Xi'an Shiyou Daxue Xuebao (Ziran Kexue Ban)/
Journal of Xi'an Shiyou University, Natural Sciences Edition
ISSN: 1673-064X
E-Publication: Online Open Access
Vol: 66 Issue 01 | 2023
DOI 10.17605/OSF.IO/Y8AQM

NURSING CREW RESOURCE MANAGEMENT TRAINING PROGRAM AND ITS EFFECT ON NURSE INTERNS' CONFIDENCE RELATED TO PATIENT SAFETY

AMERA MOSTAFA ABDALLA
M.SC., Nursing Administration-Faculty of Nursing- Ain Shams University.

SAMAH FAISAL FAKHRY
Professor of Nursing Administration-Faculty of Nursing- Ain Shams University.

NEMA FATHY SAAD
Assistant Professor of Nursing Administration-Faculty of Nursing- Ain Shams University.

Abstract

Background: Nursing Crew Resource Management (NCRM) training program is a modified version of Crew Resource Management (CRM) training program and its concept of managing errors associated with the effects of human factors on skills. NCRM is a training program designed to improve nurses' knowledge, performance, and confidence related to patient safety in health care. **Aim:** This study aims at investigating the effect of nursing crew resource management (NCRM) training program on nurse interns' confidence related to patient safety. **Research design:** Quasi-experimental one group pre and post-test design was used to carry out this study. **Study setting:** The study was conducted at Ain-Shams University Hospitals. **Study subjects:** 139 nurse interns whom are succeeded in fourth year at faculty of nursing Ain-Shams University. **Tools:** Data were collected by using Patient Safety Knowledge Questionnaire, Observational Checklist for Nurse Interns' Safety Performance and Health Professional Education in Patient Safety Survey (H-PEPSS).**Result:** Demonstrate that 6.5 % of the nurse interns had satisfactory knowledge, 0.00% had adequate performance, and 25.2% had high confidence at the pre-intervention phase. This rose to74.8 % of the nurse interns had satisfactory knowledge,97.8% had adequate performance, and 86.3 % had high confidence at the post- intervention phase, and declined to 37.4 % of the nurse interns had satisfactory knowledge,43.5% had adequate performance, and 73.4 % had high confidence at the follow up phase. The differences were statistically significant (P <0.001). **Conclusion:** NCRM training program produced significant improvement in the nurse interns' knowledge, performance, and confidence related to patient safety. **Recommendations:** Implementing NCRM training program is highly recommended for nurses to improve knowledge, performance, and confidence related to patient safety.

Keywords: Confidence, Nurse Interns', Nursing Crew Resource Management, Patient Safety.

INTRODUCTION

Crew Resource Management (CRM) is training program most often used in high-risk industries such as aviation, astronautics, nuclear power production and management. CRM is most appropriately used in industries where human error can have a devastating, dangerous or lethal effect on people and safety outcomes. Originally developed by NASA in 1979 and later adopted by the aviation industry, which focuses on teamwork and human factors such as interpersonal communication, situational awareness, and decision-making skills **(Gross et al ., 2019).**

Xi'an Shiyou Daxue Xuebao (Ziran Kexue Ban)/
Journal of Xi'an Shiyou University, Natural Sciences Edition
ISSN: 1673-064X
E-Publication: Online Open Access
Vol: 66 Issue 01 | 2023
DOI 10.17605/OSF.IO/Y8AQM

Nursing Crew Resource Management (NCRM) is a modified version of CRM, and its concept of managing errors associated with the effects of human factors on skills. Specific areas addressed by this program included situational awareness, decision making, task management, teamwork, and communication. NCRM is being utilized and evaluated in health care and initial findings show promising improvements in several areas of patient safety .NCRM is a training program designed to improve nurses' knowledge, skills, and confidence related to patient safety in health care that training focuses on human factors and skills to produce competent safe practitioners **(Gallagher, 2016).**

NCRM focuses on training the practitioner to be aware of the potential dangers associated with providing patient care and attempts to teach students and health care providers to recognize, intervene and respond to potentially adverse actions and events .Also, NCRM is a training program that teaches the learner awareness of how to practice safely and gives specifics on how to respond when adverse situations arise NCRM helps nursing team members develop skills that promote uninterrupted focus and teaches knowledge, skills, and attitudes (KSAs) that can guide them in the event of an unexpected outcome **(Roth, Brewer., & Wieck ,2016).**

Also , NCRM directed at the primary goal of improving patient safety and decreasing medical errors **.**NCRM training places a strong focus on a four-step assertive communication that teaches the learner how to; get attention, state the problem, offer a plan, and pose a question to get resolution. This four-step assertive communication teaches the learners' how to react when they feel they are not being heard and was designed to enhance the learner's confidence **(Aubeeluck, Stacey., & Stupple, 2016).**

Confidence or self-confidence and self-efficacy are often used interchangeably in the literature, they are different concepts. The word confidence originates from the Latin word confidere, which means "to be sure", "to believe in", "to have full trust" ,"to have full trust in yourself" ,or "to believe in yourself." Confidence defines as the self-confidence in one's self, one's abilities, qualities, powers, and judgments… etc. Confidence is an important attribute for nurse interns which mean the belief in one's ability to perform a specific task, and an essential part of the nurse intern's ability to perform successfully (**Kershaw, 2019).**

Confidence is an indication of how nurse interns will perform, act, and think in practice. Nurse interns with low levels of confidence tend to disengage and avoid challenging tasks thereby missing out on quality learning opportunities and vice versa .It is important to understand nurse interns level of confidence at bedside practice, and its effect on the quality of care that patients receive .Nurse interns entering the profession with lack of confidence in their ability to provide nursing care with safety. A lack of confidence may contribute to the nurse interns' inability to perform timely nursing interventions leading to patient harm **(Huang et al., 2020).**

To date, no many studies are available in the literature that have reported the impacts of NCRM training on confidence related to patient safety in any health care profession or setting. Evaluating the impact of NCRM training on nursing students' confidence can provide scientific groundwork for the potential integration or exclusion of NCRM training

Xi'an Shiyou Daxue Xuebao (Ziran Kexue Ban)/
Journal of Xi'an Shiyou University, Natural Sciences Edition
ISSN: 1673-064X
E-Publication: Online Open Access
Vol: 66 Issue 01 | 2023
DOI 10.17605/OSF.IO/Y8AQM

into nursing curriculums and open a door for more research on the impacts of NCRM on patient safety .In addition, when it comes to healthcare, patient safety is an issue that is a top priority for everyone involved, including patients, providers, nurses, family members and every single member of the health care team **(Donaway, 2016).**

Patient safety is a major challenge for quality improvement and enhancing providers' (nurse interns) performance. The World Health Organization (WHO) is committed to make patient safety a high priority on the policy agenda of countries. The increasing incidence of documented cases of adverse events in healthcare has led to a growing concern in a number of countries about patient safety, which remains a fundamental principle of patient care and a critical component of quality management **(World Health Organization [WHO], 2020).**

Therefore, patient safety is defined as freedom from accidental or preventable injuries produced by health care; also patient safety is a discipline in the healthcare sector that applies safety science methods towards the goal of achieving a trustworthy system of healthcare delivery. Patient safety is an attribute of healthcare systems that minimizes the incidence and impact of and maximizes recovery from adverse events **(Lee et al., 2020).**

SIGNIFICANCE OF THE STUDY

During the clinical supervision of nurse interns training the researchers observed that they lacked knowledge and skills related to patient safety which reflected on their confidence in dealing with patients. Also, Many studies confirmed the researchers point of view they have found that students experience varying levels of apprehension about their future roles as nurse. Senior students expected lacked overall confidence in their nursing knowledge, and worried about assuming full responsibility for patients and their safety **(Aldeeb, Abdelaziz & Elnagar, 2016).**

NCRM have been tested in education and health care settings and have proven the ability to positively impact knowledge, skills, attitudes, confidence and outcomes when appropriately implemented and utilized. NCRM focuses on concepts such as managing fatigue and workload, stress management, creating and managing teams, recognizing and responding to adverse situations, cross-checking and communicating, assertiveness, situational awareness, and giving and receiving performance feedback **(Chan et al. 2016).**

AIM OF THE STUDY

The aim of this study is to investigating the effect of nursing crew resource management (NCRM) training program on nurse interns' confidence related to patient safety.

Xi'an Shiyou Daxue Xuebao (Ziran Kexue Ban)/
Journal of Xi'an Shiyou University, Natural Sciences Edition
ISSN: 1673-064X
E-Publication: Online Open Access
Vol: 66 Issue 01 | 2023
DOI 10.17605/OSF.IO/Y8AQM

SUBJECTS & METHODS

Research design:

Quasi-experimental one group pre and post-test design was used in this study.

Setting

The study was conducted at Ain-Shams University Hospitals where nurse interns are having their training, namely; Ain-Shams University hospital, El-Demerdash hospital, Pediatrics hospital, and cardiovascular hospital.

Study subjects

The subjects of the study were included nurse interns who started their internship at the above mentioned settings. Their total number was (205), the sample size selected by simple random sampling technique. The sample size was calculated to detect improvement in the scores of confidence with a moderate effect size 0.51, based on the mean score pre intervention was 3.83 (0.58) and post intervention was 4.49 (0.44) and statistical power of 90%, level of confidence (1-Alpha Error): 95%, Alpha 0.05, Beta 0.1 based on a study carried out by **Donaway, (2016)** .The sample size determines at group is (139) nurse interns. Sample size calculates using test comparing two means through Kane SP. Sample Size Calculator. ClinCalc **(Rosner, 2011).**

Tools for data collection:

Data for this study was collected by using three tools:

1- Patient Safety Knowledge Questionnaire:

It consists of two parts:

- **Part (1):** This was aimed at collect the personal data of the respondents such as age, gender, nationality, pre-university education, training hospital, area, and hours.
- **Part (2):** This was developed by the researchers based on pertinent literature review **Macedo et al., (2020); Santos et al., (2019)** to assess knowledge of the nurse interns regarding the patient safety. It included (55) Multiple-Choice questions "MCQ" that cover different aspects of patient safety these included evidence based practice, patient safety, accuracy of patient identification, medical error, communication among caregivers, safety medications administration, safe surgery, prevention of healthcare-acquired infections, fall protection, patient safety culture, and non- technical skills, for each aspect has five MCQ questions.
- **Scoring**: For each question, a correct response was scored one and the incorrect zero. For each aspect of knowledge, the score of the items were summed-up and the total divided by the number of the items, giving a mean score for the part. Theses scores were converted into percent scores. Knowledge was considered satisfactory if the percent score was 60% or more and unsatisfactory if less than 60%.

Xi'an Shiyou Daxue Xuebao (Ziran Kexue Ban)/
Journal of Xi'an Shiyou University, Natural Sciences Edition
ISSN: 1673-064X
E-Publication: Online Open Access
Vol: 66 Issue 01 | 2023
DOI 10.17605/OSF.IO/Y8AQM

2- Observational Checklist for Nurse Interns' Safety Performance:

It consists of two parts:

- **Part (1):** This was included code number, observation number, observation timing (pre-post-follow up), hospital name, and unit name.
- **Part (2):** This was developed by the researchers based on pertinent literature review **Souza et al., (2019); Vasconcelos et al., (2019)** to assess performance of nurse interns regarding patient safety. It was covering certain tasks such as accuracy of patient identification, communication among caregivers, safety medication administration, prevention of healthcare - acquired infections, and fall protection. It included 88 items they are divided as follows:

  1 - Accuracy of patient identification (22 items).

  2- Communication among caregivers (13 items).

  3- Safety medications administration (16 items) .

  4- Prevention of healthcare-acquired infections (26 items).

  5- Fall protection (11 items)

- **Scoring**: The items observed "done" and "not done" were scored "1" and "0", respectively. The items "not applicable" were not scored and were discounted from the totals. For each task, the scores of the items were summed-up and the total divided by the number of the corresponding items, giving a mean score for the part. These scores were converted into percent scores. The performance was considered adequate if the percent score was 85% or more and inadequate if less than 85% given that patient safety is a critical issue in quality.

3- Health Professional Education in Patient Safety Survey (H-PEPSS): This was used to measure confidence of nurse interns' regarding patient safety based on **Ginsburg, Castel, Tregunno & Norton, (2012).** It included 27 statements grouped under seven sections are :

1. Clinical safety (4 items).
2. Working in teams with other health professionals (6 items).
3. Communicating effectively (3 items).
4. Managing safety risks (3 items).
5. Understanding human and environmental factors (3 items).
6. Recognize, respond to and disclose adverse events and close calls (4 items).
7. Culture of safety (4 items).

Xi'an Shiyou Daxue Xuebao (Ziran Kexue Ban)/
Journal of Xi'an Shiyou University, Natural Sciences Edition
ISSN: 1673-064X
E-Publication: Online Open Access
Vol: 66 Issue 01 | 2023
DOI 10.17605/OSF.IO/Y8AQM

- **Scoring:** The responses from “strongly agree” to “strongly disagree” were scored from 5 to 1, respectively. Reverse scoring was used for negatively stated items, so that a higher score indicates higher level of confidence. The totals of each section and of the total scale were calculated, and the sums of scores were converted into percent scores. For the categorical analysis of each section as well as for the total score of confidence, a score of 80% or higher was considered as high, while a lower score was considered low confidence.

Validity and Reliability of the data collection tools:

- Validity the data collection tools were presented to a panel of experts for face and content validation, the jury panel consisted of five expert’s professors of nursing administration, medical surgical nursing, critical care nursing and emergency, and psychiatric mental health nursing from the faculties - Ain Shams and Cairo Universities. The process involved their general or overall opinions about the forms. Then, they assessed each item for clarity, comprehensiveness, simplicity, understanding, and applicability.
- Reliability of the data collection tools were Patient Safety Knowledge Questionnaire reliability was 0.748 which means acceptable reliability. Observational Checklist for Nurse Interns’ Safety Performance reliability was 0.779, which means acceptable reliability. Health Professional Education in Patient Safety Survey (H-PEPSS) reliability was 0.992, which means good reliability.

Pilot study

A pilot study was conducted at the end of December 2020 .It was done on fourteen nurse interns' representing approximately 10% of the main study sample. The pilot served to assess the clarity and feasibility of the data collection tools. Since no changes were done in the tools; the pilot sample was included in the main study sample.

Fieldwork

The actual fieldwork of the study lasted for nine months from the beginning of January to the end of September 2021. It involved phases of assessment, planning, implementation, and evaluation.

- **Assessment phase:** This phase involved pre-testing of the study nurse interns' knowledge, performance, and confidence using the relevant data collection tools. The researchers visited each of the four hospital included in the study to explain the purpose and nature of the study to the administration and obtain their permission to carry out the study. Then, the researchers met with the nurse interns, oriented them about the study aim and procedures, and invited them to participate. The nurse interns who gave their verbal consent to participate were handed the self-administered questionnaire form to assess their knowledge, and confidence related to patient safety, along with filling instructions. This was done during the morning shift at their training units .The researchers were present during this process to clarify any queries and to prevent any

Xi'an Shiyou Daxue Xuebao (Ziran Kexue Ban)/
Journal of Xi'an Shiyou University, Natural Sciences Edition
ISSN: 1673-064X
E-Publication: Online Open Access
Vol: 66 Issue 01 | 2023
DOI 10.17605/OSF.IO/Y8AQM

knowledge contamination .Every nurse intern took approximately 25-30 minutes to the answer the knowledge questionnaire . The filed forms were handed back to the researchers who checked them for completeness. The nurse interns were then observed individually by the researchers using the observation checklist of patient safety performance .Each nurse intern was observed three times .The period between successive observations was at least two days. The observation lasted 40 to 45minutes for each nurse intern. The average of the three observations was used in the statistical analysis. This process took approximately one month conducted until the end of January 2021.

- **Planning phase:** After completing the data collection in the assessment phase, analysis was done in order to identify all strengths and weaknesses of nurse interns' knowledge, performance, and confidence related to patient safety. It also involved all comments reported and recorded by the researchers. This process took approximately two month conducted until the end of March 2021. Based on the information obtained from analysis of the assessment phase data, the researchers developed the NCRM training program content and booklet. The researchers also used pertinent literature in this process. The NCRM training program was aimed at improving nurse interns' knowledge, skills, and confidence related to patient safety. It consisted of nine sessions; they are preceded by an opening session. The nine sessions were divided into (6) theoretical and (3) practical sessions with total hours (18) for each trained group, two hours per session for 9 sessions were divided into (12) hours for theoretical and (6) hours for practical sessions.

- **Implementation phase:** General objective of this training program aims at preparing the nurse interns to give safe patient care. Teaching methods were used are mini lectures, group discussion, brain storming, real situations, role play, small group activities, and participation in discussion. Media used are handouts, videos and data show for power point presentation. During each training program session the researchers discussed with nurse interns the strong and weak aspects regarding their performance related to patient safety. At the end of the training program each nurse intern was handed with the NCRM training program booklet. Also, after implementing NCRM training program the researchers held many meetings with nurse interns to discuss issues related to their performance ,and answer their questions if any .The group meeting started every day from at 11:00am to 1:00 pm .This phase took one months conducted until the end of April 2021.

- **Evaluation phase:** One month after completion of implementing the NCRM training program, the researchers evaluated the effect of the intervention on nurse interns' knowledge, performance, and confidence related to patient safety. This was done using the same data collection tools and checklist as in the assessment phase. The observations were done three times for each participant, and the average was used in analysis. This phase took one month. For follow up, the same process was repeated three months after the post assessment evaluation, using the same data collection tools and

Xi'an Shiyou Daxue Xuebao (Ziran Kexue Ban)/
Journal of Xi'an Shiyou University, Natural Sciences Edition
ISSN: 1673-064X
E-Publication: Online Open Access
Vol: 66 Issue 01 | 2023
DOI 10.17605/OSF.IO/Y8AQM

checklist. This phase took one month .The researchers collected the data four days/week some days lasted from 10:00 am to 1:00 pm, while other days lasted from 3:00pm to 7:00pm.

Administrative design

Before any attempt to collect data, official permissions to conduct the study were obtained from hospital directors through letters from the Dean of the Faculty of Nursing, Ain Shams University.

The researchers met with the Directors of the four hospitals, and explained to them the purpose of the study to obtain their help and cooperation during the study.

Ethical considerations

Prior to the actual work of research study, the study protocol was approved by the ethics committee of the Faculty of Nursing, Ain Shams University. The aim of the study and its procedures were explained to all study participants and their verbal informed consent was obtained.

They were reassured that any obtained information would be confidential, and used only for the purpose of research. The study maneuvers had no actual or potential harms on participants. The study beneficence was clear in the improvement of performance of nurse interns, which would be reflected positively on their settings.

Statistical design

Data entry and statistical analysis were done using SPSS 20.0 statistical software package. Data were presented using descriptive statistics in the form of frequencies and percentages for qualitative variables, and means and standard deviations and medians for quantitative variables.

Cronbach alpha coefficient was calculated to assess the reliability of the scales used through their internal consistency. Qualitative categorical variables were compared using chi-square test.

Whenever the expected values in one or more of the cells in a 2x2 tables was less than 5, Fisher exact test was used instead. In larger than 2x2 cross-tables, no test could be applied whenever the expected value in 10% or more of the cells was less than 5. Spearman rank correlation was used for assessment of the inter-relationships among quantitative variables and ranked ones.

In order to identify the independent predictors of the scores of knowledge, attitude, performance, and confidence, multiple linear regression analysis was used. Statistical significance was considered at p-value <0.05.

Xi'an Shiyou Daxue Xuebao (Ziran Kexue Ban)/
Journal of Xi'an Shiyou University, Natural Sciences Edition
ISSN: 1673-064X
E-Publication: Online Open Access
Vol: 66 Issue 01 | 2023
DOI 10.17605/OSF.IO/Y8AQM

RESULTS

- **Table 1**: Demonstrates that, the study sample included 139 nurse interns who's age ranged between 21 and 27 years, with median 23.0 years, with a slightly more than half of them were females (57. 6%). The great majority had Egypt nationality (89.9%) and secondary pre-university education (82.0%). The highest percentage had their training was in ICUs (64.0%), and their duration of training in the hospital was 2 months (74.8%).Also, all study sample trained 36 hours weekly And none of them at all receive any training regarding patient safety or NCRM training program.

- **Table 2**: Shows that, at the pre-intervention phase, nurse interns' knowledge related to patient safety was low with only (19.4%) of them having satisfactory knowledge for the evidence based practice. On the other hand, the highest percentage of adequate knowledge was for the last of non-technical skills (59. 0%).Statistically significant improvement were revealed at the post intervention phase in all aspects (P <0. 001).The follow-up phase had some declines in nurse interns' knowledge related to patient safety in some aspects such as medical errors and fall protection, but the levels remained significantly higher compared with the pre-intervention levels (P <0.001).

- **Figure 1:** Demonstrate that, none of the nurse interns' (0.00%) had adequate performance at the pre-intervention phase. This rose to 97.80 at the post- intervention phase, and declined to 34.50 at follow up phase. The differences were statistically significant (P <0.001).

- **Table 3:** Illustrates that, at the pre-intervention phase, nurse interns' confidence related to patient safety was (69.1%) of them having high confidence on the clinical safety section, while the highest percentage of confidence related to patient safety was for (78.4%) for work in team and communicate effectively section. Statistically significant improvement were revealed at the post-intervention phase in all areas (P <0.001). The follow-up phase had some declines in nurse interns' confidence related to patient safety in some areas, but the levels remained significantly higher compared with the pre-intervention levels (P <0.001).

- **Table 4:** Displays statistically significant moderate positive correlation between knowledge and performance (r = 0.655), knowledge and confidence (r = 0.490), performance and confidence (r = 0.555), performance and internship months (r = 0.436), confidence and internship months (r = 0.427) .Meanwhile statistically significant week positive correlation between knowledge and internship months (r = 0.396).

- **Table 5:** Demonstrates that, the statistically significant independent positive predictors of nurse interns' confidence score were the study intervention, training in pediatric hospital, internship months, knowledge score, and performance score, the model explain 61% of the variation in the confidence score.

Xi'an Shiyou Daxue Xuebao (Ziran Kexue Ban)/
Journal of Xi'an Shiyou University, Natural Sciences Edition
ISSN: 1673-064X
E-Publication: Online Open Access
Vol: 66 Issue 01 | 2023
DOI 10.17605/OSF.IO/Y8AQM

Table 1: Personal data of nurse interns in the study sample (n=139)

	Frequency	**Percent**
Age:		
<24	101	72.7
24+	38	27.3
Range	21-27	
Mean±SD	23.3±1.1	
Median	23.0	
Gender:		
Male	59	42.4
Female	80	57.6
Nationality:		
Egyptian	125	89.9
Non-Egyptian	14	10.1
Pre-university education:		
General secondary	114	82.0
Nursing	25	18.0
Hospital:		
Ain-Shams University	50	36.0
Cardiovascular	34	24.5
El-Demerdash	30	21.6
Pediatrics	25	18.0
Unit:		
ICU	89	64.0
OR	29	20.9
Kidney	10	7.2
PICU	11	7.9
Training months:		
1	34	24.5
2	104	74.8
3	1	0.7
Training hours per week: 36	139	100
Attend any training regarding patient safety	0	0
Attend any training regarding Nursing Crew Resource Management	0	0

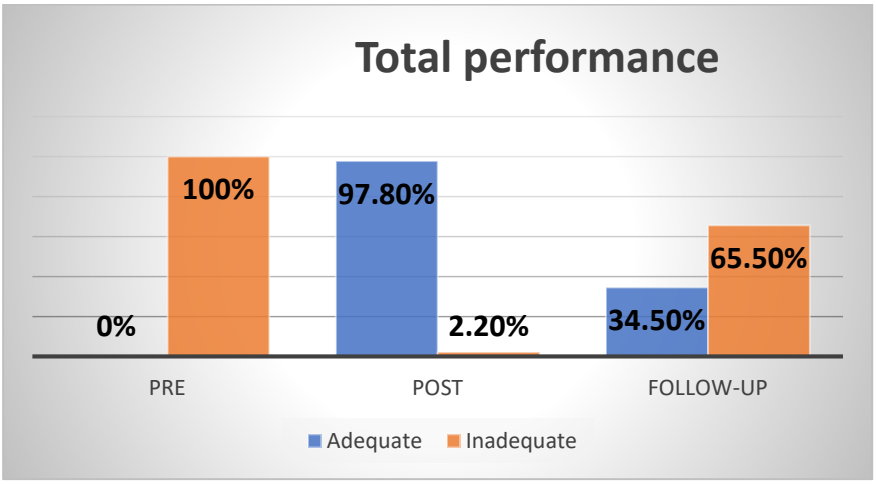
Xi'an Shiyou Daxue Xuebao (Ziran Kexue Ban)/
Journal of Xi'an Shiyou University, Natural Sciences Edition
ISSN: 1673-064X
E-Publication: Online Open Access
Vol: 66 Issue 01 | 2023
DOI 10.17605/OSF.IO/Y8AQM

Table 2: Nurse interns' knowledge of patient safety throughout intervention phases

Satisfactory Knowledge (60%+)	Time						X^2 (pre-post) (p-value)	X^2 (pre-FU) (p-value)
	Pre (n=139)		Post (n=139)		FU (n=139)			
	No.	%	No.	%	No.	%		
Evidence-based practice	27	19.4	107	77.0	68	48.9	92.21 (<0.001*)	26.88 (<0.001*)
Patient safety	77	55.4	115	82.7	65	46.8	24.31 (<0.001*)	2.07 (0.15)
Patient identification	72	51.8	117	84.2	95	68.3	33.47 (<0.001*)	7.93 (0.005*)
Medical errors	45	32.4	105	75.5	56	40.3	52.13 (<0.001*)	1.88 (0.17)
Communication among caregivers	40	28.8	117	84.2	77	55.4	86.76 (<0.001*)	20.20 (<0.001*)
Safe medication administration	48	34.5	115	82.7	72	51.8	66.57 (<0.001*)	8.45 (0.004*)
Safe surgery	67	48.2	121	87.1	87	62.6	47.91 (<0.001*)	5.82 (0.02*)
Prevention of HCI	81	58.3	115	82.7	62	44.6	20.00 (<0.001*)	5.20 (0.02*)
Fall protection	71	51.1	119	85.6	88	63.3	38.31 (<0.001*)	4.25 (0.03*)
Patient safety culture	26	18.7	112	80.6	116	83.5	106.42 (<0.001*)	116.60 (<0.001*)
Non-technical skills	82	59.0	112	80.6	114	82.0	15.35 (<0.001*)	17.71 (<0.001*)
Total knowledge:								
Satisfactory (60%+)	9	6.5	104	74.8	52	37.4	134.56	38.83
Unsatisfactory (<60%)	130	93.5	35	25.2	87	62.6	(<0.001*)	(<0.001*)

(*) Statistically significant at p<0.05

Figure (1) Distribution of nurses interns according to their total performance (pre, post, and follow up" (n=139)



Xi'an Shiyou Daxue Xuebao (Ziran Kexue Ban)/
Journal of Xi'an Shiyou University, Natural Sciences Edition
ISSN: 1673-064X
E-Publication: Online Open Access
Vol: 66 Issue 01 | 2023
DOI 10.17605/OSF.IO/Y8AQM

Table 3: Nurse interns' confidence related to patient safety throughout intervention phases

High (70%+) confidence:	Time						X^2 (pre-post) (p-value)	X^2(pre-FU) (p-value)
	Pre (n=139)		Post (n=139)		FU (n=139)			
	No.	%	No.	%	No.	%		
Clinical safety	96	69.1	119	85.6	105	75.5	85.45 (<0.001*)	55.54 (<0.001*)
Work in teams	109	78.4	125	89.9	94	67.6	131.60 (<0.001*)	59.63 (<0.001*)
Communicate effectively	109	78.4	119	85.6	104	74.8	114.56 (<0.001*)	78.89 (<0.001*)
Manage safety risks	101	72.7	121	87.1	102	73.4	101.22 (<0.001*)	58.91 (<0.001*)
Understand human/ environmental factors	107	77.0	123	88.5	105	75.5	120.75 (<0.001*)	76.69 (<0.001*)
Recognize/respond/ disclose adverse events	102	73.4	122	87.8	103	74.1	106.15 (<0.001*)	62.68 (<0.001*)
Culture of safety	106	76.3	122	87.8	108	77.7	115.50 (<0.001*)	80.95 (<0.001*)
Total confidence:								
High	35	25.2	120	86.3	102	73.4	105.4	64.6
Low	104	74.8	19	13.7	37	26.6	(<0.001*)	(<0.001*)

(*) Statistically significant at p<0.05

Table 4: Correlation matrix of nurse interns' scores of overall knowledge, performance, and confidence, and with their age and internship months

	Spearman's rank correlation coefficient		
	Knowledge	**Performance**	**Confidence**
Knowledge	1.000		
Performance	.655**	1.000	
Confidence	.490**	.555**	1.000
Age	-.048	-.028	.007
Internship months	.396**	.436**	.427**

(**) Statistically significant at p<0.01

Table 5: Best fitting multiple linear regression model for the confidence score

	Unstandardized Coefficients		Standardized Coefficients	t-test	p-value	95% Confidence Interval for B	
	B	Std. Error				Lower	Upper
Constant	-68.17	10.22		-6.671	<0.001	-88.26	-48.09
Intervention	3.89	0.90	0.15	4.299	<0.001	2.11	5.66
Pediatrics hospital	2.13	0.59	0.11	3.595	<0.001	0.97	3.30
Internship months	6.19	1.93	0.12	3.214	0.001	2.40	9.98
Knowledge score	0.18	0.04	0.22	4.112	<0.001	0.10	0.27
Performance score	0.11	0.05	0.09	2.088	0.037	0.01	0.22

r-square=0.61 Model ANOVA: F=1062.17, p<0.001

Variables entered and excluded: age, gender, nationality, pre-university education, unit

Xi'an Shiyou Daxue Xuebao (Ziran Kexue Ban)/
Journal of Xi'an Shiyou University, Natural Sciences Edition
ISSN: 1673-064X
E-Publication: Online Open Access
Vol: 66 Issue 01 | 2023
DOI 10.17605/OSF.IO/Y8AQM

DISCUSSION

CRM is a training program of error management that originated in the aviation industry. Originally known as cockpit resource management, since its origination in the aviation industry, CRM has been applied to many other professions. Among these applications are various aspects of healthcare. The implementation of CRM training in the healthcare industry is young but shows great potential **(Zurman, Hoffmann & Ruff-Stahl, 2019).**NCRM is a nursing focused version of CRM which has been found to decrease errors and improve safety practices, aimed to managing errors **(Donaway, 2016).**

Current study results revealed the statistically significant improvement at all patient safety knowledge aspects from pre to post intervention phase. This may due to those undergraduate curricula contain little information "knowledge" related to patient safety. In this respect, **Mohamed (2018)** study conducted in Ain-Shams University hospitals demonstrated statistically significant improvements of nurse interns' patient safety knowledge from pre to post intervention phase especially in patient identification, communication among caregivers, safe medication administration, prevention of health care infection, and fall protection, all of the previous knowledge aspects involved in the current study findings.

Regarding nurse interns' total performance of patient safety tasks, the current study findings revealed that there was none of the nurse interns had adequate performance at the pre-intervention phase. However, majority of patient safety skills demonstrated statistically significant improvement at the post-intervention phase, with declines at the follow-up phase but still higher compared with the pre intervention levels. The differences were statistically significant. It is worth nothing that during the application of the NCRM training program, the whole world was suffering from the Covid-19 pandemic and therefor nurse interns' were committed to both patient safety as well as their personal safety such as follow measures to prevent any health care acquired infection. On the same line, **Rarang (2015)** study conducted in Capella University demonstrated low nursing students' performance related to patient safety at the pre-intervention phase. Then becoming skilled in patient safety and improving technical skills at post -intervention phase.

The present study results addressed statistically significant improvement were revealed at the post-intervention phase in all sections of nurse interns' confidence related to patient safety. The follow-up phase had some declines in some sections, but the levels remained significantly higher compared with the pre-intervention levels. About the first section is clinical safety, the current study results demonstrated the lowest section level of nurse interns' confidence related to patient safety at pre and post intervention phase. This can be explained by nurse interns consider tasks such as safe medication &equipment practice and safe clinical practice are basics for health care providers who are directly and officially responsible for the patient care. Conversely, other study in Las Vegas demonstrated the clinical safety as the highest level section of confidence of nursing students at pre- and post-intervention phases **(Donaway, 2016).**

Concerning the second section is working in teams ,the current study findings revealed that

Xi'an Shiyou Daxue Xuebao (Ziran Kexue Ban)/
Journal of Xi'an Shiyou University, Natural Sciences Edition
ISSN: 1673-064X
E-Publication: Online Open Access
Vol: 66 Issue 01 | 2023
DOI 10.17605/OSF.IO/Y8AQM

majority of them have high level towards working in teams with other health professionals at post-intervention study phase. This is explained by NCRM training program included theory and role play session about teamwork, so it was reflectd directly on level towards working in teams with other health professionals at post-intervention study phase. These findings offer additional support to the study conducted by **West et al. (2012)** who found an increase in perceived teamwork abilities in nurses after receiving CRM training. Also, **Berry et al.(2016)** reported significant decreases in serious safety events, hospital mortality and hospital harm along with improved teamwork after the implementation of a hospital wide patient safety program.

As regards third section is communicating effectively, the current study findings revealed that high percentage of nurse interns have high level to communicate effectively at three study phases. NCRM training program included session about communication, so it was reflect directly on level towards communication at post-intervention study phase, and communication is very valued between all personnel in health care team and considered as vital part for continuity health care delivery. .In this respect, study conducted by **Chan et al. (2016**) identified positive links between CRM training and improvements in communication skills

For fourth section is managing safety risks, the current study findings revealed a statistically significant improvement at post-intervention phase. The follow-up phase had some decline but this level remained higher than pre-intervention phase. This may due to nurses' frequently work in erratic environments where they must make decisions quickly and where their clinical judgments and decisions directly impact the health and safety of the patients they care for. Also, consistent with those **Donaway (2016)** demonstrated positive findings indicate that the NCRM training did positively influence the confidence of student nurses regarding managing safety risks.

For fifth section is understanding human & environment factors, the results showed significant improvement from pre- to post-intervention phase. This is can be due to the numerous benefits of teamwork in hospital and incorporating communication skills into training and cooperation, and indeed this was covered during the program sessions and therefore reflected on the level of understanding human & environment factors and the difference happened from pre- to post-intervention phase. In this respect, study conducted by **Roth, Brewer,and Wieck (2016)** a study in order to rank the top ten human& environment factors associated with patient safety errors. The top three human factors on the researchers list were all factors that were included in NCRM training are fatigue, large workloads and communication problems confirming the importance of this category in NCRM training.

Also, for sixth section is recognizing, respond to and disclose adverse events and close calls section, the current study result demonstrated statistically significant improvement at post-intervention phase. The follow up phase had some decline; but this level remained higher than pre-intervention phase. There is an increasing top management emphasize on using Occurrence Variance Report (OVR), and incident report by all staff in university

Xi'an Shiyou Daxue Xuebao (Ziran Kexue Ban)/
Journal of Xi'an Shiyou University, Natural Sciences Edition
ISSN: 1673-064X
E-Publication: Online Open Access
Vol: 66 Issue 01 | 2023
DOI 10.17605/OSF.IO/Y8AQM

hospitals. On the same line, **Lukewich et al.(2015)** released the results of a study on baccalaureate nursing students in which they evaluated the student's confidence about learning patient safety .This finding supports the need for new and additional training techniques such as NCRM for senior students to ensure that new graduates are confident in their abilities to recognize and respond appropriately to adverse events.

For seventh and final section of confidence related to patient safety is culture of safety, the present study findings indicated a statistically significant improvement at post-intervention phase. The follow up phase had some decline; but this level remained higher than pre-intervention phase. In this regard literature emphasize culture of safety requires a full commitment to safety from all members of an organization including practitioners and leaders, and four elements that are key to a strong culture of safety are acknowledgment of the high-risk nature of an organization's activities and the determination to achieve consistently safe operations, a blame-free environment where individuals are able to report errors or near misses without fear of reprimand or punishment, encouragement of collaboration across ranks and disciplines to seek solutions to patient safety problems, and organizational commitment of resources to address safety concerns **(Safety culture, 2016).**

Finally, in multivariate analysis, identified the current study intervention as positive predictor of the confidence score. This is certainly due to the positive effect of the intervention on nurse interns' knowledge, performance, and confidence related to patient safety. Therefore, the findings confirm the success of the NCRM training program in improving nurse interns' confidence related to patient safety. The current study findings demonstrated that the adequacy of nurse interns' performance of patient safety was sustained through the follow-up phase. This indicates that it became deeply rooted in their practice, which reflects nurse interns become a high confident and knowledgeable related to patient safety. This result is supported by **Donaway (2016)** who identified that NCRM training does positively impact student nurses' confidence related to patient safety.

CONCLUSION

The study findings lead to the conclusion that the nurse interns in the study settings have unsatisfactory knowledge, inadequate performance, and low confidence related to patient safety at pre intervention phase. The use of the developed NCRM training program is effective in improving their knowledge, performance, and confidence related to patient safety. These predictors were intervention, pediatric training hospital, internship months, knowledge score, and performance score as presented by best fitting multiple linear regression model. Thus, the set research hypothesis can be accepted and the NCRM training program can be used for this purpose.

Xi'an Shiyou Daxue Xuebao (Ziran Kexue Ban)/
Journal of Xi'an Shiyou University, Natural Sciences Edition
ISSN: 1673-064X
E-Publication: Online Open Access
Vol: 66 Issue 01 | 2023
DOI 10.17605/OSF.IO/Y8AQM

Recommendations

- Implementing NCRM training program is highly recommended for nurses to improve knowledge, performance, and confidence related to patient safety.
- The hospital administration should encourage the application of patient safety procedures and measures to improve nurse's safety performance.
- Patient safety tasks must be an integral part of the orientation and ongoing on-job educational activities to all nursing staff in hospitals.
- Close and continuing supervision of the application of patient safety tasks is recommended in all settings, to enhance the development of patient safety culture among nurses.

References

- **Aldeeb .G., Abdelaziz. D., & Elnagar. A, (2016):** Perceptions of Role Transition among Nursing Interns at Tanta University, (5), (5), PP 16-22.
- **Aubeeluck, A., Stacey, G., & Stupple, E. J. N. (2016):** Do graduate entry nursing student's experience 'imposter phenomenon'?: An issue for debate. Nurse Education in Practice,19, 104-106. doi:10.1016/j.nepr.2016.06.003.
- **Berry, J. C., Davis, J. T., Bartman, T., Hafer, C. C., Lieb, L. M., Khan, N., & Brilli, R. J. (2016):**Improved safety culture and teamwork climate are associated with decreases in patient harm and hospital mortality across a hospital system. Journal of Patient Safety, 1.doi:10.1097/PTS.0000000000000251.
- **Chan, C. K. W., So, H., Ng, W., Chan, P., Ma, W., Chan, K., Ho, L. (2016):** Does classroombased crew resource management training have an effect on attitudes between doctors and nurses? International Journal of Medical Education, 7, 109.
- **Donaway,D,M.(2016):** The Impact of crew resource management training on Patient Safety Self-Efficacy of Nursing Students, Doctor of Philosophy - Nursing University of Nevada, Las Vegas,pp1-9.
- **Gallagher, D. (2016):** Crew resource management. following up. Nursing Management, 47(7),50.
- **Ginsburg, L., Castel, E., Tregunno, D., & Norton, P. G. (2012):** The H-PEPSS: An instrument to measure health professionals' perceptions of patient safety competence at entry into practice. Quality and Safety in Health Care.
- **Gross b., et al .(2019) :** Crew resource management training in healthcare: a systematic review of intervention design, training conditions and evaluation .BMJ Open 2019;9:e02524.
- **Huang ., et al.(2020):** Self-reported confidence in patient safety competencies among Chinese nursingstudents: a multi-site cross-sectional survey . BMC Medical Education (2020) 20:32.
- **Kershaw M.E.(2019):** The Relationship Between Nursing-Faculty Incivility and New-Graduate-Nurse Self-Confidence During Transition to Practice: A Correlational Study. Doctor of Education inHigher Education. Concordia University–Portland.PP 10-27.
- **Lee S.E., et al.(2020):** Assessment of Patient Safety and Cultural Competencies among Senior Baccalaureate Nursing Students. nt. J. Environ. Res. Public Health2020,17, 4225.
- **Lukewich, J., Edge, D. S., Tranmer, J., Raymond, J., Miron, J., Ginsburg, L., & VanDenKerkhof, E. (2015):** Undergraduate baccalaureate nursing students' self-reported confidence in learning about

ISSN: 1673-064X
E-Publication: Online Open Access
Vol: 66 Issue 01 | 2023
DOI 10.17605/OSF.IO/Y8AQM

patient safety in the classroom and clinical settings: An annual crosssectional study (2010-2013). International Journal of Nursing Studies, 52(5), 930.doi:10.1016/j.ijnurstu.2015.01.010.

- **Macedo, L.L., Silva ,A.M.R., Silva, J.F., Mdcfl, H., &Girotto, E. (2020):** The culture regarding the safety of the patient in primary health care: distinctionsamong professional categories. Trab Educ Saúde Rio de Janeiro. 2020;18(1).
- **Mohamed L.A.A. (2018):** self-learning package related to patient safety goals and its effect on nurse interns' performance and awareness of patient safety culture. Unpublished Doctorate Thesis, Faculty of Nursing, Ain Shams University.
- **Rarang S.A.(2015):** Measuring Beginning Nursing Students' Knowledage, Skills , and Attitudes Towards Patient Safety: A Study of the Effects of Scenario-Based High-Fidelity Simulation. Doctor of Philosophy. Capella University.PP127-133.
- **Rosner B. (2011):** Fundamentals of Biostatistics. 7th ed. Boston, MA: Brooks/Cole; 2011. Kane SP. Sample Size Calculator. ClinCalc: https://clincalc.com/stats/SampleSize.aspx. Updated July 24, 2019. Accessed September 18, 2020.
- **Roth, C., Brewer, M., & Wieck, K. L. (2016):** Using a delphi method to identify human factors contributing to nursing errors: Human factors. Nursing Forum, doi:10.1111/nuf.12178.
- **Safety culture. (2016):** Retrieved from https://psnet.ahrq.gov/primers/primer/5/safetyculture.
- **Santos, P.V.M., Mendes, P.M., Abreu, I.M., Sá ,A.G.S., Ramos ,J.V.,& Avelino ,F.V. (2019):** Nurses'knowledge about adverse events and the challenges of reportingthese events. Cogitare Enferm. 2019;89(27):01–8.
- **Souza ,M.M., et al. (2019):** Patient safety culture in the primary health care. Rev BrasEnferm. 2019;72(1):27–34.
- **Vasconcelos PF, de Freitas CHA, Jorge MSB, et al. (2019):** Safety attributes in primarycare: understanding the needs of patients, health professionals, andmanagers. Public Health. 2019;171:31–40.
- **West, P., Sculli, G., Fore, A., Okam, N., Dunlap, C., Neily, J., & Mills, P. (2012):** Improving patient safety and optimizing nursing teamwork using crew resource management techniques. Journal of Nursing Administration, 42(1), 15-20. doi:10.1097/NNA.0b013e31823c17c7.
- **World Health Organization [WHO], (2020):** WHO Patient Safety delivers a number of programmes covering safety and quality of care" was held at the 69th World Health Assembly on 25 May.
- **Zurman C., Hoffmann H. O., and Ruff-Stahl H. K. (2019):** Difference in attitudes toward Crew Resource Management based on nationality. International Journal of Aviation, Aeronautics, and Aerospace, 6(4).