8-2019

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Scientific Research Publishing

Open Journal of Nursing, 2019, 9, 809-834
http://www.scirp.org/journal/ojn
ISSN Online: 2162-5344
ISSN Print: 2162-5336

Knowledge and Practices among Nurses Regarding Patients' Care Following Cardiac Catheterization at a Tertiary Care Hospital in Karachi, Pakistan

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How to cite this paper: Yaqoob, A., Barolia, R., Noor, A. and Nazar, A. (2019) Knowledge and Practices among Nurses Regarding Patients' Care Following Cardiac Catheterization at a Tertiary Care Hospital in Karachi, Pakistan. *Open Journal of Nursing*, **9**, 809-834.
https://doi.org/10.4236/ojn.2019.98062

Received: April 17, 2019
Accepted: August 10, 2019
Published: August 13, 2019

Abstract

Aims: The purpose of this study was to assess the knowledge and practices among nurses regarding patient care, following cardiac catheterization, at a tertiary care hospital in Karachi, Pakistan. **Background:** Cardiovascular diseases (CVDs) are the major cause of morbidity and mortality, globally. Nurses are the largest body of health care professionals who attempt to reduce the burden of cardiovascular diseases. Design: This study employed a descriptive analytical cross-sectional study design to answer the research questions. **Methodology:** The data were collected from 70 participants using two instruments. Knowledge was assessed through a 50-multiple-choice questions-based questionnaire, whereas, to assess the practices, an observational checklist was utilized which comprised of 20 components. **Findings:** The majority of the nurses, 54.3%, had adequate, 40% nurses had inadequate, and only 5.7% nurses had excellent knowledge scores. Moreover, 87.1% nurses were observed as carrying out unsatisfactory practices, whereas, only 12.9% nurses were found carrying out satisfactory practices. **Conclusion:** Since variation in the practices was observed in each of the department, therefore, there is a need for further research, to assess nurses' attitudes through a qualitative approach and to develop and implement a standard post-cardiac catheterization care protocol.

Keywords

Nurses' Knowledge, Nurses' Practices, Cardiac Catheterization, Post PCI Nursing Care

1. Introduction

Cardiovascular diseases (CVDs) are the major cause of death, globally. Ap-

proximately, 56.4 million deaths were reported worldwide in 2015 [1]. Out of 56.4 million deaths, 30 million were due to the top 10 major causes, which also included Ischemic Heart Disease (IHD), and stroke [2]. IHD and stroke are the leading cause of death which remained responsible for 17.5 million deaths alone [3]. Cardiovascular diseases are the leading cause of death in the United States, whereas coronary artery diseases are responsible for 9.87% of the total deaths in Pakistan. One in 635,000 Americans experiences a coronary event in every 34 seconds [4]. Coronary Artery Disease (CAD) affects more than 385,000 persons annually in the United States [5]. It has been found that deaths due to cardiovascular diseases are significantly increasing the mortality figures globally, more than any other causes [6].

In the same way, the trend of cardiovascular diseases is increasing in Pakistan. An estimated that 34% of all deaths in Pakistan are due to cardiovascular diseases (CVD) that take approximately 200,000 lives away every year. In every hour, 12 people die due to a cardiovascular disease in Pakistan [7].

Background of the Study

Cardiovascular diseases are the major cause of morbidity and mortality worldwide. Developing countries contribute a greater share to the global burden of cardiovascular disease. Nurses are the largest body of health care professionals who attempt to reduce the burden of cardiovascular diseases. Being at the patient's bedside round the clock, a nurse is in the best position to closely monitor and initiate the resuscitation process if any complication is observed. Hence, a competent nurse with sound knowledge and practical expertise is a key person for any health care organization.

A nurse's role in caring for patients post coronary intervention is identified as having a "spider-in-the-web" like character. A specialized nurse can effectively deal with cardiovascular emergencies, including rhythm recognition, early defibrillation, and emergency medication administration.

Nurses can play a key role between the attending consultants and patients. This intermediary role can be combined using two aspects, caring as "nurse" and curing as "physician" [8]. This role can be appreciable only if nurses show these competencies through building sound knowledge and achieving expertise in practical skills.

The purpose of this study was to evaluate the gaps in knowledge and practices among nurses regarding patient care following cardiac catheterization, at a tertiary care hospital in Karachi, Pakistan. This study also attempted to identify the gaps in nursing knowledge and practices, in order to improve the quality of nursing care and patient outcomes.

The study intended to answer the following questions:

Q1. What is the level of knowledge among nurses regarding patient care following cardiac catheterization, at a tertiary care hospital in Karachi, Pakistan?

Q2. What are the practices among nurses regarding patient care following cardiac catheterization, at a tertiary care hospital in Karachi, Pakistan?

2. Methods

This study employed a cross-sectional analytical study design to answer the research question. The cross-sectional design was used because it involved the collection of data about different variables of the sample at one point of time in order to uncover relationships existing among those variables [9].

The study was conducted at a 300-bed, charity-based tertiary care teaching hospital during Feb.-May 2018. It consists of 150 beds for adults and 150 beds for the peads population. Since it is a charity hospital, therefore, patients from all over Pakistan come to this facility.

The target population of this study included registered nurses with a qualification of at least diploma in general nursing, and had a valid license issued by the Pakistan Nursing Council (PNC).

2.1. Eligibility Criteria

Nurses with the following characteristics were eligible to participate in this study:

Inclusion criteria.

1) Staff nurses above 20 years of age, from both the genders.

2) Nurses who had a qualification at least three years general nursing diploma.

3) Full-time employee.

4) Registered Nurses who had at least six months of experience dealing with cardiac patients.

Exclusion criteria.

1) Nurses who were not registered with the Pakistan Nursing Council.

2) Registered Nurses working in the non-cardiac Intensive Care Unit of the ICU.

2.2. Study Variables

Independent variables.

1) Age

2) Years of experience

3) Novice Nurses

4) Expert Nurses

5) Specialization

6) Professional Qualifications

Dependent variables.

1) Level of knowledge

2) Level of practices

2.3. Data Collection Plan

The data were collected using two instruments, which were designed by the primary investigator with the help of literature. The knowledge was assessed through a questionnaire, which was based on 50 multiple-choice questions. The

knowledge questionnaire was divided into six sections: cardiac physiology, cardiac diseases, cardiac catheterization and PCI procedure, ECG interpretation, complications of cardiac catheterization and PCI procedure, and cardiac medications. The participants were given one hour to complete the knowledge questionnaire.

To assess practices, an observational checklist was utilized by the data collectors. This checklist was based on post-cardiac catheterization care standards and was developed with the help of literature. It composed of 20 components and the data collectors were had to fill it after observing each participant. Each participant was observed thrice, on three consecutive days, except for holidays; with three different patients in the morning and evening shifts. The purpose of frequent and long-term observations was to minimize the "hawthorne effect" [10].

The participants were recruited using universal sampling technique after taking permission from the nursing manager and the area head nurse. The list of all eligible participants was obtained. Based on their willingness and voluntarily participation, all the participants were recruited from different units, which included the Coronary Care Unit (CCU), Male Higher Dependency Unit (MHDU), Female Higher Dependency Unit (FHDU), Male General Ward (MGW), Female General Ward (FGW), and the Day Care Unit (DCU). Since the study setting was a philanthropic organization, and all the care provided was free of cost, therefore, the ratio of patients coming from different regions of country was high. However, due to the limited cardiac designated beds, they utilize non-designated beds regardless of the unit. Hence, patients undergo cardiac catheterization stay in all these units.

Study Bias: To the best of researchers' knowledge, this study had no potential bias.

2.4. Sample Size Calculation

A total of 79 nurses were working, at the time of the study, in the target units, where cardiac patients were taken care of, but, only 70 nurses (89%) were able to participate in this study. The sample size was calculated through the National Statistical Service & Sample Size Calculator. The total number of nurses who were working in the cardiac units was taken as population, which were calculated as being 79 participants. The confidence level was set at 95% and the level of significance was less than 0.05. The proportion of knowledge was taken as 53% by referring to the study conducted by Shini, Paul, and Smitha (2018) who evaluated the effectiveness of the nursing care protocol on knowledge and practice among staff nurses, regarding the management of patients undergoing coronary angioplasty. The sample size was 65 participants, and an additional 10 percent attrition rate was included in the sample. Finally, the total sample size comprised of 72 participants. Two participants refused to take part in this study once they understood that their practices will be observed. So, the total sample size included 70 participants.

2.5. Content Validity Index

After approval from the Ethical Review Committee (ERC), Karachi, and the Institutional Review Board (IRB), the study tool was reviewed by eight experts, who were approached based on their experience and qualification in the discipline of cardiology. The panel included six medical experts and two nursing experts. Out of the six medical experts, two were consultant cardiologists, of which one was a professor, having more than 10 years of experience in the field of cardiology, two were cardiology residents, having more than four years of experience in the relevant field, and two were medical officers, one of whom was an SMO, having more than eight years of experience in cardiology. Out of the two nursing experts, one was a nurse specialist in cardiology, having more than five years of experience, and one of them was a Head Nurse (CCU), who had three years of relevant experience. A four-point ordinal likert scale was utilized to evaluate the content validity of each of the 50 questions. The relevancy and clarity of the questions were assessed in relation to the study topic. The eight experts had to give scores on a scale in the following format. 1 = not being relevant, 2 = somewhat relevant, 3 = quite relevant, 4 = highly relevant; the same scoring was used for clarity. Scores of 3 and 4 were considered acceptable, while scores of 1 and 2 required further modifications. Finally, results from the eight experts were quantified and the CVI of the study tool was calculated, which was 0.98 for relevancy and 0.98 for clarity. For the reliability of the study instruments, Cronbach's alpha was calculated using SPSS which was found to be 0.87. Hence, based on the results of CVI and Cronbach's alpha, it was evident that the study instruments were valid, clear, and reliable for the study context.

2.6. Pilot Testing

Pilot testing of the tool was done on 7 participants (10% sample size) after the CVI calculation. The purpose of pilot testing was to examine the tool's utility and its weaknesses. No significant suggestions were reported during the process of pilot testing.

2.7. Data Analysis

The collected data were entered and analyzed using the statistical package for social sciences (SPSS) version 20, this was done by the primary investigator and the data input operator. Once the data collection was complete, it was checked for any inconsistencies. Descriptive and inferential statistics were used to analyze the data. Mean and standard deviation were calculated for continuous variables, whereas proportions and frequencies were calculated for categorical variables. The nature of the relationship between the level of knowledge and practices were compared using the independent t-test and chi-square test [11]. These comparisons were done between expert and novice nurses, between nurses who have different levels of qualification, between nurses with and without having cardiac diploma, and between male and female nurses. The difference between three

practice observations was analyzed using the repeated measures ANOVA test [12]. P-value of less than 0.05 was considered significant. The study was adherent to the strengthening of the reporting of observational studies in epidemiology (STROBE) statement.

2.8. Ethical Considerations

The confidentiality of the study participants was maintained throughout the study. All the data files were locked in cabinets and all the soft copies were kept protected by a password, to which no one had access except the primary investigator, thesis supervisor, and the thesis committee members.

3. Results

This chapter presents the findings of the study. It has four sections: section one describes the demographic characteristics of the participants. Section two discusses the overall knowledge level among nurses and the level of knowledge related to knowledge subcategories. Section three explores the level of practices among nurses and the difference in practice scores between the various demographic characteristics of the participants. Lastly, Section four represents the practice associations with theoretical knowledge and its sub categories.

3.1. Section One

A total of 70 nurses, who had more than six months of experience dealing with cardiac patients, were recruited for this study. Table 1 describes the demographic characteristics of the study participants, including their age, gender, qualification, specialization, professional experience, and the respective departments where they worked. The mean age of the participants was 26.8 + 5.3 years and the age range was between 20 - 48 years. Furthermore, a total of 32 nurses (45.7%) were between 25 - 29 years of age. In terms of gender, a total of 41 participants (58.6%) were males, whereas, 29 (41.4%) were females. Qualification analysis showed that 40 nurses (57.1%) had a diploma in general nursing and 22 (31.4%) had a post RN BScN degree, whereas only eight nurses (11.4%) were BScN degree holders. With regard to specialization, half of the nurses (50%) had a diploma in cardiology, whereas the remaining 50% did not.

Table 2 shows that the mean experience of the nurses was 3.86 + 3.7 and the range of experience was between 1 - 19 years. It also shows that 38 nurses (54.3%) were experts, whereas 32 nurses (45.7%) were novices. Findings related to different departments indicate that 30 nurses (42.9%) were from the Female Ward, 20 nurses (28.6%) were from the Male Ward, 16 nurses (22.9%) were from the CCU, and only four nurses (5.7%) were from the Day Care Unit.

3.2. Section Two

One of the major outcomes of the study was to assess the level of knowledge among nurses, regarding patient care following cardiac catheterization. The

knowledge tool comprised of 50 questions. Each question was given a score of one and the total score was 50. The mean knowledge score was 27.2 + 6. The minimum knowledge score was 16, whereas the maximum knowledge score was 46. Knowledge was categorized into three levels: inadequate, adequate, and excellent knowledge levels. A total of 38 nurses (54.3%) showed adequate knowledge scores, 28 nurses (40%) had inadequate knowledge scores, while only four nurses (5.7%) reached up to the excellent knowledge level (see Table 3).

Table 1. Demographic characteristics of the study participants (n = 70).

Characteristics	Frequency (%age)
Age in Years	*min* 20 *years and max* 48 *years*
Age (ranges)	
20 - 24 years	24 (34.3)
25 - 29 years	32 (45.7)
30 - 34 years	6 (8.6)
35 - 39 years	5 (7.1)
>39 years	3 (4.3)
Gender	
Male	41 (58.6)
Female	29 (41.4)
Qualification	
Generic BScN	8 (11.4)
Post RN BScN	22 (31.4)
Diploma in General Nursing	40 (57.1)
Specialization	
Diploma in Cardiology	35 (50)

Table 2. Professional experience and departments of the participants (n = 70).

Characteristics	Frequency (%age)
Years of Experience	*min* 1 *year and max* 20 *years*
Novice Nurses	32 (45.7)
Expert Nurses	38 (54.3)
Departments	
Coronary Care Unit (CCU)	16 (22.9)
Male General Ward (MGW)	20 (28.6)
Female General Ward (FGW)	30 (46.9)
Day Care Unit (DCU)	04 (5.7)

Table 3. Overall knowledge scores among nurses.

Knowledge Scores among Nurses	Mean (±SD)	Frequency (%age)
Overall Knowledge	27.2 ± 6	*min* 16 *and max* 46
Knowledge Scores (Categories)		
Excellent Knowledge Scores		4 (5.7%)
Adequate Knowledge Scores		38 (54.3%)
Inadequate Knowledge Scores		28 (40%)

The mean knowledge related to cardiac physiology was 4.8 + 2.4. The minimum knowledge score was zero, whereas the maximum was 10. A total of 31 nurses (44.3%) showed inadequate knowledge scores, 28 nurses (40%) obtained adequate knowledge scores, and 11 nurses (15.7%) got excellent knowledge scores related to cardiac physiology. The mean knowledge related to cardiac pathology was 7 + 1.4. The minimum knowledge score was four, whereas the maximum was 10. A total of 39 nurses (55.7%) attained adequate knowledge scores, two nurses (2.9%) got inadequate knowledge scores, whereas 29 nurses (41.4%) got excellent knowledge scores related to cardiac pathology.

Similarly, in terms of knowledge related to common electrocardiogram interpretation, the mean knowledge was 1.5 + 0.9. The minimum knowledge score was zero, whereas the maximum was three. A total of 34 nurses (48.6%) scored adequate knowledge and 28 nurses (40%) showed inadequate knowledge, whereas only eight nurses (11.4%) had excellent knowledge related to the interpretation of common electrocardiogram strips.

In analysis of knowledge related to the procedure, the mean knowledge was 6.8 + 1.3. The minimum knowledge score was four, whereas the maximum was 10. A total of 47 nurses (67.1%) attained adequate knowledge scores, three nurses (4.3%) acquired inadequate knowledge scores, whereas 20 nurses (28.6%) got excellent knowledge scores related to procedural awareness.

In the knowledge related to procedural complications, the mean knowledge was 3.4 + 1.8. The minimum knowledge score was zero, whereas the maximum was nine. A total of 52 nurses (74.3%) acquired inadequate knowledge scores, 16 nurses (22.9%) got adequate knowledge scores, whereas only two nurses (2.9%) had excellent knowledge scores.

The mean knowledge related to cardiac pharmacology was 5 + 1.8. The minimum knowledge score was one, whereas the maximum was nine. A total of 37 nurses (52.9%) got adequate knowledge scores regarding cardiac pharmacology, 26 nurses (37.1%) obtained inadequate knowledge scores, whereas seven nurses (10%) achieved excellent knowledge scores related to cardiac pharmacology (see Table 4).

Difference in knowledge scores between age categories was analyzed using one-way ANOVA. To have a better understanding, the age brackets were divided into five groups, which included: 20 - 24, 25 - 29, 30 - 34, 35 - 39, and >39. In all, there were 24 participants in the first age group, with a mean knowledge

score of 26.2 + 6.6, there were 32 in the second age group, with a mean knowledge score of 27.1 + 6.3; in the third age group with a mean knowledge score of 29.6 + 5.3; and five and three in the fourth and fifth age groups, with a mean knowledge score of 28.2 + 10.4 and 29.3 + 7.5, respectively. There was no statistically significant difference in the knowledge scores between these age groups, as the p-value was 0.78 (see Table 5).

To identify the difference between the knowledge scores of male and female nurses, the t-test of two independent samples was utilized. The mean knowledge score of male nurses was 27.8 + 6.3, whereas for female nurses it was 26.2 + 6.9. Therefore, no statistically significant difference was found between the knowledge scores of male and female nurses, as the p-value was 0.31 (see Table 6).

Table 4. Classification of knowledge scores.

Categories	Frequency (%)	Mean (±SD)	Min - Max
Cardiac Physiology			
Excellent Knowledge Scores	11 (15.7%)		
Adequate Knowledge Scores	28 (40%)	4.8 (±2.4)	0 - 10
Inadequate Knowledge Scores	31 (44.3%)		
Cardiac Pathology			
Excellent Knowledge Scores	29 (41.4%)		
Adequate Knowledge Scores	39 (55.7%)	7 (±1.4)	4 - 10
Inadequate Knowledge Scores	2 (2.9%)		
Common Rhythm Interpretation			
Excellent Knowledge Scores	8 (11.4%)		
Adequate Knowledge Scores	34 (48.6%)	1.5 (±0.9)	0 - 3
Inadequate Knowledge Scores	28 (40%)		
Procedural Knowledge			
Excellent Knowledge Scores	20 (28.6%)		
Adequate Knowledge Scores	47 (67.1%)	6.8 (±1.3)	4 - 10
Inadequate Knowledge Scores	3 (4.3%)		
Procedural Complications			
Excellent Knowledge Scores	2 (2.9%)		
Adequate Knowledge Scores	16 (22.9%)	3.4 (±1.8)	0 - 9
Inadequate Knowledge Scores	52 (74.3%)		
Cardiac Pharmacology			
Excellent Knowledge Scores	7 (10%).		
Adequate Knowledge Scores	37 (52.9%).	5 (±1.8)	1 - 9
Inadequate Knowledge Scores	26 (37.1%)		

Table 5. Difference of knowledge scores between age categories.

Age Categories	Frequency n = 70	Mean (±SD)	P-Value
20 - 24	24	26.2 (±6.6)	
25 - 29	32	27.1 (±6.3)	
30 - 34	6	29.6 (±5.3)	0.78
35 - 39	5	28.2 (±10.4)	
>39	3	29.3 (±7.5)	

P-value was calculated using the ANOVA test, with level of significance at $P < 0.05$.

Table 6. Comparison of knowledge scores between male and female nurses.

Variable	Male Nurses (n = 41) Mean (±SD)	Female Nurses (n = 29) Mean (±SD)	P-Value
Knowledge Scores	27.8 ± 6.3	26.2 ± 6.9	0.311

P-value was calculated using independent t-test, with level of significance at $P < 0.05$.

One of the study outcomes was to compare the knowledge scores of nurses with specialization, *i.e.* diploma in cardiology. For this comparison, the t-test of independent samples was used. The mean knowledge score of nurses having specialization was 28.5 + 6.5, whereas it was 25.8 + 6.4 for nurses without specialization. The current finding was statistically insignificant. Therefore, it was concluded that there was no difference between the knowledge scores of nurses with and without specialization (see Table 7).

The difference in the scores of the knowledge subcategories between nurses with and without specialization was compared using the t-test for independent samples. The mean knowledge score in cardiac physiology among nurses having specialization was 5.2 + 2.4, whereas the same among nurses without specialization was 4.4 + 2.4. There was no statistically significant difference between the knowledge scores of both groups, as p-value was 0.19.

Similarly, the mean knowledge score in cardiac pathology among nurses having specialization was 7.2 + 1.5, whereas those without specialization had a mean score of 6.9 + 1.4. There was no significant difference between the knowledge scores of both the groups, as the p-value was 0.52.

On the contrary, the mean score of procedural knowledge among nurses having specialization was 7.1 + 1.3, whereas this was 6.4 + 1.3 among nurses without specialization. There was a significant difference in the scores of procedural knowledge between nurses with and without specialization, as the p-value was 0.02.

On the other hand, the mean knowledge score of procedural complications among nurses having specialization was 3.6 + 1.7, whereas the mean knowledge score in procedural complications among nurses without specialization was 3.2 + 1.8. There was no significant difference in the scores of procedural complications between nurses with and without specialization, as the p-value was 0.39.

Table 7. Comparison of knowledge scores between nurses with and without specialization.

Variable	Nurses with Specialization (N = 35) Mean (±SD)	Nurses without Specialization (N = 35) Mean (±SD)	P-Value
Knowledge Scores	28.5 ± 6.5	25.8 ± 6.4	0.08

P-value was calculated using independent t-test, with level of significance at $P < 0.05$.

In the same way, the mean knowledge score in cardiac pharmacology among nurses having specialization was 5.3 + 1.7, whereas the same in the cardiac pharmacology of nurses not having specialization was 4.7 + 1.8. Hence, no significant difference was found between the knowledge scores of both the groups, as the p-value was 0.19 (see Table 8).

The difference in knowledge scores of nurses with different qualifications was analyzed using the chi-square test. Three types of qualifications were observed during analysis, *i.e.* BScN, Post RN BScN, and Diploma in General Nursing. Out of the eight BScN nurses, seven nurses attained adequate knowledge scores, one nurse got inadequate knowledge scores, whereas no BScN nurse reached up to the excellent knowledge scores. Similarly, out of 22 Post RN BScN nurses, 10 nurses obtained adequate knowledge scores, nine nurses acquired inadequate knowledge scores, whereas only three nurses attained excellent knowledge scores. In the same way, out of 40 diploma nurses, 21 nurses got adequate knowledge scores, 18 nurses got inadequate knowledge scores, whereas only one nurse obtained excellent knowledge scores. The current findings suggest that there was no statistically significant difference in the knowledge scores of nurses having varying qualifications, as the p-value was 0.14 (see Table 9).

The knowledge scores of procedural complication and cardiac pharmacology were found to be significantly different among nurses with varying qualifications, as the p-values were 0.015 and 0.012, respectively. Whereas, the rest of the knowledge subcategories were found insignificant when compared with different qualifications (see Table 10).

The comparison of knowledge scores among nurses in different departments was done using the chi-square test. The overall knowledge scores were compared for all these departments. Out of 16 nurses from CCU, 12 nurses got adequate knowledge, four nurses obtained excellent knowledge scores, whereas the number of inadequate knowledge scores was zero. Likewise, out of 20 nurses from GMW, eight nurses acquired adequate knowledge scores, 12 nurses attained inadequate knowledge scores, whereas no participant reached up to the excellent knowledge level. Similarly, out of 30 nurses from GFW, 14 nurses got adequate knowledge scores, 16 nurses achieved inadequate knowledge scores, whereas no one obtained excellent knowledge scores. Lastly, out of 4 nurses from DCU, all of them got adequate knowledge scores. There was a statistically significant difference between the knowledge scores of nurses working in different departments, as the p-value was 0.00 (see Table 11).

Table 8. Scores of knowledge subcategories between nurses with and without specialization.

Knowledge Scores	Nurses with Specialization (N = 35) Mean (±SD)	Nurses without Specialization (N = 35) Mean (±SD)	P Value
Cardiac Physiology	5.2 ± 2.4	4.4 ± 2.4	0.19
Cardiac Pathology	7.2 ± 1.5	6.9 ± 1.4	0.52
Procedural Knowledge	7.1 ± 1.3	6.4 ± 1.3	**0.02**
Procedural Complications	3.6 ± 1.7	3.2 ± 1.8	0.39
Cardiac Pharmacology	5.3 ± 1.7	4.7 ± 1.8	0.19

P-value was calculated using independent t-test, with level of significance at $P < 0.05$.

Table 9. Comparison of knowledge scores among nurses with different qualifications.

Qualification	Adequate Knowledge (n = 38)	Inadequate Knowledge (n = 28)	Excellent Knowledge (n = 4)	P Value
BScN	7	1	0	
Post RN BScN	10	9	3	0.14
Diploma General Nursing	21	18	1	

P-value was calculated using the chi-square test, with level of significance at <0.05.

Table 10. Comparison of scores of knowledge subcategories with regard to qualifications.

Knowledge Category & Qualification	P Value(s)
Cardiac Physiology	0.18
Cardiac Pathology	0.73
Procedural Knowledge	0.36
Procedural Complication	**0.015**
Cardiac Pharmacology	**0.012**

P-value(s) was calculated using chi-square test, with level of significance at <0.05.

Table 11. Difference in knowledge scores among nurses of different departments.

Qualification	Adequate Knowledge (n = 38)	Inadequate Knowledge (n = 28)	Excellent Knowledge (n = 4)	P Value
Coronary Care Unit (CCU)	12	0	4	
General Male Ward (GMW)	8	12	0	
General Female Ward (GFW)	14	16	0	0.00
Day Care Unit (DCU)	4	0	0	

P-value was calculated using the chi-square test, with level of significance at <0.05.

The difference in the scores of knowledge subcategories between the nurses of different departments was analyzed using the chi-square test. The knowledge score of cardiac physiology was significantly different among all the depart-

ments, as the p-value was 0.00. On the contrary, there was no significant difference in the scores of cardiac pathology among all the departments, as the p-value was 0.41. However, when compared, the scores of procedural knowledge, procedural complications, and cardiac pharmacology were found to be significantly different in all the departments except for Cardiac Pathology, as the p-values were 0.03, 0.00, and 0.00, respectively (see Table 12).

3.3. Section Three

The second major outcome of the study was to assess the practices of nurses regarding patient care following cardiac catheterization. In the analysis of three time practice observations, the mean practice score was 10.3 + 2.2. The minimum practice score was 6.3, whereas the maximum score was 15.6. This shows that the majority of the nurses (87.1%) were carrying out unsatisfactory practices, whereas only nine (12.9%) nurses were carrying out satisfactory practices (see Table 13).

Difference in the practice scores of participants with regard to their demographic characteristic was determined using the chi-square test and one way ANOVA. No significant difference was found in the mean of all age groups, as the p-value was 0.25 (see Table 14). The results were found to be significant when the practice scores were compared on the basis of qualification, as the p-value was 0.05. So, there was a significant difference between practice scores of nurses, who had BScN, Post RN BScN, or Diploma in general nursing. Surprisingly, the findings were found to be insignificant when the practices of participants were compared with their specialization status and their experiences, as the p-value was 1.0 and 0.93, respectively. On the contrary, the results were found to be significant when the practice scores of participants working in CCU and different departments were compared, using chi-square, as the p-value was 0.00 (see Table 15).

The difference in three time practices was analyzed using the repeated measures ANOVA. The value of Mauchly's test of sphericity was 0.90, which indicated that there was no violation of sphericity. The mean of all the three observations (n = 70) were 10.1, 10.3, and 10.2, respectively. The findings of three time practices revealed no mean difference in all three observations, as the p-value was 0.403 (see Table 16).

Table 12. Scores of knowledge subcategories between departments.

Knowledge Category & Departments	P Value(s)
Cardiac Physiology	**0.00**
Cardiac Pathology	0.41
Procedural Knowledge	**0.03**
Procedural Complications	**0.00**
Cardiac Pharmacology	**0.00**

P-value(s) was calculated by using chi-square test with level of significance at <0.05.

Table 13. Practice scores of nurses.

Practice Scores among Nurses	Mean (±SD)	Frequency (%age)
Overall Practice Scores	10.3 ± 2.2	*min* 6.3 *and max* 15.6
Practice Scores (Categories)		
Unsatisfactory Practices		61 (87.1%)
Satisfactory Practices		9 (12.9%)

Table 14. Difference in practice scores between age groups of participants.

Age Categories	Frequency n = 70	Mean (±SD)	P-Value
20 - 24	24	9.4 (±1.7)	
25 - 29	32	10.7 (±2.4)	
30 - 34	6	10.8 (±2.4)	0.25
35 - 39	5	10.8 (±2.5)	
>39	3	P.3 (±1.0)	

P-value was calculated using One Way ANOVA, with level of significance at <0.05.

Table 15. Difference in practice scores between demographic characteristics.

Variables	Practices categories (n = 70)		P-Value
Gender	**Satisfactory**	**Unsatisfactory**	
Male	04	37	0.47
Female	05	27	
Qualifications			
BScN	02	6	**0.05**
Post RN BScN	05	17	
Diploma in Nursing	02	38	
Specialization			
Diploma in cardiology	05	30	1.00
Non Specialized	04	31	
Experience			
Novice	04	28	1.00
Expert	05	33	
Departments			
CCU	09	7	
GMW	00	20	**0.00**
GFW	00	30	
DCU	00	4	

P-value(s) was calculated using chi square test, with level of significance at <0.05.

Table 16. Difference in three time practice observations.

Practice Observations	Mean (s)	Mauchly's Test Sig.	P Value within Subjects
1st Observation	10.1		
2nd Observation	10.3	0.90	0.40
3rd Observation	10.2		

P-value was calculated using repeated measures ANOVA, with level of significance at <0.05.

The difference in three time practice observations within departments was analyzed using the repeated measures ANOVA. The value of Mauchly's test of sphericity was >0.05 which indicated that there was no violation of sphericity. No difference was found between the three time practice observations within each of the departments, as the p-value was >0.05 (see Table 17).

The frequency of obtaining the vital signs was analyzed, using descriptive statistics in SPSS. The analysis of observations of vital signs indicated different practices in each of the observations. The standard of vital sign monitoring following cardiac catheterization used in literature and in other quality health care setups was set as: For first hour, vitals should be obtained every 15 minutes. For the second hour, every 30 minutes then every hour till the fourth hour.

Surprisingly, the findings of this study indicated that in all the three observations, the majority of nurses were not obtaining the vital signs as described above, but the duration of vitals was adopted according to the protocol used in their respective departments. The duration of Blood Pressure (BP) measurement, Heart Rate (HR), and oxygen saturation varied from 1st to 6th hours. A total of 69 nurses (98.6%) were obtaining BP as per the standard set by their department. Most of the times, the heart rate and oxygen saturation were monitored in the fourth hours and their frequencies were 42 and 44 times, respectively (see Table 18).

Descriptive statistics were utilized to determine the catheter site assessments. The findings were explored by taking the average of all the three observations for catheter access site assessment upon receiving the patient in the unit. A total of 54 nurses (77.1%) assessed the access site upon receiving the patients in their respective unit. Out of 54 nurses (77.1%), assessments of 33 nurses (47.1%) were consistent in all the three observations. Unexpectedly, 16 nurses (22.9%) did not assess the catheter access site even a single time, out of the three observations (see Table 19).

The frequency of assessing the catheter access site following catheterization was checked through descriptive statistics. The findings showed that 32 nurses (45.7%) did not check the catheter access site, even a single time, in their entire shift. However, 28 nurses (40%) assessed the catheter access site only once, in their entire shift. Moreover, eight nurses (11.4%) assessed the access site every three hours, whereas only 2.9% (n = 2) nurses assessed the access site every two hours, in their entire shift.

Table 17. Difference in three time practice means within departments.

Practice Observations	Mean (±SD)	Mauchly's Test Sig.	P Value within Subjects
CCU			
1st Observation	12.9 (±2.7)	0.38	0.81
2nd Observation	13.3 (±2.6)		
3rd Observation	13.0 (±2.1)		
GMW			
1st Observation	9.3 (±1.6)	0.93	0.74
2nd Observation	9.5 (±1.6)		
3rd Observation	9.5 (±1.3)		
GFW			
1st Observation	9.2 (±1.3)	0.32	0.36
2nd Observation	9.6 (±1.2)		
3rd Observation	9.4 (±1.4)		
DCU			
1st Observation	9.5 (±1.2)	0.72	0.69
2nd Observation	8.7 (±0.9)		
3rd Observation	9.5 (±1.2)		

P-value was calculated using the repeated measures ANOVA, with level of significance at <0.05.

Table 18. Frequency of obtaining vital signs following cardiac catheterization.

Measurement Duration		Frequency of BP (%)		Frequency of Heart Rate (%)		Frequency of Oxygen Saturation (%)	
1st	hour	12	(17.1)	12	(17.1)	12	(17.1)
2nd	hour	5	(7.1)	5	(7.1)	5	(7.1)
4th	hour	44	(60)	42	(60)	44	(62.9)
5th	hour	3	(4.3)	3	(4.3)	3	(4.3)
6th	hour	5	(7.1)	5	(7.1)	4	(5.7)
15 minx1 hour then 30 minx1 then every hour till 4th hour		1	(0.7)	00	(00)	00	(00)
Not checked		00	(00)	3	(4.3)	2	(2.9)

Descriptive statistics, frequencies.

Table 19. Assessment of access site upon receiving the patient.

Assessments	Frequency (n = 70)	(%)
Assessed one time out of three observations	9	12.9
Assessed two times out of three observations	12	17.1
Assessed in all three observations	33	47.1
Not checked in all three observations	16	22.9

Descriptive statistics, frequencies.

In the same way, the frequency of palpating the distal pulses was also determined through descriptive statistics. The findings revealed that nine (12.9%) nurses checked the distal pulses once in their shift, whereas only one nurse (1.4%) checked the distal pulses, every two hours. Surprisingly, 60 nurses (85.7%) did not check the distal pulses, even a single time, in their entire shift (see Table 20).

3.4. Section Four

The association between practice and overall knowledge scores was analyzed, using the chi-square test. When practice scores were evaluated with overall knowledge, the findings showed that nurses who scored as excellent and adequate in knowledge were better at carrying out satisfactory practices, whereas those nurses, who received scores showing inadequate in knowledge, were found carrying out unsatisfactory practices. Hence, with these findings, it can be concluded that there is an association between good knowledge and satisfactory practices, as the p-value was 0.00 (see Table 21).

With regard to association between practices and knowledge of cardiac physiology and cardiac pharmacology, the findings indicate that nurses who scored inadequate in knowledge were carrying out unsatisfactory practices. Whereas, those nurses, who scored as adequate and excellent in knowledge were found better at carrying out satisfactory practices, as the p-values were 0.001 and 0.006, respectively. The association turned out to be positive when analyzed for practices and knowledge about procedural complications as the p-value was 0.00 (see Table 22).

Some important findings were also found during analysis. The different responses of the nurses and their practices were compared. Initially, nurses who were aware of the signs of thrombus formation were compared, whether they knew where to palpate the pulses or not. The findings suggested that, out of the 20 nurses who were aware of the signs of thrombus formation, nine nurses did not know where to palpate the pulses as compared to those 11 participants who knew that. On the other hand, nurses who were not aware of the signs of thrombus formation were 50 in number, out of which 40 did not know where to palpate the pulses, whereas 10 participants knew. The findings remained significant, as the p-value was 0.00. It can be concluded that there is a difference in the knowledge of nurses who were aware of the signs of thrombus formation and they knew where to palpate the pulses, as compared to those who were unaware of the signs of thrombus formation and they did not know about the site of pulse palpation (see Table 23).

In this analysis, a comparison was carried out to see how frequently nurses who were aware of the signs of thrombus formation assessed the distal pulses of patient after cardiac catheterization. The findings indicated that, out of the 20 participants who were aware of the sign of thrombus formation, 15 nurses did not check the distal pulses even a single time in their entire shifts, whereas five

participants checked the distal pulses once in a shift. Whereas, out of the 50 nurses who were not aware of the signs of thrombus formation, 45 nurses did not check the distal pulses even a single time in their entire shift, whereas four participants checked the distal pulses once in a shift, and one participant checked the distal pulses every two hours. The findings remained insignificant, as the p-value was 0.136 (see Table 24).

Practices of participants who were aware and unaware of the reasons for obtaining serum creatinine levels after cardiac catheterization were also compared, to see whether they monitored urine output, despite knowing the risk of developing Dye Induced Nephropathy (DIN), or not. The findings showed that out of the 31 participants who were aware of the reasons for obtaining serum creatinine levels after cardiac catheterization, only 12 participants monitored the urine output, whereas 19 participants did not check. In the same way, out of the 39 participants who were not aware of the reasons for obtaining serum creatinine levels after cardiac catheterization, 34 participants did not check the urine output, whereas 5 participants monitored the output. The finding was statistically significant, as the p-value was 0.01 (see Table 25).

Table 20. Frequency of assessment of catheter access site and distal pulses.

Time Duration	Two Hourly (%)	Three Hourly (%)	Once in a Shift (%)	Not Checked (%)
Catheter Access Site (n = 70)	2 (2.9)	8 (11.4)	28 (40)	32 (45.7)
Distal Pulses	1 (1.4)	00	9 (12.9)	60 (85.7)

Descriptive statistics, frequencies.

Table 21. Association between practices and overall knowledge scores.

Variables	Practice Category (n = 70)		P Value
Knowledge Category	Satisfactory	Unsatisfactory	
Inadequate	0	28	0.00
Adequate	7	31	
Excellent	2	2	

P-value was calculated using the chi square test, with level of significance at <0.05.

Table 22. Association between practices and knowledge sub-categories.

Knowledge Subcategory	Practice Category (n = 70)		P Values
	Satisfactory	Unsatisfactory	
Cardiac Physiology			
Inadequate	0	31	0.006
Adequate	4	24	
Excellent	5	6	

Continued

Cardiac Pathology			
Inadequate	0	2	0.245
Adequate	3	36	
Excellent	6	23	
Procedural Knowledge			
Inadequate	0	3	0.145
Adequate	4	43	
Excellent	5	15	
Procedural Complications			
Inadequate	2	50	0.001
Adequate	6	2	
Excellent	1	1	
Cardiac Pharmacology			
Inadequate	0	26	
Adequate	6	31	0.00
Excellent	3	4	

P-value was calculated using the chi square test, with level of significance at <0.05.

Table 23. Signs of thrombus formation and the site of pulse palpation.

Variables		Q: Where to Palpate the Pulses (n = 70)		P Value
		Knew	Didn't Know	
Q: Signs of Thrombus Formation (n = 70)	Knew	11	9	0.004
	Didn't Know	10	40	

P-value was calculated using chi square test, with level of significance at <0.05.

Table 24. Signs of thrombus formation and frequency of checking the distal pulses.

Variables		Q: Frequency of Checking the Distal Pulses (n = 70)			
		Every 2 Hours	Only Once	Not Checked	P Value
Q: Signs of Thrombus Formation (n = 70)	Knew	0	5	15	0.136
	Didn't Know	01	4	45	

P-value was calculated using the chi-square test, with level of significance at <0.05.

Table 25. Reasons for obtaining serum creatinine level with urine output monitoring.

Variables		Q: Urine Output Monitoring (n = 70)		P Value
		Done	Not Done	
Q: Reasons for Obtaining Serum Creatinine Level (n = 70)	Knew	12	19	0.01
	Didn't Know	5	34	

P-value was calculated using chi-square test, with level of significance at <0.05.

4. Discussion

In this study, the overall mean knowledge score was found to be 27.2 + 6 (out of 50). This finding is consistent with [13], in which they reported that the mean knowledge scores of staff nurses regarding the pre and post-procedural nursing care of PTCA was found to be 23.58 + 2.52 (out of 30). Furthermore, the majority of the study participants (54.3%) had adequate knowledge, 40% had inadequate knowledge, whereas only 5.7% had excellent knowledge. The reason for inadequate knowledge of 40% nurses could be ascribed to the fact that nurses are not offered training sessions as, in general, institutions pay little attention to the training of nurses [14].

The mean knowledge related to cardiac physiology was 4.8 + 2.4 (out of 10). Most of the nurses (31 out of 50) showed inadequate knowledge related to cardiac physiology. On the contrary, the study [15], reported that the knowledge level of nurses regarding cardiac physiology was found to be high in 54.7% of the total nurses. With regard to knowledge about cardiac pathology, the mean knowledge was 7 + 1.4 (out of 10). The findings showed that the majority of the nurses (55.7%) had adequate knowledge and 2.9% had inadequate knowledge, whereas 41.4% of nurses had an excellent knowledge score related to cardiac pathology. This finding is consistent with the study [16], in which they reported that the knowledge level among Turkish nursing students was high regarding cardiac diseases.

In a similar way, knowledge related to interpreting common electrocardiogram strips showed that the mean knowledge was 1.5 + 0.9 (out of 3). A total of 34 nurses (48%) had adequate knowledge in identifying the abnormal ECG rhythms, 28 had inadequate knowledge, whereas, only eight nurses had excellent knowledge. On the contrary, the study [17], reported that 43 participants (out of 69) were comfortable in identifying the abnormal ECG rhythms. However, in this study, it is indicated that nurses had limited knowledge regarding ischemia monitoring on the ECG and had a room for improvement in this regard. The findings of current study may be attributed to the fact that nurses are not provided on-job training and professional development in many organizations. However, studies indicate that the provision of ECG session by the unit management can improve the nurses' confidence and knowledge to identify the abnormal ECG rhythms [18].

In the analysis of knowledge related to procedure, the mean knowledge was 6.8 + 1.3 (out of 10). Findings showed that a total of 47 nurses (67.1%) had adequate knowledge scores, three (4.3%) had inadequate knowledge, whereas 20 (28.6%) had an excellent level of knowledge related to procedural awareness. These findings are consistent with the study [13] in which, they reported that 62% of the nurses (31 out of 50) had good knowledge and 36% (18 out of 50) had very good knowledge scores regarding pre and post-procedure care of PTCA.

Findings related to procedural complications showed that the mean know-

ledge score was 3.4 + 1.8 (out of nine). A total of 52 nurses got inadequate knowledge scores and 16 nurses got adequate knowledge scores, whereas only two nurses had excellent knowledge scores. These findings are inconsistent with the study [19], in which he reported that the majority of the respondents had a high percentage of knowledge regarding complications. Opposite to that, study [20], reported no relationship between nursing knowledge and occurrence of complications.

The mean knowledge related to cardiac pharmacology was 5 + 1.8 (out of nine). A total of 37 nurses got adequate knowledge scores regarding cardiac pharmacology and 26 had inadequate knowledge, whereas only seven nurses had excellent knowledge scores. These findings are consistent with the study [21], in which they reported that 57.5% nurses (23 out of 40) had a good level of knowledge and 10% (4 out of 40) had excellent knowledge, whereas 30% nurses (12 out of 10) had average knowledge scores. The low level of knowledge may imply that since the majority of the nurses (57.1%) in this study were diploma holders they did not learn pharmacology in their institutes; however, they learned it from their practical experience during their jobs. In general, when these nurses were hired, their competency-based orientations were not conducted in many organizations.

In the analysis of three time practice observations, the mean practice score was 10.3 + 2.2. The minimum practice score was 6.3, whereas the maximum score was 15.6. Results showed that a total of 61 nurses (87.1%) were carrying out unsatisfactory practices, whereas only nine nurses (12.9%) were carrying out satisfactory practices. On the contrary, the study [22] reported that the mean practice score among nurses after the administration of a nursing care protocol was found to be high. Since the nurses in this study were found carrying out practices without any standard protocol, this could have led to unsatisfactory practices.

The difference in three time practices indicated that there was no mean difference in all the three observations, as the p-value was 0.403. This finding added to the researcher's confidence that since there was no difference in the means of the three different observations of practices, the Hawthorne effect had been minimized (Gaskell, 2012). Moreover, literature suggests that frequent and long term observations can minimize the Hawthorne effect. In this study, the researcher employed a six step protocol for Hawthorne effect mitigation [23].

For determining the access site assessments, the findings were presented by taking the average of all three observations. A total of 54 nurses (77.1%) assessed the access site upon receiving the patients in their respective units. Out of 77.1% nurses, assessments of 47.1% (n = 33) were consistent in the three times observation, whereas the assessments of 30% (n = 21) were inconsistent in the three observations, while a total of 16 nurses (22.9%) did not assess the catheter access site even a single time. These findings imply that due to the non-availability of a standard protocol, nurses were practicing based on their feasibility; therefore, it is suggested that a post-cardiac catheterization care protocol should be devel-

oped and followed by all the departments.

The frequency of assessing the catheter access site following catheterization showed that 45.7% nurses did not check the catheter access site, even a single time, during their entire shift. However, 40% nurses assessed the catheter access site only once in their entire shift, 11.4% nurses assessed the access site every three hours, whereas only 2.9% nurses assessed the access site every two hours in their entire shift.

The association between practices and the overall knowledge scores showed that nurses who scored as excellent and adequate in the knowledge scores, were carrying out somewhat satisfactory practices, whereas, those nurses, who scored inadequate on the knowledge score, were found carrying out unsatisfactory practices. Hence, with these findings, it can be concluded that there is an association between good knowledge and satisfactory practices, and inadequate knowledge and unsatisfactory practices, as the p-value was 0.00. This being the case, the conceptual model proposed by Clarke and Donaldson (2007) could bring about a difference. The model says that safe patient outcomes depend on four major components: The nurses' knowledge, experience, practice, and attitude. In this study, it is evident that adequate knowledge was directly associated with satisfactory practices.

However, the findings of those who had adequate knowledge but did not show satisfactory practices can be related to their attitudes, therefore, the reason of their attitudes towards the practices need to be assessed in further studies. Moreover, in this study, years of experience did not show a significant difference in both knowledge and practices, which the researcher considers is a result of recruiting only 70 participants; this may have been significant if more participants had been recruited.

Some important findings were also found during analysis. Different responses of nurses, on the questionnaire, were compared and contrasted. For Instance, nurses who were aware of the signs of thrombus formation, *i.e.* absence of distal pulses, did not know where to palpate the pulses. Likewise, nurses who were aware of the sign of thrombus formation did not check the distal pulses, even a single time, during their entire shifts. In a similar way, nurses who were aware of the rationale for obtaining serum creatinine levels after cardiac catheterization, *i.e.* Dye Induce Nephropathy (DIN), did not monitor the urine output.

Therefore, it is concluded that, there is a difference in participants' responses and their real practices because, despite the fact that they had the knowledge, they were not found translating it into clinical practice, due to which best practices were not apparent. Hence, there is a need for further study to evaluate the nurses' attitudes, to identify the reasons as to why, despite having knowledge, they did not apply it their practices, so that the practice standards could be enhanced.

4.1. Strengths of the Study

The strengths of the current study are as follows:

1) The study is easily replicable.

2) This study had gender equality, which evidently has benefits for patient care.

3) The study tool was designed and validated according to the Pakistani context, by conducting a pilot test.

4) The CVI for the study tools was 0.98. The content clarity and inter-rater reliability was also ensured by eight expert reviews, of whom six were medical and two were nursing experts.

5) The practices were observed thrice, in three different time periods, through three different data collectors. Each participant was observed for 21 hours, cumulatively. This study employed 1470 hours of observation, for 70 participants.

6) Post hoc power analysis was done which was found to be 99.9%.

7) The study has attempted to minimize the Hawthorne effect through frequent and long duration of observations.

4.2. Limitations of the Study

This study has a few limitations, which are as follows:

1) Considering the scope of the master's thesis, only one tertiary care hospital was selected as a study setting.

2) Due to frequent and long durations of observations, only 70 participants could be recruited as a sample.

3) The attitude of nurses towards the practices could not be examined due to limited time.

5. Conclusion

Based on these findings, it can be concluded that there is a need to conduct periodic competency-based orientations, increased continuous development sessions, seminars, and simulation-based training for nurses, to provide better patient care. Furthermore, frequent spot rounds, audits, and quality education in nursing institutions by hiring qualified faculty should also be considered by the institute. Moreover, due to variations in the practices in each of the department, the need for further research is indicated, to assess nurses' attitudes through the qualitative approach, and to develop and implement a standard post-cardiac catheterization care protocol.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Abbreviations and Acronyms

CVD: Cardiovascular Disease
CCU: Coronary Care Unit
IHD: Ischemic Heart Disease
CAD: Coronary Artery Disease
PCI: Percutaneous Coronary Intervention
ECG: Electrocardiograph
LHC: Left Heart Catheterization
CHD: Coronary Heart Disease
WHO: World Health Organization
PTCA: Percutaneous Transluminal Coronary Angioplasty
MI: Myocardial Infarction
ICU: Intensive Care Unit
TIH: The Indus Hospital
PNC: Pakistan Nursing Council
MHDU: Male High Dependency Unit
FHDU: Female High Dependency Unit
GMW: General Male Ward
GFW: General Female Ward
DCU: Day Care Unit
ERC: Ethical Review Committee
AKUH: Aga Khan University Hospital
IRB: Institutional Review Board
SMO: Senior Medical Officer
CVI: Content Validity Index
SPSS: Statistical Package for Social Sciences
ANOVA: Analysis Of Variance
RN: Registered Nurse
BScN: Bachelor of Science in Nursing
HR: Heart Rate
BP: Blood Pressure
DIN: Dye Induced Nephropathy