical differences were observed in some questions such as MAOI withtyramine containing foods (Q3), caffeine with diazepam (Q4), alcohol with metronidazole (Q20), digoxin with fiber (Q8), grapefruit juice with amiodarone (Q25). The meantotal score differences significant. All nurses that participated in this study proposed that food and drug interaction update should be an integral part of nursing in-service training.

5. Limitations

Limitations of this study are small sample size and use of higher statistical level analysis.

6. Recommendations

Future research calls for a larger sample size and to assess FDI knowledge, attitude and awareness amongst nurses working in different clinical units, nurses with varied experience and education, and nurses working in different facility (hospital, nursing home, college), Regression, propensity analysis inclusive is recommended in future for variables' interactions, to enable more validated results.

References

AHRQ (Agency for Health Care Research and Quality). (2007). Nursing staffing and quality of patient care. (Evidence Report/Technology Assessment Number 151) Retrieved from http:// www.ahrq.(accessed January 10, 2015)

AHRQ (Agency for Healthcare Research and Quality). 2010. Medical Errors: The Scope of the Problem. Fact Sheet. Publication No. AHRQ 00-P037. Rockville, MD: AHRQ. http://www.ahrq.gov/qual/errback.htm. (Accessed January 10, 2015).

Aiken, L., Havens, D. & Sloane, D., (2009). The Magnet nursing services recognition program; a comparison of two groups of Magnet hospitals. JONA, 39(7/8), S5-S14.

Andrade, C.(2014). Fruit juice, organic anion transporting polypeptides, and drug interactions in psychiatry.J Clin Psychiatry.75(11):e1323-5.

Benner, P. (1984). From novice to expert: Excellence and power in clinical nursing practice. Menlo Park, CA: Addison-Wesley.

Blegen, M.A., Vaughn, T.E., Goode, C.J. (2001). Nurse experience and education: Effect on quality of care. Journal of Nursing Administration. 31:33–39.

Bobay, K., Gentile, D.L., Hagle, M.E. (2009). The relationship of nurses' professional characteristics to levels of clinical nursing expertise. Applied Nursing Research. 22:48–53

Burritt, J., &Steckel, C. (2009). Supporting the learning curve for contemporary nursing practice. JONA, 39(11), 479-484.

Bushra, R., Aslam, N., & Khan, A. Y. (2011). Food-Drug Interactions. Oman Medical Journal, 26(2), 77–83. doi:10.5001/omj.2011.21

Carmago S.M.R., Vuille-dit-Bille, R.N., Mariotta, L., Ramadan, T., Huggel, K., Singer, D. Gotze, O., and Verrey, F. (2014). The molecular mechanism of intestinal Levodopa absorption and its possible implications for the treatment of Parkinson's disease. Journal of Pharmacology and Experimental Therapeutics; 351(1): 114-123

Carrillo, J.A.(2012). Drug interactions and clinical relevance: it all began with cheese.Rev Enferm. 35(4):8-18.

Committee on Quality of Health Care in America (2000): Institute of Medicine. To err is human: building a safer health system. Washington, D.C. National Academy Press

Dunton, N., Gajewski, B., Klaus, S., & Pierson, B. (2007). The relationship of nursing workforce characteristics to patient outcomes. OJIN: TheOnline Journal of Issues in Nursing,12(3). Retrieved May 17, 2015 from: www.nursingworld.org/MainMenuCategories/ANAMarketplace/ANAPeriodicals/OJIN/TableofContents/Volume122007/No3Sept07/NursingWorkforceCharacteristics.asp

Ericsson, K.A, Whyte, J., Ward, P. (2007). Expert performance in nursing: Reviewing research on expertise in nursing within the framework of the expert-performance approach. Advances in Nursing Science. 30:E58–E71.

Evans, R., & Donnelley, G. (2006). A model to describe the relationship between knowledge, skill and judgment in nursing practice. Nursing Forum,41(4), 150-157.

Haen, E. (2014). Drug-drug interactions: interactions between xenobiotics. Nervenarzt 85 (4): 417-26

Hanley, M.J., Cancalon,P., Widmer, W.W., Greenblatt, D.J.(2011). The effect of grapefruitjuice on drug disposition. Expert Opin Drug MetabToxicol. 7(3): 267–286

Hill, K. (2010) "Improving Quality and Patient Safety by Retaining Nursing Expertise"OJIN: The Online Journal of Issues in Nursing Vol. 15 No. 3.

Hussain, S. (2011). Patient Counseling about Herbal-Drug Interactions. African Journal of Traditional, Complementary, and Alternative Medicines, 8(5 Suppl), 152–163. doi:10.4314/ajtcam.v8i5S.8

IOM (Institute of Medicine). 1999. To Err Is Human: Building a Safer Health System. Washington, DC: National Academy Press.

IOM Recommendations (2010).The Future of Nursing Leading Change, Advancing Health Advising the nation/Improving health; Retrieved March 20, 2015 from www.iom.edu/nursing

Johnson, F.B., Rodin, S.M. and Hoch K. 1987. The effect of dietary fiber on the Bioavailability of digoxin in capsules. J.ClinPharmacol; 27: 487-490

Jyoti, M.B., Jayanthi, M.K., Basavaraj, R.T., Renuka, M. (2012) Knowledge and Awareness of food and drug interactions (FDI): a survey among health care professionals. International journal of Pharmacology and Clinical Sciences. 1(4): 97-105

Kersemaekers, W.M., Dogterom, P., Xu, J., Marcantonio, E.E., de Greef,R., Waskin ,H., van Iersel, M.L.(2015). Effect of a High-Fat Meal on the Pharmacokinetics of Posaconazole 300 mg in a Solid Oral Tablet Formulation. Antimicrob Agents Chemother. pii: AAC.05000-14

de Lima Toccafondo, V. M., Huang, S.M. (2012) Botanical-drug interactions: a scientific perspective.Planta Med.78(13):1400-15.

McHugh, M. D., & Lake, E. T. (2010). Understanding Clinical Expertise: Nurse Education, Experience, and the Hospital Context. Research in Nursing & Health, 33(4), 276–287.

Manrique, Y.J., Lee, D.J., Islam, F., Nissen, L.M., Cichero, J.A., Stokes, J.R., Steadman, K.J.(2014). Crushed tablets: does the administration of food vehicles and thickened fluids to aid medication swallowing alter drug release? J Pharm Pharm Sci. 17(2):207-19.

Mason, P. (2010). Important drug–nutrient interactions. Proceedings of the Nutrition Society, 69, pp 551-557.

McCance-Katz, E. F., Gruber, V. A., Beatty, G., Lum, P. J., & Rainey, P. M. (2013). Interactions between alcohol and the antiretroviral medications ritonavir or efavirenz. Journal of Addiction Medicine, 7(4), 264–270.

Mouly, S., Morgand, M., Lopes, A., Lloret-Linares, C., Bergmann, J.F.(2015). Drug-food interactions in internal medicine: What physicians should know? Rev Med Interne. pii: S0248-8663(14)01114-X.

Nazari, A.M., Salamzadeh, J., Hajebi, G., and Gilbert,B.(2011). The role of clinical Pharmacists in educating nurses to reduce drug-food interactions (absorption Phase) in hospitalized patients. Iranian Journal of Pharmaceutical Research 10(1): 173-177

Nutescu E, Chuatrisorn I, Hellenbart E. (2011). Drug and dietary interactions of warfarin and novel oral anticoagulants: an update.J Thromb Thrombolysis. 31(3):326-43.

Omotoso, G. O., Enaibe, B. U., Oyewopo, A. O., &Onanuga, I. O. (2013). Liver enzymes derangement and the influence of diet in animals given oral albendazole. Nigerian Medical Journal : Journal of the Nigeria Medical Association, 54(5), 310–312. doi:10.4

Palma, R., Vidon, N., Houin, G., Pfeiffer, A., Rongier, M., Barre, J. & Bernier, J (1986)

Influence of bile salts and lipids on intestinal absorption of griseofulvin in man. Eur.J.clinPharmac., 31-319-325

Qing-ping, S., Xiao-dong, J., Feng, D., Yan, L., Mei-ling, Y., Jin-xiu, Z., & Shu-qiang, Z. (2014). Consequences, measurement, and evaluation of the costs associated with adverse drug reactions among hospitalized patients in China. BMC Health Services Research, 14, 73. doi:10.1186/1472-6963-14-73

Simmons, B., Lanuza, D., Fonteyn, M., Hicks, F., Holm, K.(2003). Clinical reasoning in experienced nurses. Western Journal of Nursing Research. 25:701–719.

Unroe, K. T., Pfeiffenberger, T., Riegelhaupt, S., Jastrzembski, J., Lokhnygina, Y., & Colón-Emeric, C. (2010). Inpatient Medication Reconciliation at Admission and Discharge: A Retrospective Cohort Study of Age and Other Risk Factors for Medication Discrepancies. The American Journal of Geriatric Pharmacotherapy, 8(2), 115–126.

Winstanley, P.A., Orme, M.L.(1989). The effects of food on drug bioavailability. Br.J.Clin. Pharmac. 28, 621-628

Appendix I: Questionnaire Items

Q # Description

1. Theophylline and Caffeine
2. Tetracycline and Dairy products
3. MAOI and tyramine containing foods (cheese)
4. Caffeine and Diazepam
5. Coumadine and Garlic
6. Antibiotics and Citrus juice
7. Ketoconazole and Fatty acid
8. Digoxin and Wheat bran
9. Levodopa and Protein meal
10. Coumadin and Green vegetables
11. Levothyroxine and Cauliflower
12. Age group at highest risk for FDI
13. Food/ Supplement commonly involved in FDI
14. Pharmacokinetic process commonly involved in FDI

15 – 19: Timings of food and drug intake

15. Omeprazole
16. Glipizide
17. Actos
18. NSAID
19. Levothyroxine

20 – 22: Drugs and alcohol

20. Metronidazole
21. Milk
22. Cimetidine

23 – 25: Drugs and grapefruit juice

23. Sildenafil (Viagra)
24. Diltiazem
25. Amiodarone

26 – 28: Hypertensive management

26. Propranolol with or without food
27. Spironolactone and potassium rich foods
28. Salt and hypertension

29 – 31: anti-HIV and food timing

29. Lopinavir
30. Didanosine
31. Zidovudine

32 – 34: fruit juices, vitamins

32. Vitamins and medications
33. Cranberry juice
34. Orange juice and alcohol
35. Role of Nurses on food and drug interaction

Appendix II: Attitude to Food and Drug Interaction

1. Reading of prescription label
2. Reading directions, interactions, precautions on drug inserts
3. Stirring of medication with food
4. Taking medication with alcoholic drinks