Knowledge of Food and Drug Interactions among Nurses: 
Assessment Strategy for Continuing Education

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Abstract
The effect of medication errors on patient quality care and safety is a critical ongoing concern requiring solutions. Although medication safety has been a concern of all healthcare professions, registered nurses play an important role in medication safety as patients’ advocates. A cross sectional study with structured questionnaire on common FDI found in the medical journal was used in this study. The questionnaire consisted of 37 questions (dichotomous and multiple choice questions). A convenience sample of 271 nurses from different inpatient community nursing units (60 medical surgical, 60 telemetry, 29 Intensive care (ICU), 21 emergency, and 101 ‘others’ across the DC-MD-VA metropolitan areas were recruited for this study. The data was subjected to descriptive analysis. The study protocol was approved by the Office of Regulatory, Research Compliance, Howard University. The result, showed no significant differences in the knowledge of FDI among the 5 groups of registered nurses. The authors propose continuing education for all nurses to update dosage calculation, follow drug administration protocol and enhance knowledge of pharmacology as avenues to reduce medication error. The authors also recommend that future studies focus on a larger sample size, inclusion of more associated FDI variables and use of high level statistical analysis.

Keywords: Food and drug interactions (FDI), Registered Nurses, Medical Surgical, Telemetry, Emergency, Intensive Care (ICU), Units

1. Introduction
The Institute of Medicine (IOM) reported that as many as 98,000 deaths occur annually from medical errors (Committee on Quality of Health Care in America, IOM, 1999). In the United States, the cost of managing drug-related morbidity and mortality is about $37.6 billion annually (IOM, 2010, Qing-ping, et al., 2014). About half of the cost, is associated to preventable errors (AHRQ, 2007, 2010). Nurses practice in a wide-range of specialty areas. These include emergency, trauma, intensive care (ICU), medical surgical units etc. Each unit demands some key skills in order to effectively carry out patient care. American Nurses Association demands that nurses are floated to a unit they have the appropriate competency (ANA 2001). Studies suggest that a better patient outcome is linked to higher nursing competency (ANA 2001). Accurate dosage calculation, following drug administration protocols and sound knowledge of pharmacology are some of the active ways to reduce medication error.

Food and Drug Interaction (FDI), an adverse drug reaction, is one of the sources of medication errors (Bushra et al., 2011). Adverse Drug Reactions (ADRs), pose a significant public health problem requiring solutions. Medication errors occur due to active failures and latent conditions (Frith et al., 2012). Latent conditions include inadequate staffing, time pressures, unit environment and fatigue (Frith et al., 2012). Equally important are active conditions that contribute to errors. Active failures include wrong dosage calculation, failure to follow drug administration protocols and lack of pharmacology knowledge. Although, many strategies such as computerized physician entry, bar code administration systems, medication reconciliation (Frith et al., 2012), are in place to reduce medication errors, the incidence of medication errors remains an issue. Health personnel are key in the management of medication errors. Registered Nurses, play an important role in patient safety (IOM, 2010). Hence, 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). Studies suggest that a better patient outcome is linked to higher nursing competency (ANA 2001). Nurses act as the final barrier between a patient and medication error (Frith et al., 2012). The authors suggested that increasing the number of RN (Registered Nurse) hours and decreasing or eliminating LPN hours can be a strategy to reduce medication errors. It has been
recommended that 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 then imperative that nurses be current on potential FDI of medications to ensure that they function properly as patient advocates. Studies on the knowledge of FDI among nurses working in different specialty units are lacking.

FDI occur when specific nutrients in foods interact with drugs if ingested concomitantly. FDI can result in changes in the bioavailability, pharmacokinetics, pharmacodynamics and therapeutic efficacy of the medication. For example, 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, an enzyme that is involved in the metabolism of many drugs (Andrade, 2014; Hanley, et al., 2011). Concomitant administration of grapefruit with drugs that are metabolized by CYP3A enzymes can cause a 5-fold increase in the bioavailability of such drugs (Mason, 2010). This is true with the administration of grape juice with felodipine, an antihypertensive drug that is 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. Patients on polypharmacy, should be assessed regularly for possible food and drug interactions (Mouly et al., 2015).

1.1 Aim

This study, examines the knowledge of pharmacology with emphasis on food and drug interaction amongst nurses working in different units in community hospitals in the DC-MD-VA.

2. Methods

2.1 Design

This was a cross-sectional descriptive survey using the modified 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 271 nurses, divided into 5 groups (60 med surgical, 60 telemetry, 21 emergency, 29 Intensive care (ICU) and 101 ‘others’) of nurses working in different inpatient care units in community hospitals in the District of Columbia metropolitan (DC-MD-VA) area. The ‘other’ unit, represents a group of data collected from units whose numbers were low due to insufficient participants. 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 the distribution of the Food and Drug Interaction questionnaire (FDIQ). Personal identifier were excluded in the questionnaire.

2.4 Data Collection

The Jyoti et al. (2012) FDIQ was adopted for this study. There were 37 questions which included dichotomous and multiple choice questions. The 37 questions, tested participants’ knowledge (see questionnaire items). The FDIQ included questions regarding food interactions with antihypertensive, antithyroids, antidepressants, anticoagulants, antiretrovirals, peptic ulcer drugs and analgesics. On average it took 30 minutes for each participant 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 37. 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 from the start of the study. The response rate was 100%, and all participants completed the FDIQ within 30 minutes. The overall knowledge of the study participants was assessed based on their responses to the questionnaire (see below).
3.1 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. Coumadin 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. -16 Food/ Supplement commonly involved in FDI
17. Pharmacokinetic process commonly involved in FDI
18 – 22: Timings of food and drug intake
18. Omeprazole
19. Glipizide
20. Actos
21. NSAID
22. Levothyroxine
23 – 25: Drugs and alcohol
23. Metronidazole
24. Milk
25. Cimetidine
26 – 28: Drugs and grapefruit juice
26. Sildenafil (Viagra)
27. Diltiazem
28. Amiodarone
29 – 31: Hypertensive management
29. Propranolol with or without food
30. Spironolactone and potassium rich foods
31. Salt and hypertension
32 – 34: anti-HIV and food timing
32. Lopinavir
33. Didanosine
34. Zidovudine
35 – 37: fruit juices, vitamins
35. Vitamins and medications
36. Cranberry juice
37. Orange juice and alcohol

Table 1 compares the knowledge of FDI among nurses working in different units: Medical Surgical, Telemetry, Emergency, Intensive care (ICU) and ‘others’. The values reported for each question represent the percentage of the correct answers in each of the groups. With respect to if drugs can be taken on an empty stomach or with food (timing-Q19-22), most of the participants were knowledgeable with proton pump inhibitors (PPI e.g. omeprazole), non-steroidal anti-inflammatory drugs (NSAIDs) and thyroid hormones (levothyroxine). Some of the participants were not sure if food will affect the absorption of certain drugs such as antidiabetic drugs (acarbose, glipizide), antacids and drug for tuberculosis (isoniazid). For NSAIDs (Q21) and levothyroxine (Q22) questions, participants working in ICU scored better than the other groups. Similar response scores were observed on question (Q25) regarding the interaction of cimetidine with alcohol. All the participants scored high in their knowledge of the interaction of theophylline with large amounts of tea, coffee and chocolates (Q1). Medical surgical nurses, scored low on question asking for common food and drug interactions such as consumption of cheese, processed meats, legumes, wine, beer, fava beans and fermented products with MAO inhibitors (Q3), as well as the interaction of drugs with dairy, iron and alcohol (Qs 13, 14 &15). Medical surgical nurses scored higher on the pharmacokinetic process where FDI occurs most (Q17). Emergency unit nurses, scored better than the other groups on the interaction of coumadin and garlic (Q5) and vitamins and medications (Q35).

Table 1. Comparison of the knowledge of FDI in the five groups (Medical Surgical (GP I), Telemetry (GP II), Emergency (GP III), ICU (GP IV) and ‘others’ (GP V), expressed as percentage of respondents with correct answers for each question.

| Q # | GP I (MS) | GP II (TELE) | GP III (EM) | GP IV (ICU) | GP V (OTHERS) | Pair wise comparison (p value) |
|-----|-----------|--------------|-------------|-------------|--------------|-----------------------------|
| 1   | 84.4      | 80.3         | 81.0        | 82.8        | 86.5         |                             |
| 2   | 59.4      | 47.5         | 57.1        | 37.9        | 46.2         |                             |
| 3   | 78.1      | 88.5         | 85.7        | 79.3        | 81.7         |                             |
| 4   | 84.4      | 88.5         | 85.7        | 86.2        | 81.7         |                             |
| 5   | 43.8      | 34.4         | 57.1        | 37.9        | 54.8         |                             |
| 6   | 45.3      | 49.2         | 66.7        | 27.6        | 56.7         |                             |
| 7   | 39.1      | 26.2         | 42.9        | 27.6        | 36.5         |                             |
| 8   | 32.8      | 37.7         | 33.3        | 27.6        | 22.1         |                             |
| 9   | 45.3      | 36.1         | 81.0        | 27.6        | 37.5         |                             |
| 10  | 64.1      | 41           | 61.9        | 51.7        | 62.5         | 0.010 0.005                 |
| 11  | 25.0      | 19.7         | 47.6        | 24.1        | 28.8         | 0.130                        |
| 12  | 46.7      | 45           | 38.1        | 58.6        | 42.6         |                             |
| 13  | 9.4       | 26.2         | 28.6        | 20.7        | 23.1         | 0.014 0.029 0.025           |
| 14  | 10.9      | 24.6         | 23.8        | 20.7        | 19.2         | 0.046                        |
| 15  | 15.6      | 31.1         | 28.6        | 24.1        | 20.2         | 0.041                        |
| 16  | 75.0      | 85.2         | 90.5        | 93.1        | 84.6         | 0.042                        |
| 17  | 73.4      | 62.3         | 61.9        | 69.0        | 66.3         |                             |
| 18  | 62.5      | 73.8         | 42.9        | 75.9        | 68.3         | 0.010                        |
| 19  | 32.8      | 24.6         | 38.1        | 24.1        | 38.5         |                             |
| 20  | 40.6      | 42.6         | 90.5        | 27.6        | 37.5         |                             |
| 21  | 68.8      | 65.6         | 66.7        | 82.8        | 64.4         |                             |
| 22  | 53.1      | 82           | 42.9        | 55.2        | 47.1         | 0.001                        |
| 23  | 87.5      | 82           | 100         | 89.7        | 92.3         | 0.038                        |
Table 1 cont. Comparison of the knowledge of FDI in the five groups (Medical Surgical (GP I), Telemetry (GP II), Emergency (GP III), ICU (GP IV) and ‘others’ (GP V), expressed as percentage of respondents with correct answers for each question

| Q # | GP I | GP II | GP III | GP IV | GP V | Pair wise comparison ( p value) |
|-----|------|-------|--------|-------|------|-------------------------------|
|     | MS   | TELE  | EM     | ICU   | OTHERS | II-IV | II-V | III-IV | III-V | IV-V |
| 24  | 26.6 | 45.9  | 14.3   | 41.4  | 19.2  | 0.017 | 0.010 |
| 25  | 84.4 | 91.8  | 90.5   | 96.6  | 95.2  |       |      |
| 26  | 81.3 | 75.4  | 81     | 62.1  | 81.7  | 0.048 |      |
| 27  | 64.1 | 62.3  | 61.9   | 72.4  | 76    |       |      |
| 28  | 65.6 | 69.2  | 57.1   | 51.7  | 52.9  |       |      |
| 29  | 73.4 | 72.1  | 66.7   | 89.7  | 71.2  |       |      |
| 30  | 84.4 | 75.4  | 81     | 89.7  | 75    |       |      |
| 31  | 87.5 | 98.4  | 90.5   | 96.6  | 98.1  | 0.019 | 0.005 |
| 32  | 90.6 | 82    | 76.2   | 86.2  | 83.7  |       |      |
| 33  | 78.1 | 68.9  | 76.2   | 79.3  | 76.9  |       |      |
| 34  | 85.9 | 72.1  | 81.0   | 89.7  | 74.0  |       |      |
| 35  | 60.9 | 52.5  | 81     | 44.8  | 54.8  | 0.012 |      |
| 36  | 67.2 | 62.3  | 57.1   | 58.6  | 70.2  |       |      |
| 37  | 65.6 | 73.8  | 71.4   | 69.0  | 63.5  |       |      |

Note: Q # represents question number, and GP I, II, III, IV, V represent Medical Surgical, Telemetry, Emergency, ICU, and ‘others’ groups, respectively.
The five groups scored low on the interaction of digoxin with foods such as wheat bran, rolled oats and sunflower seeds (Q8). The nurses working in the Telemetry unit scored high on the FDI of amiodarone with grapefruit juice (Q28). There was no significant difference among the five groups on their knowledge of FDI between diltiazem and grapefruit juice (Q27). The total scores on the knowledge test as displayed in Table 2 were as follows: Medical Surgical (22.13±4.97), Telemetry (21.78±4.58), Emergency (23.38±3.39), ICU (21.79±4.22) and others (21.96±4.43). Hence, no significant differences in knowledge were found among the five groups.

Limitations of this study are small sample. Future research calls for a larger sample size and to assess FDI knowledge, practice and awareness amongst nurses working in different facilities (hospital, nursing home, college). In addition, higher statistical analysis such as regression, propensity is recommended in future studies for more validated results.

Table 2. Total score, mean difference and the mean score percentage of Attitude of FDI among five groups

| Total score | Med/Surg (n = 60) | Telemetry (n= 60) | Emergency (n = 21) | ICU (n = 29) | ‘Other’ (n= 101) |
|-------------|------------------|------------------|------------------|-------------|-----------------|
| Mean±SD     | 22.13±4.97       | 21.78±4.58       | 23.38±3.39       | 21.79±4.22  | 21.96±4.43      |
| Mean difference | -0.3500         | -1.5976          | -1.2476          | -0.3402     | -0.1729         |
| Mean score percentage | 59.8%          | 58.9%            | 63.0%            | 58.9%       | 59.3%           |
| p value     | 0.60             | 0.60             | 0.60             | 0.60        | 0.60            |

4. Discussion

The present study was successful in evaluating the knowledge of FDI among nurses working in different nursing units. With respect to knowledge of FDI, there were no significant differences among nurses working in different nursing units. However, there were some significant differences in some individual questions such as interaction of coumadin with garlic (Q5), ketoconazole with garlic (Q7), digoxin with fiber (Q8), milk and alcohol (Q20). This observation in the knowledge of FDI amongst nurses working in different nursing units suggest that the nursing preparation is the same irrespective of the unit they work in. This supports the finding that there is no difference between patient outcome and nursing education (IOM, 2010).

The results also showed that drug interaction does not only occur between two drugs rather, they can occur between drugs and between any kind of foreign substance (xenobiotica), food (e.g. grapefruit juice, broccoli, and 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 changes in gastric emptying, and changes in the activity of drug metabolizing enzymes (Kersemaekers et al., 2015).

In addition, 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 FDIIQ such as the timing of foods and drugs such as glipizide, actose, synthroid (thyroid hormone). To enhance therapeutic effects, drugs such as glipizide, atenolol, and synthroid that interact with foods should be taken on an empty stomach (Manrique et al., 2014; Winstanley et al., 1989). 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 that worked in the intensive care unit (ICU), 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 as griseofulvin in the presence of a fatty meal. Unlike griseofulvin, a high carbohydrate, low fat meal significantly reduces the plasma concentration of ketoconaole 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 (Omotoso et al., 2013).

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. All the groups scored below 80 %. Nurses working on the Medical surgical unit, scored better as compared to other groups. Similar scores were noticed on the effect of grapefruit juice on amiodarone. Nurses in ICU scored very low compared to other groups on some questions such as ketoconaole and fatty diet (Q7), digoxin and wheat bran (Q8), levodopa and protein diet, synthroid and the timing of food (Q19), metronidazole and alcohol (Q20).

5. Conclusions

Our studies are in agreement with previous studies (Nazari et al., 2011; Jyoti et al., 2012) that have shown that health care professionals lack knowledge about FDI. This study shows that the level of knowledge of FDI among nurses working in the different units are similar. Suggesting that the nurses are equally prepared in pharmacology. However some units scored lower than others in some individual questions. Some significant differences were observed in certain questions such as interaction of Coumadin with garlic (Q5), digoxin with fiber (Q8), theophylline with caffeine (Q1). There were no significant differences on the total score earned by each group (table 2). There were no significant differences on the total score earned by each group (table 2). The results of this study support the Code of Ethics for Nurses with Interpretive Statements that nurses should not be assigned to a particular unit without first
having established the ability to provide professional care in such unit (ANA, 2001). The authors propose continuing education for all nurses to update dosage calculation, follow drug administration protocol and enhance knowledge of pharmacology as avenues to reduce medication error.

References

AHQR (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.gov/qual/errback.htm. (accessed January 10, 2015)

AHRF (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).

America Nurses Association (ANA). (2001) mission statement. Retrieved from: http://www.aacn.org/wd/practice/content/nurse-staffing-ratio.pcms?menu=practice on 7/28/2016.

Andrade, C. (2014). Fruit juice, organic anion transporting polypeptides, and drug interactions in psychiatry, 75(11), e1323-5. http://dx.doi.org/10.4088/JCP.14f09572.

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

Carmago S.M.R., Veuille-dit-Bille, R.N., Mariotta, L., Ramadan, T., Huggel, K., Singer, D. Gotze, O., & 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. https://doi.org/10.1124/jpet.114.216317

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.

de Lima Toccafondo, V. M., Huang, S.M. (2012) Botanical-drug interactions: a scientific perspective. Planta Med., 78(13), 1400-15. https://doi.org/10.1055/s-0032-1315145

Frith, K.H., Anderson, E.F., Tseng, F. & Fong, E.A. (2012). Nurse staffing is an important strategy to prevent medication errors in community hospitals. Nursing Economics, 30(5), 288-294.

Haen, E. (2014). Drug-drug interactions: interactions between xenobiotics. Nervenarzt, 85(4), 417-26. https://doi.org/10.1007/s00115-013-3935-0

Hanley, M.J., Cancalon,P., Widmer, W.W., Greenblatt, D.J. (2011). The effect of grapefruit juice on drug disposition. Expert Opin Drug Metab Toxicol, 7(3), 267–286. https://doi.org/10.1517/17425255.2011.53189

Hussain, S. (2011). Patient Counseling about Herbal-Drug Interactions. African Journal of Traditional, Complementary, and Alternative Medicines, 8(5 Suppl), 152–163. https://doi.org/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. & Hoch K. (1987). The effect of dietary fiber on the Bioavailability of digoxin in capsules. J.Clin Pharmacol, 27, 487-490. https://doi.org/10.1002/j.1552-4604.1987.tb03054.x

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. https://doi.org/10.1128/AAC.05000-14

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. https://doi.org/10.18433/J39W3V
Mason, P. (2010). Important drug–nutrient interactions. *Proceedings of the Nutrition Society, 69*, 551-557. https://doi.org/10.1017/S0029665110001576

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. https://doi.org/10.1097/ADM.0b013e318293655a

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 Intern. pii: S0248-8663(14)01114-X.*

Nazari, A.M., Salamzadeh, J., Hajebi, G., & 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. https://doi.org/10.1007/s11239-011-0561-1

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. https://doi.org/10.4103/0300-1652.122333

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.clin Pharmac., 31*-319-325. https://doi.org/10.1007/bf00981131

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. https://doi.org/10.1186/1472-6963-14-73

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. https://doi.org/10.1016/j.amjopharm.2010.04.002

Winstanley, P.A., Orme, M.L., 1989. The effects of food on drug bioavailability. *Br.J.Clin. Pharmac. 28*, 621-628. https://doi.org/10.1111/j.1365-2125.1989.tb03554.x