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Safe Handling of Anti-Neoplastic Drugs in the University Hospitals: A Descriptive Survey Study Among Oncology Nurses

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Abstract

Background: Occupational exposure to anti-neoplastic drugs (ANPDs) is still a concern among oncology health care workers.
Objectives: The current study aims at evaluating the knowledge, attitude, and practice (KAP) of oncology nurses towards the safe handling of ANPDs as well as determining the educational needs for the promotion of safe behaviours.
Methods: A cross sectional study was conducted between November 2014 and August 2015 in 6 university hospitals in Iran. A specialized questionnaire (4 sections and 49-items) was developed by a clinical pharmacologist and an occupational toxicologist in order to assess the KAP of oncology nurses in terms of safe handling of ANPDs.
Results: A total of 80 nurses responded to the questionnaire. The KAP scores of oncology nurses towards the safe handling of ANPDs were fairly satisfactory. The mean scores of responses for knowledge, attitude, and practice were 54.30 ± 10.86 out of 65, 32.83 ± 5.88 out of 40, and 50.35 ± 10.21 out of 60, respectively. About half of the nurses were trained in oncology ward (by in-service training) and most of them used unreliable sources of information for safe handling of ANPDs.
Conclusions: While the nurses' knowledge in safe handling of ANPDs is acceptable, training providers and information sources are not appropriate. An ongoing educational program provided by expert pharmacists could decrease the occupational exposure to ANPDs.

Keywords: Anti-Neoplastic Drugs, Knowledge, Occupational Exposure, Oncology Nurses

1. Background

Exposure to anti-neoplastic drugs (ANPDs) among oncology nurses has been increasing due to the widespread use of these agents. The anti-neoplastic agents' exposure may lead to toxicological effects including carcinogenicity, teratogenicity, and mutagenicity in human (1-3). Several guidelines and protocols have been established in order to improve the safe handling of ANPDs and protect oncology nurses against unwanted exposure (4-7). Despite the presence of these guidelines, some studies have shown different levels of exposure to ANPDs among health care workers, particularly in developing countries (1, 3, 8).

Lack of knowledge and adherence to the guidelines are important reasons for unsafe handling of ANPDs. Therefore, the guidelines cannot guarantee safe behaviors, and knowledge is an important factor to change the performance (3). Pharmacists can improve the knowledge, attitude, and practice (KAP) of oncology nurses by providing educational programs (1).

The studies that measure the KAP of a community are important tools for organizing applicable educational programs. Some studies have been conducted to evaluate knowledge and/or attitude and/or practice of oncology nurses about safe handling of ANPDs, but no standard questionnaire has been presented so far (1, 3, 9). In addition, no comprehensive study in this regards has been carried out in Iran. Therefore, we designed the current study to evaluate the KAP of oncology nurses on safe handling of ANPDs, using a specific designed questionnaire.

2. Methods

2.1. Development and Psychometric of Questionnaire

A questionnaire consisted of 4 sections (49-items) was prepared to assess the KAP of oncology nurses. Since no previously validated questionnaire was available, the items were developed by the experts (a clinical pharmacologist and an occupational toxicologist) in safe handling of ANPDs.

A panel of experts including 2 pharmacists, 2 occupational toxicologists (with more than 2 years' work experiences in oncology field) and 4 oncology nurses (with more than 5 years' work experiences in handling of ANPDs) were approached to evaluate the content and face validity of the questionnaire, using a Likert scales questionnaire.

To determine the content validity ratio (CVR) and content validity index (CVI), the questionnaire was sent to the panel of experts. The responses scales were appropriately rated for CVR and CVI (essential, useful but not essential, and not necessary for CVR, quite relevant, relevant, approximately relevant, and irrelevant for CVI). The critical values were 0.75 and 0.78 for CVR and CVI, respectively (10, 11).

In order to calculate the face validity, the impact score of each question was computed based on the importance (quite important, important, moderately important, a bit important, and unimportant). The calculated scores above 1.50 were evidenced as an appropriate impact score (12).

Internal consistency was measured separately for the different sections (using Cronbach's alpha). The minimum requirement for internal consistency has been recommended as 0.7 (13).

The questionnaire was also reviewed and approved by ethics committee of National Research Institute of Tuberculosis and Lung Diseases (NRITLD), Shahid Beheshti University of Medical Sciences.

2.2. Assessment of the KAP of Oncology Nurses

The survey was carried out among 6 university hospitals in Tehran, Iran. The targeted group of the study was 80 registered nurses working in oncology ward of the hospitals. All nurses were involved in handling of antineoplastic agents.

The developed questionnaire was filled out by the nurses. The first section solicited demographic information of the nurses. The second part assessed the participants' knowledge about protocols and standards for preparation, administration, waste disposal, and storage of ANPDs. The third section evaluated the participants' attitudes towards working as an oncology nurse and their concerns and feelings. The last part contained items directed at the participant's practice in preparation, administration, waste disposal, and storage of ANPDs. All the items required an ordinal response via a 5-point Likert scale (strongly agree, agree, neutral, disagree, and strongly disagree) (Appendix 1).

The KAP scores were calculated for each nurse based on their answers (strongly agree = 5, agree = 4, neutral = 3, disagree = 2, and strongly disagree = 1). The mean scores were calculated and a higher mean score indicated greater agreement with the statement. The level of the KAP was assessed, using the mean score as cut off point. The scores above the mean were evaluated as sufficient (3).

2.3. Statistical Analysis

All data were entered and analyzed, using the SPSS, version 11.0 (SPSS). Spearman's correlation analysis was performed to determine whether any of the demographic factors significantly predicted the knowledge, attitude, and practice scores. Mann-Whitney U test were applied to compare the score of each section with various demographic and educational characteristics. Correlation between the different domains of questionnaire was also assessed by Spearman's correlation coefficient.

3. Results

A total of 80 nurses from 6 university hospitals participated in the present study. The mean age was 33.60 $\pm$ 7.50 and 12.5% of nurses were male. More than half of the respondents (67.5%) were married. The median of their work experience in oncology was 3.50 (0.80 - 20) years. The demographic and educational characteristics of the participants, as well as the correlations and comparisons of their KAP scores with their characteristics are shown in Table 1.

Out of all respondents, 59 (73.8%) had been trained for working in oncology, 35 (43.8%) had on-going training, and only 5 (6.3%) were in association with professional organization. Most of them (98.8%) declared that they need educational programs and 87.5% believed in positive effect of education on work quality.

The result of Spearman test indicated that there was a significant correlation between age, work experience in nursing, and in oncology ward with knowledge and practice scores.

The results also showed that the knowledge and attitude of the nurses trained for working in oncology ward were significantly different from the others. Meanwhile, the time of train (before and within work) had effects on attitude and practice scores. Nurses who had been trained in subjects related to handling of ANPDs were different from other nurses (without training in related subjects) in terms of knowledge's score. Being in collaboration with any oncology professional organizations made significant differences in nurses' knowledge and practice (Table 1).

The percentages of the responses to each item are presented in Table 2. Significant correlation (P value < 0.01) was observed between the scores of different sections (knowledge and attitude, rho: 0.60; knowledge and practice, rho: 0.61; practice and attitude, rho: 0.51).

The maximum scores for knowledge, attitude, and practice were 65, 40, and 60, respectively. The mean scores

Table 1. Demographic and Educational Characteristics of the Participants and the Colorations and Comparisons of their KAP Scores with their Characteristics

Demographic and Educational Characteristics	Number (%)	Knowledge P Value/ roh[a]	Attitude P Value/ roh	Practice P Value/ roh
Gender		0.03	0.17	0.00
Male	10 (12.5)			
Female	70 (87.5)			
Marriage status		0.08	0.07	0.03
Single	26 (32.5)			
Married	54 (67.5)			
Age (Mean ± SD)	33.6 ± 7.5	0.02/0.30	0.51/0.07	0.01/0.28
Work experience in nursing (median (range))	8 (0.8 - 29)	0.01/0.29	0.90/-0.01	0.01/0.27
Work experience in oncology (median (range))	3.5 (0.8 - 20)	0.00/0.50	0.17/0.16	0.01/0.29
Work experience in work with cytotoxic (median (range))	4 (0 - 18)	0.00/0.39	0.25/0.15	0.09/0.22
Educational level		0.24	0.64	0.31
Bachelor	71 (88.7)			
Master Science	9 (11.3)			
Trained for working in oncology ward		0.00	0.01	0.10
Yes	59 (73.8)			
No	19 (23.8)			
Trained		0.14	0.01	0.02
Before work	3 (5.7)			
Within work	46 (86.8)			
Both	4 (7.5)			
Training subjects				
Safe preparation	46 (57.5)	0.03	0.06	0.82
Safe administration	46 (57.5)	0.02	0.06	0.53
Safe transport	24 (30)	0.02	0.13	0.47
General oncology	19 (23.8)	0.01	0.07	0.31
Chemotherapy	46 (57.5)	0.01	0.02	0.79
Radiotherapy	9 (11.3)	0.01	0.07	0.49
Hazard of cytotoxic drugs	32 (40)	0.01	0.07	0.79
Others	5 (6.3)	0.02	0.11	0.44
Collaboration with professional organization		0.02	0.44	0.03
Yes	5 (6.3)			
No	68 (85)			
Continue training		0.10	0.31	0.09
Yes	35 (43.8)			
No	44 (55.0)			

[a] rho is shown for Spearman's correlation analysis.

of responses were 54.30 ± 10.86 for knowledge, 32.83 ± 5.88 for attitude, and 50.35 ± 10.21 for practice. Of the total of respondents, 52.5% had a knowledge score above the mean and 60% were above the attitude and practice mean scores.

A high number of nurses (97.5%) improved their knowledge using the different sources of information depicted

Table 2. The Percentages of Responses to the KAP Items

Variables	Number of Respondents, No. (%)				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Knowledge Statements					
1- ANPDs are cytotoxic	59 (75.6)	15 (19.2)	4 (5.1)	0	0
2- I am aware of all routes of exposure to ANPDs	36 (45.6)	32 (40.5)	7 (8.9)	3 (3.8)	1 (1.3)
3- I am aware of adverse health effects of ANPDs	37 (46.8)	28 (35.4)	4 (5.1)	8 (10.1)	2 (2.5)
4- I know management of adverse health effects of ANPDs	28 (35.4)	26 (32.9)	12 (15.2)	11 (13.9)	2 (2.5)
5- I know guidelines and standards for safe preparation of ANPDs	34 (43)	35 (44.3)	5 (6.3)	5 (6.3)	0
6- I know safe administration of ANPDs	36 (45.6)	33 (41.8)	5 (6.3)	5 (6.3)	0
7- I know safe transport and storage of ANPDs	31 (40.3)	21 (27.3)	13 (16.9)	11 (14.3)	1 (1.3)
8- I have to use biological safety cabinet (BSC) for all preparations	55 (69.6)	18 (22.8)	1(1.3)	3 (3.8)	2 (2.5)
9- I know correct use of BSC	52 (65.8)	20 (25.3)	4 (5.1)	3 (3.8)	0
10- I know management of accidents in handling of ANPDs	28 (35.9)	27 (34.6)	13 (16.7)	8 (10.3)	2 (2.6)
11- I know all required PPE	45 (58.4)	24 (31.2)	3 (3.9)	4 (5.2)	1 (1.3)
12- I know how to use PPE correctly	44 (55.7)	28 (35.4)	2 (2.5)	5 (6.3)	0
13- I know safe waste disposal of ANPDs	36 (45.6)	29 (36.7)	7 (8.9)	5 (6.3)	2 (2.5)
Attitude statements					
1- Safe handling of ANPDs make me ensure that I am not at risk	51 (66.2)	19 (24.7)	2 (2.6)	2 (2.6)	3 (3.9)
2- Use of PPE in handling of ANPDs is essential	70 (88.6)	8 (10.1)	0	1 (1.3)	0
3- Unsafe handling in work overload condition is unacceptable	36 (46.2)	21 (26.9)	4 (5.1)	9 (11.5)	8 (10.3)
4- Adverse health effects of ANPDs exposure are worrying	64 (81.0)	13 (16.5)	1 (1.3)	1 (1.3)	0
5- I handle ANPDs without hurrying	42 (54.5)	22 (28.6)	3 (3.9)	10 (13.0)	0
6- I pay attention to precautions measurement's	36 (45.6)	34 (43.0)	5 (6.3)	2 (2.5)	2 (2.5)
7- I started my work in oncology with my willing	19 (24.7)	17 (22.1)	15 (19.5)	14 (18.2)	12 (15.6)
8- I continue my work in oncology with my willing	36 (46.8)	22 (28.6)	8 (10.4)	5 (6.5)	6 (7.8)
Practice Statements					
1- I always prepare ANPDs in preparation room	62 (79.5)	15 (19.2)	0	1 (1.3)	0
2- I always prepare ANPDs in BSC	62 (79.5)	14 (17.9)	0	2 (2.6)	0
3- I never do risky behaviour (eat, drink, smoke,...) in preparation room	70 (89.7)	5 (6.4)	3 (3.8)	0	0
4- I don't store ANPDs in preparation room	52 (67.5)	12 (15.6)	9 (11.7)	1 (1.3)	3 (3.9)
5- I use standard guidelines for handling of ANPDs	51 (65.4)	23 (29.5)	4 (5.1)	0	0
6- I use PPE for preparation of ANPDs	50 (64.1)	24 (30.8)	2 (2.6)	2 (2.6)	0
7- I use PPE for administration of ANPDs	43 (55.8)	23 (29.9)	8 (10.4)	3 (3.9)	0
8- I use PPE for transport and storage of ANPDs	30 (39.0)	20 (26.0)	18 (23.4)	7 (9.1)	2 (2.6)
9- I manage accidents in handling based of standard protocols	43 (55.8)	20 (26.0)	11 (14.3)	2 (2.6)	1 (1.3)
10- I record and report all accidents in handling of ANPDs	47 (60.3)	28 (35.9)	3 (3.8)	0	0
11- I consult with clinical pharmacist about safe handling	25 (32.1)	10 (12.8)	27 (34.6)	10 (12.8)	6 (7.7)
12- I consult with occupational medicine specialist about related health problems	19 (25.0)	13 (17.1)	28 (36.8)	7 (9.2)	9 (11.8)

in Figure 1. There was a significant difference between practice score of nurses who read articles, participated in con-

ferences, and were in collaboration with nursing society and other nurses ($P < 0.05, 0.01, 0.05$). Participating in conferences also had effects on knowledge and attitude scores ($P < 0.01, 0.05$).

More than half of the respondents (70%) had participated in educational programs provided by different organizations (Figure 2).

With regard to the face validity, the average of impact score was 4.90 (range = 4.25 - 5.00) and all the questions reached an impact score $\geq$ 1.50, demonstrating excellent validity. The average CVR (0.90, range = 0.50 - 1.00) and CVI (0.95, range = 0.63 - 1.00) of developed questionnaire were acceptable. The critical values for the CVR (0.75) and CVI (0.78) were not met by only 3 and 4 questions, respectively. The internal consistency of the questionnaire was indicated by a Cronbach's alphas score of 0.92 (knowledge = 0.94, attitude = 0.61, practice = 0.83).

4. Discussion

4.1. Knowledge

The results of the present study indicated that the knowledge score of the oncology nurses about safe handling of ANPDs was fairly satisfactory. The high levels of knowledge about the cytotoxic drugs and related adverse health effects are extremely important to enhance nurses' compliance to safety measures. Pharmacists can play a significant role to increase nurses' knowledge in this issue (1).

Based on occupational safety and health administration (OSHA) guidelines, training of staff involved in any aspect of handling of ANPDs is essential (14, 15). As reported in the previous studies, participating in training programs significantly enhances the nurse's knowledge (16-18). The current study also showed a significant difference between knowledge scores of trained and untrained nurses regarding work in oncology ward. Among nurses who had received training for working in oncology, 86.8% were trained within work; while, very few (5.7%) had received training before starting work in oncology ward. Starting work in oncology without any training especially for nurses graduated in general nursing may put them in unsafe situation at early stage of their career. The literature also indicated that the majority of oncology nurses had not received any special pre- or post-training related to the handling of ANPDs and protection against their harmful effects (1, 3, 16, 19-21). Therefore, training oncology nurses in the safe handling of ANPDs before and after starting work in oncology is important for preventing unwanted exposures and related adverse health effects.

The results of this research showed the most frequent training subjects reported by trained nurses were safe preparation (60%), safe administration (57.5%), and chemotherapy (57.5%). Training in various subjects showed different effects on nurses' knowledge scores. Constantindis et al. reported that a significant percentage of respondents had no relevant information and only 29.6% of health care workers had received training for preparation and reconstruction of chemotherapeutical agents (22).

In terms of training providers, the results of this study showed that about half of the nurses were trained in oncology ward at their hospital (by in-service training). This kind of training is not appropriate to provide a scientific, applicable, and adequate knowledge for safe handling of ANPDs; that is why most of the nurses tried to use various sources of information such as colleagues, internet, books, and ward physicians. It is in accordance with a study in Nepal that presented non-satisfactory nurses' knowledge. Their nurses did not participate in training programs about cytotoxic drugs and improved their knowledge through internet, books, nursing associations, and mass media (23). A study in Greek also showed that only half of the nurses received formal information (not provided by the hospital). Other nurses improved their information by the colleagues, medical doctors, and chemotherapeutic drug reconstruction unit (22).

The current study indicated that participating in seminar and conference as formal and scientific sources of information significantly improved nurses' knowledge. Kyprianou et al. reported an adequate level of knowledge about cytotoxic agents among oncology nurses. Lectures, seminars, and conferences were the most frequent sources of cytotoxic information in their study (3). The study in Greek also demonstrated that 78% to 80% of the health care workers were aware of hazardous effects of cytotoxic drugs. Leaflets, books, and seminars were the sources of information for half of the nurses (22).

The findings of the present study revealed that more than half of the participants had not received a continuous education. Most of the nurses were aware of the needs for continuous education and positive effects of education. These results are in accordance with Constantinidis's findings that reported a poor potential for ongoing education (22). Therefore, there is a desperate need for designing an ongoing training program by expert pharmacists in order to enhance and update nurses' knowledge in handling of ANPDs.

The membership in professional organisations like oncology society as an important criterion of professionalization was not in a good level. Karadag et al. in 2004 stated that the low level of membership in proportional organization was related to the inadequacy of proportional organization (23). Based on the results of this research, only 6.3%

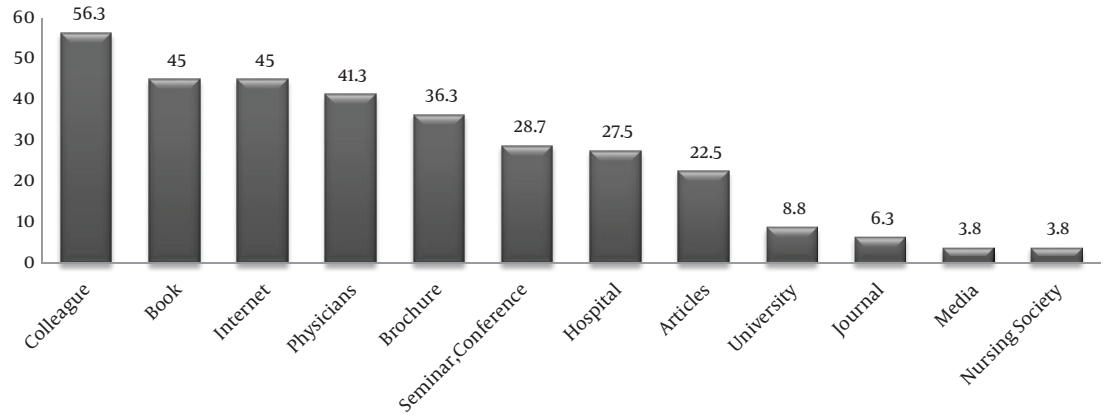

Figure 1. Sources of Information Used by the Nurses

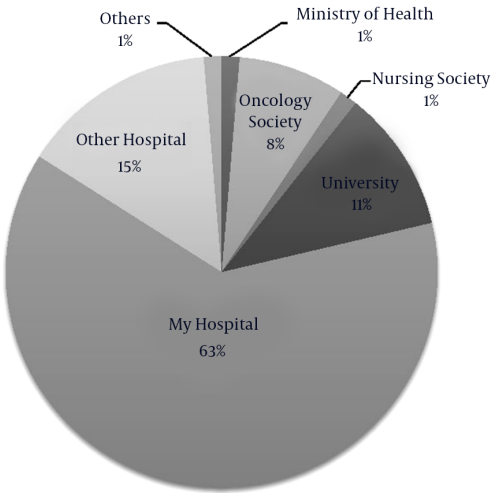

Figure 2. Percentages of Training Providers Used by the Nurses

of the nurses were associated with a professional organization. A significant difference was observed between nurses in association with oncology society and other nurses in terms of knowledge scores. Therefore, in order to enhance nurses' knowledge, health care system should provide an appropriate situation to support and encourage nurses' membership in professional organization.

The evaluation of nurses' responses to the knowledge questions revealed that the management of adverse health effects of ANPDs, the control of accidents in handling of ANPDs, and the safe transport and storage of ANPDs should be considered for future educational programs.

4.2. Attitude

The results of the current study showed that the attitude score of oncology nurses about the safe handling of ANPDs was in a good level. A significant correlation was found between the knowledge and attitude of the participants. Increasing the knowledge levels of the nurses is important to improve their adherence to the safe handling guidelines (24). Less than half of the respondents tended to work in oncology ward. A study in UK revealed a positive attitude of oncology nurses towards chemotherapy (25); however, Corner et al. reported a negative attitude towards the cancer and its treatment among oncology nurses (26). A significant correlation was found between attitude and practice, showing that a good attitude could improve the practice.

A significant difference was also found between the attitude scores of trained and untrained nurses for working in oncology. Time of training (before and after starting work) made differences in attitude scores. This indicates that training programs could have effect on nurses' attitude. There was a significant difference between nurses trained in chemotherapy subject and in other subjects regarding the level of their attitude. Participation in conference in order to self-education had positive effect on attitude score.

4.3. Practice

The results of the present research indicated that the practice score of oncology nurses about the safe handling of ANPDs was satisfactory. There was also a significant correlation between knowledge/attitude and practice in the current study. Chaudhary et al. reported that nurses with a higher knowledge score used personal protective equipment (PPE) significantly more than nurses with a lower

score (17). Overall practice score was relatively appropriate, showing that oncology nurses may follow guideline instructions. Findings from the previous studies in Pakistan, Malaysia, and Nepal are in contrast with results of the current study, where practices on handling of ANPDs were not according to the international standards (1, 9, 17). Keat et al. showed that pharmacist-based interventions had significant effects on the ward practice (1). Reading articles, participation in conferences, and becoming a member of nursing professional organizations had effects on practice score. The participants of this study did not appropriately practice in some part of handing activities. The storage of ANPDs in preparation room, PPE usage for transport, the storage of ANPDs, accidents management based on standard protocols, consultation with clinical pharmacists about safe handling, and consultation with occupational medicine specialists about related health problems are important areas for practice interventions.

4.4. Conclusions

Formal training providers and information sources are recommend for oncology nurses in order to acquire adequate, reliable, and applicable knowledge in the safe handling of ANPDs. Essential interventions for the improvement of oncology nurses' KAP could be determined using our questionnaire.

Supplementary Material

Supplementary material(s) is available here [To read supplementary materials, please refer to the journal website and open PDF/HTML].

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Footnotes

Authors' Contribution: None declared.

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