Objective: The aim of this study was to determine oncology nurses awareness of drug interactions. Methods: This descriptive study was conducted with nurses working in the oncology clinics who are a member of Oncology Nursing Association of Turkey. A total of 115 nurses (response rate 20%) were responded to the online survey that consists of 28 questions. Results: The mean age of the nurses was 33 ± 6.8. The majority of nurses work in university hospital (60%) as a clinical nurse (62.6%) and have a Bachelor Degree in Nursing (63.5%). The mean working years in oncology was 4 years. Half of them stated receiving information on drug interactions mostly through in-service education and courses/congresses in last 5 years. The majority of them (84.3%) indicated that they are considering the possibility of drug interactions when they are scheduling the medication administration time. More than half of the responders (59.1%) encountered drug interactions; however, few explored drug interactions with food, drinks, and nutritional supplements. Their practices to assess possibility of drug interactions were reviewing the drug prospectus (78.3%); consulting with their colleagues (58.3%) and searching on the available website (42.6%) and looking at the drug interaction (39.1%). More than half (65.2%) stated lack of any system to identify drug interactions in their workplace. Nearly half of them indicated to including the drug interaction into patient education mostly for food-drug (73.9%) and drug-drug (63.5%) interactions. Conclusions: Almost all indicated the needs for further education on drug interactions and suggested to have guideline/packet guide.

Key words: Drug interaction, oncology nursing, patient safety, oncology patients

Introduction

The term “drug interaction” is most often used to describe drug-drug interactions, but there are various substances such as food and nutritional supplements that can alter the pharmacokinetics and/or pharmacodynamics of medications. According to Food and Drug Administration, 3%-30% patients experienced the drug-drug interaction. Drug-drug interaction is a growing problem with the addition of medications for chemotherapeutic agents for cancer to other health problems. In a study, 12.4% of the unplanned admission to hospital (n = 1275) in cancer patients were considered to be associated with a drug-related problems, and 94.5% of these problems were adverse drug reactions.

Although several studies have evaluated the frequency and
consequences of medication errors, few have explored their causes. In particular, nurses’ knowledge regarding medications has been evaluated minimally.

Nurses are uniquely positioned in the prevention of drug interactions. Little is known about nurses’ knowledge regarding this area; therefore, the aim of this study is to determine awareness of nurses working in oncology about drug interactions.

Methods

Study design
A descriptive and cross-sectional design was used to determine awareness of oncology nurses about drug interactions, organization treatment of the patients in the oncology clinics and taking into account the situation of drug interactions in patient teaching.

Instruments
Data were collected via a questionnaire developed by researchers based on the relevant literature. The questionnaire consisted of 28 items with both fixed-choice and open-ended questions on demographic and professional characteristics (institution, educational status, place of work, position, working years in oncology), education about drug interaction, problems with drug interaction, nurses’ opinion, and preventive practice for drug interactions and what they have done to determine drug interaction risk was used. This form was converted electronically, and it was filled as online survey system that is named as Survey.

Sampling procedure and settings
Nurses who are a member of the Oncology Nursing Association of Turkey (TONA) work in oncology clinics and have an E-mail address were the sample of this study. TONA was established in 1989. TONA aims to develop knowledge and comprehension of oncology nursing and spread this knowledge and comprehension. At the time of the study, there were 600 members of TONA in the Turkey.

An E-mail explaining the aim of the study and link to the survey was sent to the nurses. A reminder was sent again 2 weeks later for the nurses who did not respond. Four nurses requested sending data collection tool directly to their E-mail address as an attachment. The process of the data collection was performed between March and August in 2014. A total of 115 nurses (response rate 20%) were responded. A presentation about drug interaction prepared by the first author was sent to nurses per their request.

Statistical analysis
Data were transferred to version 17.0 (SPSS for Windows, Chicago, IL, USA) packed program. Percentages and means were used to illustrate the descriptive properties of demographic characteristics. The open-ended questions were grouped into themes and summarized as percentages.

Ethical considerations
Permission to undertake this study was obtained from the Turkish Oncology Nursing Association Board and nurses.

Limitation of the study
The response rate (20%) was low. The low response rate may be caused by recently using online survey system for studies in Turkey. Hence, nurses may not be familiar with surveys.

Results
In the sample, 95.7% were women, and the mean age of the nurses was 33 ± 6.8 (range: 18-52). The majority of nurses worked in university hospital (60%) as a clinical nurse (62.5%) and had a Bachelor Degree in Nursing (63.5%) and also 38.7 of them worked in the oncology clinics between 2 and 5 years. The mean number of years in oncology was 4.7 years (range: 0.1-22 years) [Table 1].

Although it was not presented in the table, the mean number of years in nursing was about 11 years (range: 1-34 years), and bed capacity of hospitals was approximately 23 in cancer clinics; nurses care for approximately 11 patients per shift. 51.3% of nurses stated receiving information on drug interactions and 75% of the nurses had it through in-service education. Most of the nurses (93.3%) stated receiving information on drug interactions in last 5 years, and 92.3% had information from in-service education in last 5 years.

Forty percent of the nurses reported that they encountered drug interaction in oncology clinics during their career, and 22.6% encountered it in the last year. The majority of them (84.3%) indicated that they consider the possibility of drug interactions when they schedule the medication administration time.

While 46% of the nurses indicated that they always discuss drug interaction in patient teaching, 48.7% of the nurses reported that they sometimes discuss it. More than half (65.2%) stated the lack of any system to identify drug interactions in their workplace [Table 2].

Some results were not shown in the tables; nearly half of them indicated including drug interaction into patient
education, mostly for food-drug (73.9%) and drug-drug (63.5%) interactions.

More than half of the responders (59.1%) sometimes encountered drug-drug interactions; 40.9% of them sometimes encountered drug-food interaction. Nurses sometimes explored drug interactions with drinks (27.8%), herbal (24.3%), substance (29.6%), and intravenous medication equipment (41.7%). 6.1%-9.6% of the nurses reported that they always take into account different drug interactions [Table 3].

Although it was not indicated in the table, nurses reported that they encountered chemotherapeutic agents-herb interactions, and they also indicated mercaptopurine interacting with allopurinol which causes elevation of liver function (alanine transaminase, aspartate aminotransferase) tests.

Nurses reported they observed nausea-vomiting (70.4%), dizziness (40%), toxicity (35.7%), elevation of the liver function tests, and headache (34.8%) due to drug interactions in cancer patient [Table 4].

Their practices to assess possibility of drug interactions were reviewing the drug prospectus (78.3%), consulting with their colleagues (53%), searching on the available website (42.6%), and checking the drug interaction charts (39.1%) [Table 5].

Although it was not presented in the table, 94.8% of the nurses indicated they need education about drug interaction and they suggested performing training program in regular periods (30.6%) and developing brochure, guidelines, and tables (17.1%) to increase awareness of the drug interactions.

Discussion

“A drug interaction is a situation in which a substance affects the activity of a drug, that is the effects are increased or decreased, or they produce a new effect that neither produces on its own.”[8] It is reported that 20%-30% of all adverse reactions to drugs are caused by interactions between drugs.[11] Drug interaction is a common reason for adverse events in cancer patients,[6] and 3%-5% are preventable adverse events.[4]

In a study, an estimated prevalence (36%) of drug interactions in cancer patients (n = 347) were found.[12] In an another study performed by Riechelmann et al.,[13] 276 potential drug interactions were observed in 405 cancer patients, and they also identified at least one drug interaction in 109 cancer patients in Canada. Considering the result of studies, drug interactions are a common problem in cancer patients. In this study, 40% of the nurses also encountered drug interaction during their clinical practice, and one-third

Table 1: Characteristics of the nurses (n = 115)

| Characteristics                     | n (%) |
|-------------------------------------|-------|
| Gender                              |       |
| Male                                | 5 (4.3) |
| Female                              | 110 (95.7) |
| Age (years) (mean±SD) 33±6.8 (minimum=18, maximum=52) |       |
| <25                                 | 13 (11.3) |
| 25-35                               | 61 (53.0) |
| >35                                 | 41 (35.7) |
| Education                           |       |
| High school                         | 13 (11.3) |
| Vocational school                   | 18 (1.7) |
| Bachelor’s degree                   | 73 (63.5) |
| Graduate (master) degree            | 11 (9.6) |
| Working institute                   |       |
| University hospital                 | 69 (60.0) |
| State hospital                      | 27 (23.5) |
| Private hospital                    | 11 (9.6) |
| Other                               | 8 (7.0) |
| Clinical positions                  |       |
| Head nurse                          | 29 (25.2) |
| Clinical nurse                      | 72 (62.6) |
| Other                               | 14 (12.2) |
| Working duration in the oncology clinics (mean±SD) 4.7±4.8 (minimum=1-month, maximum=22 years) |       |
| <2 years                            | 38 (33.0) |
| 2-5 years                           | 44 (38.3) |
| >5 years                            | 33 (28.7) |

Table 2: Nurses’ practices for drug interactions

| Practices                                    | n (%) |
|----------------------------------------------|-------|
| Encountered drug interactions                |       |
| Yes                                          | 46 (40.0) |
| No                                           | 69 (60.0) |
| Encountered drug interactions in last year   |       |
| Yes                                          | 26 (22.6) |
| No                                           | 89 (77.4) |
| Considering drug interactions when scheduling the drug? |       |
| Yes                                          | 97 (84.3) |
| No                                           | 2 (1.8) |
| Sometimes                                    | 16 (13.9) |
| Teaching to patients about drug interaction  |       |
| Always                                       | 53 (46.1) |
| Sometimes                                    | 56 (48.7) |
| Never                                        | 6 (6.2) |
| Having any system to identify drug interactions in the workplace |       |
| Yes                                          | 75 (65.2) |
| No                                           | 40 (34.8) |

SD: Standard deviation
Table 3: Drug interactions and frequency as reported by nurses in clinical settings

| Interactions types                          | Frequency |
|---------------------------------------------|-----------|
|                                             | Never n (%) | Sometimes n (%) | Always n (%) |
| Drug-drug                                   | 36 (31.3)   | 68 (59.1)       | 11 (9.6)     |
| Drug-food                                   | 58 (50.4)   | 47 (40.9)       | 10 (8.7)     |
| Drug-drink                                  | 75 (65.2)   | 32 (27.8)       | 8 (7.0)      |
| Drug-herbal                                 | 79 (68.7)   | 28 (24.3)       | 8 (7.0)      |
| Drug-substance (alcohol, smoke)             | 74 (64.3)   | 34 (29.6)       | 7 (6.1)      |
| IV medication equipment such as bag, line   | 58 (50.4)   | 48 (41.7)       | 9 (7.8)      |

Table 4: Patient problems encountered from drug interactions in the clinics

| Problems                                | n (%) |
|-----------------------------------------|-------|
| Nausea/vomiting                         | 81 (70.4) |
| Dizziness                               | 46 (40.0) |
| Drug intoxications                      | 41 (35.7) |
| Headache                                | 40 (34.8) |
| Impairment of liver functions           | 40 (34.8) |
| Heart rhythm problems                   | 33 (28.7) |
| A sudden increase in blood pressure     | 33 (28.7) |
| A sudden decrease in blood pressure     | 33 (28.7) |
| Impairment of kidney functions          | 33 (28.7) |
| Chest pain                              | 28 (24.3) |
| Increase of the drug level in the blood | 17 (14.8) |
| Decrease of the drug level in the blood | 11 (9.6)  |

Table 5: Nurses’ practices to learn about drug interactions

| Practices                                      | n (%)   |
|------------------------------------------------|---------|
| Reviewing the drug prospectus                 | 90 (78.3) |
| Consulting with their colleagues             | 67 (58.3) |
| Reviewing the drug handbook                  | 61 (53.0) |
| Searching on available website               | 49 (42.6) |
| Looking at the drug interaction charts        | 45 (39.1) |
| Consulting with the hospital pharmacy        | 41 (35.7) |
| Searching computer program                   | 34 (29.6) |

In our study, nurses encountered drug-drug interactions and drug-food interactions more often than other interactions. In a study, 6 of 298 unplanned hospital admission were caused by drug-drug interactions that were related to warfarin, captopril, and anti-inflammatory agents. Drug interactions can lead to severe toxicity, a loss of therapeutic efficacy or an imbalance in physiological substrates. Drug interactions seem to be the cause of death in 4% of cancer patients. In a study, 9% of the drug interactions were classified as major, and 77% of the drug interactions were classified as minor. In our study, nurses reported problems with drug interactions like nausea-vomiting, and yet they gave limited examples for drug interactions that caused these problems. Some drug interactions that are reported by nurses may be confused with side effects.

The majority of the nurses reported that they read the drug prospectus to determine drug interactions, and they also use some alternative resources like drug handbooks and colleagues. Limited numbers of nurses have access to computer programs for drug interaction, and there are no any clinical pharmacists in oncology clinics. All these problems may cause limited access of the knowledge about drug interactions.

Conclusion

According to results of this study, approximately half of nurses encountered drug interactions in oncology clinics. Although oncology nurses take into account interactions
between chemotherapeutic agent, other drugs and products,
they have low awareness and high demand for education on
drug interactions. Only half of nurses provided education
to patients about drug interaction. These problems and
inadequate patient education related to drug interactions
may negatively affect the quality of care.

In-service training programs should be implemented about
drug interactions at the appropriate time and adequate
number. Drug interaction guidelines should be developed
for oncology nurses. Education program supported with
materials should be organized for oncology patients.

Acknowledgments
The authors would like to thank all nurses who participated in
this study and the Turkish Oncology Nursing Association for
support. This study was presented at a poster presentation in
EONS 9 Congress, Istanbul/Turkey, 18-19 September 2014.

Financial support and sponsorship
The authors would like to thank all nurses who participated
to this study and the Turkish Oncology Nursing Association
for support.

Conflicts of interest
There are no conflicts of interest.

References
1. Scripture CD, Figg WD. Drug interactions in cancer therapy. Nature 2006;6:546-58.
2. Hussar DA. Drug Interaction. The Merc Manual Home Health Handbook; 2007. Available from: http://www.merck.com/
mh/health/ccc/02/c013/c013c.html. [Last accessed on 2011 Oct 24].
3. Frandsen G, Pennington SS. Basic concepts and processes In: İyigün E, Taştan S, editors. Abrams’s Clinical Medicine
Treatment: Practice of Rational Drug for Nurses. 10th ed. Ankara, Turkish: Akademisyen Medicine Book; 2014. p. 25.
4. Food and Drug Administration. Preventable Adverse Drug Reactions: A Focus on Drug Interactions; 2009. Available from:
http://www.fda.gov/drugs/developmentapprovalprocess/
developmentresources/druginteractionslabeling/
ucm110632.htm. [Last accessed on 2011 Oct 24].
5. Riechelmann RP, Moreira F, Smaletz O, Saad ED. Potential for drug interactions in hospitalized cancer patients. Cancer
Chemother Pharmacol 2005;56:286-90.
6. Lohr LK. Drug interactions with newer oral chemotherapy
agents US pharm. Oncol Suppl 2009;34:4-8. Available from: http://www.uspharmacist.com/content/s/82/c/14138/. [Last
accessed on 2011 Oct 24].
7. Chan A, Soh D, Ko Y, Huang YC, Chiang J. Characteristics of unplanned hospital admissions due to drug-related problems
in cancer patients. Support Care Cancer 2014;22:1875-81.
8. Daouphars M, Magali A, Bertrand E, Basuyau F, Violette S, Varin R. Knowledge assessment and information needs of
oncology nurses regarding inpatient medication. Clin J Oncol
Nurs 2012;16:182-7.
9. Hsaio GY, Chen JJ, Yu S, Wei IL, Fang YY, Tang FI. Nurses’ knowledge of high-alert medications: Instrument
development and validation. J Adv Nurs 2010:66:177-90.
10. Bushra R, Aslam N, Khan AY. Food-drug interactions. Oman
Med J 2011;26:77-83.
11. Kuhlmann J, Mück W. Clinical-pharmacological strategies to
assess drug interaction potential during drug development. Drug Saf 2001;24:715-25.
12. Bayraktar-Ekincioglu A, Demirkan K, Keskin B, Aslantas O,
Ozdemir E. Potential drug interactions and side effects in
an outpatient oncology clinic: A retrospective descriptive
study. Eur J Hosp Pharm 2014;21:216-21.
13. Riechelmann RP, Tannock IF, Wang L, Saad ED, Taback NA,
Krzyzanowska MK. Potential drug interactions and duplicate
prescriptions among cancer patients. J Natl Cancer Inst
2007;99:592-600.
14. Alfaro CL, Piscitelli SC. Drug interactions. In: Atkinson AJ,
Daniels CE, Dedrick RL, Grudzinskas CV, Markey SP, editors.
Principals of Clinical Pharmacology. San Diego, Calif: Academic Press; 2001. p. 167-80.
15. Corcoran ME. Polypharmacy in the older patient with cancer.
Cancer Control 1997;4:419-28.
16. British Medical Association. British National Formulary. London: British Medical Association, Royal Pharmaceutical
Society of Great Britain; 2005. p. 50.
17. Ives G, Hodge K, Bullock S, Marriott J. First year RNs’ actual
and self-rated pharmacology knowledge. Aust J Adv Nurs
1996;14:13-9.
18. Ndosi ME, Newell R. Nurses’ knowledge of pharmacology
behind drugs they commonly administer. J Clin Nurs
2009;18:570-80.
19. Miranda V, Fede A, Nobuo M, Ayres V, Giglio A, Miranda M,
et al. Adverse drug reactions and drug interactions as causes
of hospital admission in oncology. J Pain Symptom Manage
2011;42:342-53.
20. Bujaordet I, Ebbesen J, Eriksen J, Brors O, Hiltberg T. Fatal
adverse drug events: The paradox of drug treatment. J Intern
Med 2001;250:327-41.