

Oncology Nurses' Knowledge and Practices Regarding Handling Hazardous Drugs: Developing Procedure Manual For Safe Handling Of Hazardous Drugs

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Abstract: Studies Found That Persons Who Are Administering Hazardous Drugs Are Highly Exposed To Hazard Through Contaminated Clothing, Work Surfaces, Medical Equipment And Patient Excreta. Nurses Can Be Affected By Risks Of Hds When Handling And Opening Drug Cases And Packages Prior To Preparation. The Highest Risk Of Exposure For Oncology Nurses Is Linked With Preparation And Administration, Mainly Through Inhalation Of Aerosolized Drug, Direct Contact (Through Eyes, Skin, Or Mucosa), And Ingestion Of An Improperly Handled Drugs. **Aim Of The Study** Ist To Investigate Oncology Nurses' Knowledge About Handling And Administering Hazardous Drugss And The Development Of A Simple Procedure Book For Safe Chemotherapy Handling For Nurses To Refer To When Needed. **Material & Method:** A descriptive Research Design Was Used. **Setting:** All Departments of Damanhour Oncology Institute Were Included. **Subjects:** Fifty Two nurses Were Handling And Administering Chemotherapy And Agreed To Participate In The Current Study (N=52). **Tools:** The Study Tool Was Developed By The Researchers To Assess The Nurses' Knowledge, Attitudes And Perceptions Of Risks And Barriers Associated With Administering Chemotherapy, It Consists Of **Ten** Parts. **Results:** Nurses' Knowledge Means And Standard Deviation Percent Score Was (39.74 ± 23.14). Nurses' Percent Scores Of Barriers Of Using Personal Protective Equipment Was (22.39 ± 12.12) And In Relation To The Percent Scores Of Perceived Risks Associated With Handling Chemotherapy Was (21.63 ± 3.41). The Same Percentage Of Nurses (96.2%) Administered Chemotherapy While Using Latex Gloves And They Were Responsible For The Waste Management Respectively. Nurses With Bachelor Degree Received The Higher Mean Percent Score In Their Knowledge As Compared To Other Qualification With A Significant Difference (P=0.001) And Nurses Who Received Previous Training Scored Higher In The Knowledge Than Those Who Did Not With A Significant Difference Between Two Groups (P= 0.046). **Recommendations:** Train The Oncology Nurses On Safe Handling Of Hazardous Drugs. Establish And Make Available Safe Handling Guidelines For All Oncology Nurses. Introduce To Nurses The Egyptian Occupational Safety And Health Laws Concerning Handling Of Hazardous Drugs Through Lectures And The Availability Of Small Informative Book About These Laws. Provide Nurses With Onsite Recurrent Demonstration On Safe Handling Of Hazardous Drugs For All Oncology Nurses.

Keywords: Hazardous Drugs, Chemotherapy, Personal Protective Equipment, Anti-Neoplastic Drugs, Safe Handling Guidelines.

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I. Introduction:

Occupational Health And Safety Has Been A Major Concern Since Many Years And How To Avoid Exposure Of Employees To Hazards During Work Is A Crucial Demand From All Employers⁽¹⁾. Healthcare Staff Are Highly Exposed To Different Hazards While Performing Their Jobs, For Instance The Handling Of Hazardous Drugs Which Has Evolved As Being A Critical Concern Due To Its Risks And Harms On Caregivers⁽²⁾.

Hazardous Drugs Have Been Used For Many Years In Cancer Treatment. As A Result Of The Increasing Use Of These Drugs, In (2016) An Updated List Of Antineoplastic And Other Hazardous Drugs Was Published By The National Institute Of Occupational Safety And Health (Nioh). In This List, Hazardous Drugs Were Defined As Those Used For Cancer Chemotherapy, Hormones, Antiviral Drugs, Some Bio-engineered Drugs, And Other Miscellaneous Drugs. Furthermore, Niosh Classified Hazardous Drugs Into Three Main Groups; 1) Antineoplastic Drugs, 2) Non Antineoplastic Drugs And 3) Drugs That Have The Potential To

Cause A Reproductive Risk For Persons Dealing With It. Moreover, Six Characteristics Were Given For Hazardous Drugs, Which Are: 1) Genotoxicity (The Ability To Cause A Change Or Mutation In Genetic Material). 2) Carcinogenicity (The Ability To Cause Cancer In Humans, Animal Models, Or Both). 3) Teratogenicity (The Ability To Cause Defects In Fetal Development Or Fetal Malformation). 4) Fertility Impairment Or Reproductive Toxicity. 5) Serious Organ Toxicity At Low Doses In Humans Or Animal Models. 6) Chemical Structure And Toxicity Profile That Mimic Existing Drugs⁽³⁾. Antineoplastic Drugs Are Therapeutic Agents Used In The Killing Of Cancerous Cells⁽⁴⁾. The International Agency For Research On Cancer Classified The Antineoplastic Drugs As Human Carcinogens⁽⁵⁾ (Characteristic Number 2 As For Nioh)⁽³⁾

Risks Associated With Exposure While Preparing Or Administering Hazardous Drugs Have Been Proven In Many Research^(6,7). Studies Found That Persons Who Are Administering Antineoplastic Drugs Are Highly Exposed To Hazards Through Contaminated Clothing, Work Surfaces, Medical Equipment And Patient Excreta. Moreover, Antineoplastic Drugs Were Inadvertently Absorbed As Their Parent Compounds And/Or Their Metabolites Were Found In Health Care Workers' Urine^(8,9). Other Serious Health Problems Were Documented In Various Previous Studies And Include Reproductive Problems, Cancer And Genetic Effects⁽¹⁰⁻¹⁵⁾. Apart From Chronic Health Problems, Acute Health Effects For Instance Skin Rash, Flush, Hair Loss, Eczema, Nausea, Faintness, And Dizziness Have Been Stated By Nurses Who Are Exposed To Antineoplastic Drugs^(16,17)

Nurses Can Be Affected By Risks Of Hazardous Drugs When They Prepare, Transport, Administer, And Dispose Chemotherapy Waste And Bodily Fluids. Since The Preparation Of Drugs Was Determined As The Stage With The Utmost Average Contamination, It Is Suggested That The Preparation Be Done In Pharmacy Units As The Pharmacists Can Use More Protection Than Nurses Do During Drug Preparation⁽¹⁸⁻²²⁾. Additionally, Exposure Risk Is Present When Handling And Opening Drug Cases And Packages Prior To Preparation. The Highest Risk Of Exposure For Oncology Nurses Is Linked With Preparation And Administration, Mainly Through Inhalation Of Aerosolized Drug, Direct Contact (Through Eyes, Skin, Or Mucosa), And Ingestion Of An Improperly Handled Drugs⁽²³⁾. In A Study Of Healthcare Workers Exposure To Antineoplastic Drugs, Although Following The Recommended Safety Guidelines, Workplace Contamination With These Drugs Was Detected In Urine Samples Which Were Positive At Least For One Drug⁽¹⁷⁾.

Despite The Presence Of Safe Handling Procedures, The Use Of Biosafety Cabinets, The Use Of Personal Protective Equipment And The Training Of Health Care Providers On Safe Handling Of Hazardous Drugs, The Likely Exposure Of Healthcare Team To Hazardous Drugs Still Exists As A Harm In The Workplace⁽²⁴⁾. Many Research Found That Environmental Contamination With Hazardous Drugs In Hospital Pharmacies Is Extremely Represented⁽²⁵⁻²⁸⁾. According To The Recommendations Issued By The (Niosh), Several Guidelines Have Been Drafted, For Instance; Barton Et Al. (2018) Developed Guidelines For The Safe Handling Of Cytotoxic Drugs In Academic Research Laboratories⁽²⁹⁾. In Egypt, The Egyptian Occupational Safety And Health Association Issued Many Laws (Law 211) In Relation To Dealing With Chemicals In General But Not Specific For Antineoplastic Drugs Or Hazardous Drugs which Stated That The Employer Should Ensure The Availability Of All Protective Equipment To Help Preventing Chemical Hazards For The Employee⁽³⁰⁾.

Many Recent Research Found That Nurses' Knowledge And Attitude Regarding Chemotherapy Exposure Perhaps May Affect Their Adherence To Safety Mitigation Measures, For Instance Their Attitude Or Performance When Handling Hazardous Drugs. Previous Findings Have Reported That There Is A Gap Between Nurses' Chemotherapy Knowledge And Their Behavior During Work With Antineoplastic Drugs⁽³¹⁻³⁴⁾. Despite The Fact Of The Risk Associated With Nurses' Exposure To Hazardous Drugs And Its Undesirable, Very Dangerous Effects, What Do Nurses Actually Know And Apply While Dealing With These Kinds Of Drugs? Do Nurses Use Personnel Protective Equipment, Do They Report Any Sign And Symptoms That Occur To Them During Administering Or Disposing Antineoplastic Drugs? Hence, The Current Study Is Conducted To Investigate Oncology Nurses' Knowledge About Handling And Administering Hazardous Drugs And The Development Of A Simple Procedure Manual To Refer To It When Needed.

Aim of The Study

The Present Study Aims To Investigate Oncology Nurses' Knowledge About Handling And Administering Hazardous Drugs And The Development Of A Simple Procedure Manual For Safe Chemotherapy Handling For Nurses To Refer To When Needed.

Research Questions:

1. What Is The Level Of Knowledge Of Oncology Nurses Regarding Exposure To Chemotherapy, Personnel Protective Equipment (Ppe), Chemotherapy Preparation, Administration, Disposal Of Chemical Wastes And Contaminated Excreta And Care Of Spills?

2. What Are The Perceived Barriers That Prevent Nurses From Using Proper Ppe While Chemotherapy Preparation, Administration, Disposal Of Chemical Wastes And Contaminated Excreta?
3. Is There A Relation Between Oncology Nurses' Demographic Characteristics And Knowledge And Attitudes Regarding Using Ppe, Chemotherapy Preparation, Administration, Disposal Of Chemical Wastes And Contaminated Excreta And Care Of Spills?

II. Methodology

Research Design

A Cross Sectional Descriptive Design Was Used.

Setting

This Study Was Conducted In All Departments Except (Icu) Of Damanhour Oncology Institute Which Serves El-Beihera Governorate And Other Governorates Around El-Beihera If They Don't Have Oncology Hospitals. Damanhour Oncology Institute Contains Medical, Surgical Departments, Chemotherapy Departments, Out Patient Clinics And An Icu.

Subjects

All Nurses Working In The Previously Mentioned Departments, Were Handling And Administering Chemotherapy And Agreed To Participate In The Current Study (N=52) Have Been Given The Questionnaire. Nurses Working In Icu Do Not Handle Or Administer Chemotherapy That Is Why They Were Not Included In The Current Study.

Tools

After Through Review Of Related Literature^(4,30,31), The Study Tool Was Developed By The Researchers To Assess The Nurses' Knowledge, Attitudes And Perceptions Of Risks And Barriers Associated With Administering Chemotherapy.

The Tool Is Self-Administered Questionnaire And It Consists Of **Six Sections**.

1. **Section One: "Nurses' Demographic Information"**: It Includes 11 Items Regarding The Nurses Personal, Academic And Job Profile As Age, Gender, Qualification, Years Of Experience In Handling Chemotherapy, Unit Of Working In The Hospital/Institute, Participation In-Service Training Program Related To Handling Chemotherapy, Need For Training Courses Regarding Chemotherapy Handling And Sources Of Information About Handling Of Chemotherapy.
2. **Section Two: "Nurses' Knowledge"**; It Includes 12 Questions Measuring Nurses' **Knowledge** About Handling Of Chemotherapy And Its Hazardous Effects. The Question Responses Are Yes, No And Don't Know. These Types Of Questions Has A Model Answer Which Was Used To Decide If The Answers Were Correct Or Not. The Questions Responses Are On 3 Points Likert Scale Ranging As Yes=2 To No =1 And Don't Know= 0. The Highest Score Is 24 And The Lowest Is 0.
3. **Section Three: "Hospital Profile"** Regarding Available Policies And Procedures Of Using Personal Protective Equipment. It Includes Statements Regarding Type Of Personal Protective Equipment Used During Chemotherapy Preparation, Administration, Handling Of Contaminated Excreta, Medical Waste Disposal, Cleaning Of Chemotherapy Spills. The Responses For The Three Questions Are Different, It Is Composed Of Yes And No And Other Questions Responses Are Multiple Choices Responses.
4. **Section Four: "Nurses' Practices"** Constitutes Of 14 Questions About Nurses' **Practices** While Administering Chemotherapy And While Dealing With Chemical Wastes, Spills And Other Excreta. The Questions Asked About Types Of Personal Protective Equipment Used, Frequency Of Using Them And The Availability Of Spill Kits In The Hospital.
5. **Section Five: "Barriers Of Using Personal Protective Equipment As Perceived By Nurses"**. The Responses Range From Strongly Agree =4 To Strongly Disagree = 1. All 13 Statements Were Inverted Which Means That The Higher The Score, The Higher The Perceived Barriers. The Highest Score Was 52 And The Lowest Was 13.
6. **Section Six: "Nurses' Perception Of The Risks Associated With Handling Chemotherapy"**. It Is Composed Of 7 Questions And Their Responses Range From Strongly Agree =4 To Strongly Disagree = 1. The Highest Score Was 28 And The Lowest 7.

III. Method

1. The Tool Validity And Its Translation Was Reviewed By Five Experts In The Field. The Experts Were Two Professors Of Oncology Medicine, One Professor Of Medical Surgical Nursing And One Professor Of Nursing Administration And One Professor Of Community Health Nursing. The Statements Were Written In English And Then Translated To Arabic. Each Statement Was Evaluated By The Expert For Its Translation And Validity For

The Related Section. If Raters Differed In Their Opinions Regarding The Validity Of One Statement, The Opinion Of The Majority Was Taken. Consequently, All Modifications Were Done.

2. The Reliability Of The Whole Tool Was Calculated Using Cronbach's Alpha Which Was (0.92).
3. A Pilot Study Was Carried Out On 10% (Five Nurses) Of The Whole Sample To Test The Clarity And Applicability Of The Tool. Accordingly, The Necessary Modifications Were Done.
4. Data Was Collected Through Out Three Weeks In April 2017.
5. The Study Instrument Is A Self-Administered Questionnaire. After Explanation Of The Study Aims And The Questionnaire Was Delivered To Participants By The Researchers And It Took Approximately 30 Minutes To Be Completed.
6. The Questionnaire Was Distributed To Nurses During The Morning Shift And Recollected At The Same Day.
7. After Data Collection, The Necessary Statistical Analysis Was Done.
8. Depending On The Study Findings, A Procedure Manual For Safe Handling Of Chemotherapy For Nurses Was Developed By Researchers. The Study Findings Showed Lack Of Knowledge Of Nurses About Handling And Administering Hazardous Drugs. So Review Was Done On The Available Guidelines On National Level. After A Thorough Review, No Standardized Guidelines Were Used Or Referred To While Handling Hazardous Drugs. All What Was Found On The National Level Was The Law Number 211 That Stated That The Employer Should Ensure The Availability Of All Protective Equipment To Help Preventing Chemical Hazards For The Employee.
9. After A Thorough Review Of International Guidelines^(7,33,35-37) And Procedure Manuals Developed. The Researchers Developed A Procedure Manual That Contains:
 - A. Definition Of Hazardous Drugs
 - B. Why To Use The Procedure Protocol Of Safe Handling Of Hazardous Drugs
 - C. When To Use The Procedure Protocol
 - D. Side Effects And Complications That Might Happen In Case Of Unsafe Handling Of Hazardous Drug
 - E. Principles Of Safe Handling Of Hazardous Drug
 - F. Each Procedure Starting From Handling Equipment To The End Of Dealing With Hazardous Drugs Is Illustrated In The Manual Using Figures And Steps To Be Followed To Ensure Safe Handling Of Hazardous Drugs In Damanhour Oncology Institute.
10. The Procedure Manual Was Reviewed By 5 Professors Namely; Two Professors Of Oncology Medicine, One Professor Of Medical Surgical Nursing And One Professor Of Nursing Administration And One Professor Of Community Health Nursing.

Ethical Considerations:

- Permission To Conduct The Study Was Obtained From The Director Of Damanhour Oncology Institute For Data Collection.
- An Informed Consent Was Obtained From All Study Subjects Who Agreed To Participate In The Study.
- Confidentiality, Anonymity And Privacy Were Assured.
- Participation Was On Voluntary Basis.
- Any Nurse Had The Right To Withdraw From The Study At Any Time Without Any Drawbacks.

Statistical Analysis

Data Were Fed To The Computer And Analyzed Using Statistical Package For The Social Sciences (Spss) Software Package Version 20.0.⁽³³⁾. Qualitative Data Were Described Using Number And Percent. The Kolmogorov-Smirnov Test Was Used To Verify The Normality Of Distribution. Quantitative Data Were Described Using Range (Minimum And Maximum), Mean, Standard Deviation And Median. Significance Of The Obtained Results Was Judged At The 5% Level.

The Used Tests Were:

1 - Student T-Test

- For Normally Distributed Quantitative Variables, To Compare Between Two Studied Groups

2 - F-Test (Anova)

- For Normally Distributed Quantitative Variables, To Compare Between More Than Two Groups, And Post Hoc Test (Tukey)For Pairwise Comparisons

IV. Results:

	Frequency N=52	%
Age (Years)		
20 – 30	8	15.4
31 – 40	30	57.7
>40	14	26.9
Sex		
Female	50	96.2
Male	2	3.8
Qualification		
Secondary School Of Nursing	27	51.9
Technical Institute	19	36.5
Bachelor Degree Of Nursing	6	11.5
Years Of Working Experiencein oncology unit:		
<5	7	13.5
5 - <10	25	48.1
10 - <15	13	25.0
≥15	7	13.5
Place Of Working In Hospital		
Medical	29	55.8
Surgical	13	25.0
Chemotherapy	10	19.2
Training On Handling Hazardous Drugs		
No	35	67.3
Yes	17	32.7
Need For Training On Handling Hazardous Drugs		
No	0	0.0
Yes	52	100.0
Sources Of Nurses' Information About Chemotherapy Handling And Hazards	(N= 83)	
Colleague	31	37.3
During Study	4	4.8
Hospital Policy	41	49.4
Hospital Bulletin	6	7.2
Media	1	1.2
Presence Of Policies Of Handling Chemotherapy		
No	1	1.9
Yes	51	98.1

Table 1: Distribution Of Nurses According To Demographic Data N=52

From Table 1, It Could Be Seen That In Relation To The Participant's Age (57.7%) Were Aged Between 31-40 Years. The Majority Of Them (96.2%) Were Female And (51.9%) Were Graduated From Secondary School Of Nursing. As For The Participant's Experience (48.1%) Had From 5 To Less Than 10 Years Of Experience. Regarding, The Participation In Previous Training Program About Chemotherapy And How To Deal With Hazardous Drugs, Only (32.7%) Participated In Previous Training About Chemotherapy But Still All Of The Participants Are In Need To Receive Training. (49.4%) Of Participants Reported That Their Source Of Information About Chemotherapy Was The Hospital's Policy And The Least (1.2%) Was From Media. In Relation To The Presence Of Policies Related To Dealing With Chemotherapy, (98.1%) Of Participants Know That There Are Policies While Only (1.9%) Did Not Know.

Variables	Mean ± Sd.	Min. – Max.
Nurses' Knowledge	4.77 ± 2.78	0.0 – 12.0
Percent Knowledge	39.74 ± 23.14	0.0 – 100.0
Perceived Barriers	21.73 ± 4.73	13.0 – 33.0
Percent Barriers	22.39 ± 12.12	0.0 – 51.28
Perceived Risks	21.63 ± 3.41	15.0 – 28.0
Percent Scores Of Risks	69.69 ± 16.22	38.10 – 100.0

Table 2: Mean Percent Scores Of Nurses' Knowledge, Perceived Barriers And Risks About Chemotherapy Handling.

It Could Be Seen From Table 2 That Nurses' Knowledge Means And Standard Deviation Percent Score Was (39.74 ± 23.14). Regarding, The Barriers Of Using Ppe While Dealing With Chemotherapy, Nurses' Perceived Percent Score Recorded Was (22.39 ± 12.12) And In Relation To The Perceived Risks Associated With Handling Chemotherapy Was (21.63 ± 3.41).

Wearing Personal Protective Equipment When	No.	%
Administering Chemotherapy		
Gloves	34	65.4
All Ppe*	14	26.9
Gloves And Mask	4	7.7
Dealing With Chemical Waste		
Gloves	34	65.4
All Ppe*	14	26.9
Gloves And Mask	4	7.7
Cleaning Chemotherapeutic Spills		
Gloves	33	63.5
All Ppe*	14	26.9
Gloves And Mask	5	9.6

* Ppe= Personal Protective Equipment

Table 3: Frequency Of Nurses Wearing Personal Protective Equipment (Ppe) During Different Phase Of Handling Chemotherapy (N=52)

From Table 3, It Could Be Observed That The Same Percentage (65.4%) Of Participants Were Wearing Gloves During Administering Chemotherapy And Getting Rid Of Chemical Waste Respectively And About (63.5 %) Of Nurses Were Wearing Gloves While Cleaning Chemicals Spills. On The Other Hand, (7.7 %) Of Participants Were Wearing Both Gloves And Mask While Administering Chemotherapy And Getting Rid Of Chemical Waste And (9.6%) Of Them Were Wearing Gloves And Mask During Cleaning Of Spills.

	No.	%
Do Nurses Administer Chemotherapy		
No	2	3.8
Yes	50	96.2
Types Of Gloves Used During Chemotherapy Administration		
Latex	50	96.2
None	2	3.8
Types Of Ppe* Rather Than Gloves		
Nothing	29	55.8
Isolation Gown	21	40.4
None	2	3.8
Responsible Of chemotherapeuticWaste Management		
No	2	3.8
Yes	50	96.2

* Ppe= Personal Protective Equipment

Table (4): Frequency Of Wearing Personal Protective Equipment While Administering Chemotherapy (N=52)

From Table 4, It Could Be Observed That The Majority Of Nurses (96.2%) Were Responsible Of Administering Chemotherapy And The Same Percentage Were Using Latex Gloves. On The Other Side, (55.8%) Of Nurses Used Only Gloves To Deal With Chemotherapy. (96.2%) Of Nurses Used Latex Gloves While Administering Chemotherapy And They Were Responsible For The chemotherapeuticWaste Management Respectively.

Frequency Of Wearing Ppe In chemotherapeutic Waste Disposal	Never		Rarely		Few Times		Sometimes		Usually		Always	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Uses Of Special Gloves	15	30.0	0	0.0	0	0.0	0	0.0	4	8.0	31	62.0
Uses Of Plastic Gloves	46	92.0	4	8.0	0	0.0	0	0.0	0	0.0	0	0.0
Uses Of Doubled Gloves	33	66.0	7	14.0	1	2.0	0	0.0	0	0.0	9	18.0
Uses Of Specialized Gown	40	80.0	7	14.0	0	0.0	0	0.0	3	6.0	0	0.0
Uses Of Other Types Of Gown	33	66.0	8	16.0	1	2.0	0	0.0	8	16.0	0	0.0
Reuse Of Disposable Gown	38	76.0	6	12.0	2	4.0	3	6.0	0	0.0	1	2.0
Uses Of Mask	35	70.0	4	8.0	1	2.0	2	4.0	3	6.0	5	10.0

* Ppe= Personal Protective Equipment

Table 5: Frequency Of Wearing Personal Protective Equipment In Case Of chemotherapeuticWaste Disposal (N=52)

It Could Be Seen From Table 5 That When Dealing With Waste Of Chemicals, (62%) Of Participants Always Wear Special Gloves, While Only (18%) Of Them Always Wear Doubled Glovesand (10%) Use Mask And Only (2%) Always Use Disposable Gown.

	n= 52	Knowledge	Barriers	Risk
Age (Years)				
20 – 30	8	30.21 ± 18.33	26.60 ± 8.98	20.50 ± 3.34
31 – 40	30	45.0 ± 25.95	22.05 ± 14.39	21.60 ± 3.38
>40	14	33.93 ± 16.17	20.70 ± 7.56	22.36 ± 3.56
F (P)		1.967 (0.151)	0.622 (0.541)	0.753 (0.477)
Sex				
Female	50	38.83 ± 23.12	22.46 ± 12.09	21.52 ± 3.42
Male	2	62.5 ± 5.89	20.51 ± 18.13	24.50 ± 0.71
T (P)		4.468* (0.028*)	0.221 (0.826)	4.281* (0.015*)
Qualification				
Preparatory Nursing Schools	2	16.67 ± 0.0	17.95 ± 0.0	21.0 ± 0.0
Secondary Nursing Schools	25	29.67 ± 19.41	21.64 ± 10.96	20.60 ± 3.93
Technical Institute Of Nursing	19	42.54 ± 13.58	23.89 ± 10.50	22.53 ± 2.67
Bachelor Degree	6	80.56 ± 15.52	22.22 ± 22.51	23.33 ± 2.58
F (P)		16.218* (<0.001*)	0.208 (0.890)	1.804 (0.159)
Working Experience				
<5	7	45.24 ± 6.56	23.44 ± 13.11	20.14 ± 2.91
5 - <10	25	40.0 ± 30.14	21.13 ± 11.78	21.48 ± 3.60
10 - <15	13	38.46 ± 12.97	19.53 ± 9.10	21.62 ± 2.57
≥15	7	35.71 ± 21.90	31.14 ± 15.56	23.71 ± 4.19
F (P)		0.207 (0.891)	1.621 (0.197)	1.362 (0.266)
Place Of Working In Hospital				
Medical	29	38.22 ± 25.64	22.46 ± 11.70	21.86 ± 3.44
Surgical	13	39.10 ± 19.95	22.68 ± 11.84	21.0 ± 3.63
Chemotherapy	10	45.0 ± 20.49	21.79 ± 14.82	21.80 ± 3.26
F (P)		0.317 (0.730)	0.016 (0.984)	0.294 (0.747)
Training Program				
No	35	35.48 ± 23.51	21.83 ± 12.0	21.37 ± 3.52
Yes	17	48.53 ± 20.25	23.53 ± 12.67	22.18 ± 3.21
T (P)		2.066* (0.046*)	0.470 (0.640)	0.796 (0.430)
Sources Of Information				
Colleague	31	32.53 ± 19.17	25.64 ± 12.30	21.26 ± 3.52
During Study	4	52.08 ± 12.50	14.10 ± 12.82	24.50 ± 1.0
Hospital Policy	41	37.40 ± 24.02	23.39 ± 12.22	21.39 ± 3.56
Hospital Bulletin	6	52.78 ± 22.77	11.97 ± 6.62	23.0 ± 3.10
Media	1	58.33	7.69	25.0
F (P)		1.811 (0.135)	2.606* (0.042*)	1.303 (0.276)

T, P: T And P Values For **Student T-Test**

F,P: F And P Values For **Anova Test**

*: Statistically Significant At P ≤ 0.05

Table 6: The Difference Between Nurses' Knowledge, Perceived Barriers And Risk According To Their Demographic Data (N=52)

Table 6 shows The Difference Between Demographic Characteristics In Relation To Nurses' Knowledge, Perceived Barriers To Using Ppe And Risks In Handling Chemotherapy. As Regards To The Sex, It Could Be Seen That Male Have More Knowledge And Perceive Risks Higher Than Female With A Significant Difference (P=0.028, 0.015) Respectively. In Relation To Qualification, It Could Be Seen That Nurses With Bachelor Degree Have The Higher Mean Percent Score In Their Knowledge As Compared To Other Qualification With A Significant Difference (P=0.001). As For Nurses' Previous Training, It Is Shown From The Table That Nurses Who Received Previous Training Scored Higher In The Knowledge Than Those Who Did Not With A Significant Difference Between Two Groups (P= 0.046). As For Source Of Information, Nurses Who Received Their Information From Their Colleagues Scored The Highest Barriers Among Other Sources With A Significant Difference (P= 0.042).

V. Discussion

Nowadays Cancer Patients Receive Many Courses Of Chemotherapy For A Longer Period Of Time⁽³⁸⁾. Hazardous Drugs (Hazardous Drugs) Are Considered Curative Agents Used In Killing Cancerous Cells, But Their Effect Is Not Selective⁽⁴⁾. Health Care Teams Who Prepare Or Administer Hazardous Drugs Are At The Risk Of Possible Exposure To These Drugs' Side Effects Through Contaminated Work Surfaces, Containers And Drug Vials, Contaminated Medical Equipment And Clothing, And Patient Excreta^(12,39). Nurses Are The One Concerned With Administering Chemotherapy For Patients, To What Extent Nurses Have Knowledge About The Chemotherapy And Its Risks As Well As The Barriers To Using Personal Protective Equipment

While Handling Hazardous Drugs Is The Current Study's Aim.

The Present Study Finding Showed That Nurses' Knowledge Is Less Than Fifty Percent. This Result Is Expected As Long As Nurses Do Not Receive Any Training Program Concerning Safety Measures When Dealing With Hazardous Drugs And They Do Not Have Updated Information About The Care They Give Or The Treatment They Provide. The Same Was Found By Boiano (2015) And Al-Azzam(2015)^(40,41) Who Reported In Two Different Studies That Nurses Lack Of Training Concerning Handling Hazardous Drugs. In The Same Line, A Study Conducted By Bolbol Et Al. Showed That Nurses Lack Of Knowledge In Two Subjects; The Nature Of Hazardous Drugs And Its Handling And Applied An Educational Program In Order To Improve Registered Nurses' Knowledge Toward Handling Hazardous Drugs⁽⁴²⁾. Also, Hon Proved That Training Programs Conducted On The Safe Handling Of Drugs Influenced The Health Of Nurses Because The Level Of Cyclophosphamide In Nurses' Urine Who Had Received Training Was Lesser Than Nurses Who Had Not Received The Training⁽²⁰⁾. Furthermore, Polovich And Clark Found The Same And Stressed The Significance Of Nurses' Training That Will Undoubtedly Increase Their Level Of Knowledge⁽⁴³⁾. The Current Study Results Revealed That Nurses Perceived Less Than Quarter Percent The Barriers Of Using Personal Protective Equipment During Handling Of Chemotherapy. This Result Could Be As A Rationale Of The Lack Of Knowledge Of Nurses About The Personal Protective Equipment That Should Be Worn While Administering Hazardous Drugs. The Same Was Found In Different Studies^(5,44) And That Nurses Should Comply To All Safety Measures Including The Use Of Personal Protective Equipment In Order To Reduce Exposure To Hazardous Drugs Side Effects.

As For Perceived Risks Associated With Handling Chemotherapy, The Present Study Findings Concluded That Nurses Perceived Risks Less Than Quarter Percent Which Is Very Low. This Result Could Be As A Cause Of Their Limited Amount Of Knowledge About Handling Hazardous Drugs And The Safety Measures That Should Be Taken To Reduce Risks Accompanied With Dealing With Hazardous Drugs. In The Egyptian Culture, It Is Well Known That Religious Matter Can Affect The Perception, Nurses Are Practicing And Leaving Everything In God's Hand So No Need For Worry About Risks. The Same Result Was Found In A Study Conducted By The National Institute For Occupational Safety And Health (2014) Which Reported That Very Few Of The Nurses Stated Personal Concern About Exposure To Chemical Spill⁽⁴⁵⁾. In The Same Line, Calahan Et Al. (2016) Found That The More Experienced Nurses Frequently Regard Safety Measures As Less Important. Lower Perceived Risk Of Harm From Hazardous Drugs Exposure Was Associated Also With Lower Gown Or Double Gloving Use In A Previous Study⁽⁴⁶⁾.

The Present Findings Reported That Over Half Of The Nurses Were Wearing Only Gloves During Administering Chemotherapy, Dealing With Chemical Waste And Cleaning Spills Of Chemicals And Less Than One Tenth Of Them Were Wearing Both Gloves And Mask While Administering Chemotherapy And Getting Rid Of Chemical Waste During Cleaning Of Spills. These Practices Are Also Reflecting The Lack Of Perceived Risks Associated With Handling Of Hazardous Drugs As Following The Safety Guidelines They Should Wear Double Gloves, Respirators And Eye Goggles. At The Same Line, He Et Al Found That Nurses Never Used The Eye Protection Or The Respirators Which In Their Opinions Underscores Persistent Administrative Trials To Improve Personal Protective Equipment Access And Acceptance⁽⁴⁷⁾.

Regarding Nurses' Practices While Manage Chemical Waste, The Present Study Reflected That Over Half Of Nurses Were Using Special Gloves, While Less Than Quarter Always Wear A Doubled Glove And The Minority Always Use Disposable Gown. It Implies That Specific Attention Should Be Paid To The Use Of Eye Protection. The Frequent Use Of Special Gloves In The Discarding Chemical Wastes Maybe Reflecting The Perceived Safety Level Specified By This Personal Protective Equipment By Nurses. The Same Was Found By Boiano Et Al (2014) And Polovich And Martin (2011) Who Reported That Nurses Nurses Were Using Doubled Gloves But Did Not Use The Eye Protection^(31,48).

The Current Study Found That Nurses With Bachelor Degree Had The Highest Mean Percent Score In Their Knowledge As Compared To Other Qualification With A Significant Difference Among All Groups. This Finding Is Expected As The Professional Nurses Receive Teaching In Their Academic Years About The Oncology Diseases And Their Treatments And The Side Effects Of The Treatment. Furthermore, The Present Results Showed That Nurses Who Received Previous Training Were Significantly Different In Their Knowledge Scores Than Those Who Did Not. This Finding Is Not Surprising As The Training Can Improve The Knowledge And The Practice Of Trainees. The Same Was Found By Jeong Et Al (2015) Who Reported That Continuing Education Should Be Provided For Chemotherapy Nurses As Its Effect On The Nurses' Level Of Knowledge And Attitudes⁽⁴⁹⁾. Moreover, Bolbol And Colleagues (2016) Stressed The Importance Of Chemotherapy Education For Oncology Nurses, And Showed How Their Implemented Educational Program Improved Nurses' Knowledge And Attitudes While Handling Hazardous Drugs⁽⁴³⁾.

VI. Conclusion And Recommendations

The Current Study Findings Concluded That Oncology Nurses' Level Of Knowledge Concerning

Handling Of Hazardous Drugs Was Very Low, While They Were Not Perceiving Highly The Barriers To Wear Personal Protective Equipment During Handling Hazardous Drugs As Well As They Were Not Aware About The Risks Associated With Handling Hazardous Drugs.

Thus The Study Recommended The Following:

- Train The Oncology Nurses On Safe Handling Of Hazardous Drugs.
- Development Of Safe Handling Procedure Manual For All Oncology Nurses.
- Introduce To Nurses The Egyptian Occupational Safety And Health Laws Concerning Handling Of Hazardous Drugs Through Lectures And The Availability Of Small Informative Book About These Laws.
- Onsite Recurrent Demonstration On Safe Handling Of Hazardous Drugs For All Oncology Nurses

Strengths And Limitations

The Study Is The First To Be Conducted To Determine Nurses' Knowledge And Their Perceived Barriers And Risk In Handling Chemotherapy In Damanhour Oncology Institute. Moreover, The Study Generated A Procedure Manual To Safe Handling Of Hazardous Drugs Aiming To Help Nurses While Handling Or Administering Hazardous Drug With The Basic Practices That Should Be Applied. The Manual Was Translated Into Arabic And Have Illustrations To Facilitate Its Use Among All Nurses' Categories Regardless Their Educational Level.

On The Other Hand, Some Limitations Can Be Recorded In The Current Study, One Of Them Is The Limited Number Of Nurses That Does Not Allow For More Results' Generalization. Another Limitation Is Despite That Damanhour Oncology Institute Is The Only Institute In El Beheira Governorate That Provides Treatment And Follow Up For Cancer Patients, It Is Considered Very Small In Comparison To The Number Of Population It Serves.

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