

▪ **Basic Research**

External Ventricular Drain: Effect of a Nursing Development Competency Program on Nurses' Knowledge and Practices

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Abstract

Background: External Ventricular Drain (EVD) care is considered a complex and advanced nursing specialty for patients with neurological conditions. Ongoing education and training are crucial in order to guarantee that nurses remain updated on the most recent developments in patient care and maintain the necessary competencies. **Aim:** Determine the effect of a nursing development competency program on nurses' knowledge and practices regarding external ventricular drain. **Methods:** A quasi-experimental design was used in this study with a convenient sample of 50 nurses. The study was conducted at the neurosurgery departments at Mansoura University Hospital, Mansoura, Egypt. Two tools were used for data collection; Tool I Self- administered Questionnaire for nurses about EVD; Part 1 Demographic characteristics, Part 2 Knowledge Questionnaire regarding EVD and Tool II Competency Observation Checklist for nursing practices regarding EVD. **Results:** There were significant differences of nurses' overall knowledge between preprogram period with both immediate and three months periods post program ($p= 0.041^*$ & 0.019^* , respectively). Also, there were significant differences of nurses' practices between pre-program period with both immediate and three months periods post program ($p= 0.014^*$ & 0.050^* , respectively). **Conclusions:** The nursing development competency program has a positive effect on the nurses' levels of knowledge and practices regarding external ventricular drain. **Recommendations:** Development of educational guidelines that are rooted in evidence-based nursing practices to promote high-quality nursing care and ensure excellence in the context of external ventricular drain (EVD) nursing care.

Key words: External Ventricular Drain, Practices, Nurses' Knowledge, Nursing Competency Program.

1. Introduction

The external ventricular drain (EVD) is a medical technology that serves both diagnostic and therapeutic purposes. It is widely recognized as the preferred method for treating certain neurological conditions characterized by intracranial hypertension (ICH), such as hydrocephalus, intracranial hemorrhage, tumors, meningitis, or traumatic brain injury. By facilitating continuous monitoring and effectively reducing intracranial pressure (ICP), the EVD enables drug delivery, blood or cerebrospinal fluid (CSF) drainage, and CSF collection samples when required (**Shay et al, 2021**).

External ventricular drains (EVDs) are frequently employed to aid in the extraction of cerebrospinal fluid (CSF) in individuals experiencing neurological impairment. Over the past few decades, the utilization of EVD catheters combined with intracranial pressure (ICP) monitoring has seen a notable rise. This monitoring technique enables the recording of ICP values and waveform patterns while maintaining continuous CSF drainage (**Chau et al., 2019**). Earlier research has advocated for the implementation of EVD management and ICP monitoring based on a set of guidelines and consensus recommendations (**Gu et al, 2020**).

External ventricular drain is contraindicated in patients who have a coagulation disorder, receive anticoagulant medication, or have a disease on their scalp or localized abscesses. This precaution is due to the significant risk of central nervous system infections, such as meningitis and ventriculitis (**Sweet & Foley, 2019**).

Patients undergoing EVD may encounter various complications that can impact their well-being. These include the possibility of infection, which can be recognized by symptoms such as elevated body temperature, redness, or the discharge of fluid or secretion. System obstruction may be observed when the drainage of cerebrospinal fluid (CSF) falls below the expected minimum level or when the CSF waveform appears flat on the monitoring device. Another potential complication is excessive CSF drainage. Furthermore, EVD can result in bleeding, problems with the ventricles, or unintentional catheter removal, requiring neurosurgical interference (**Kato, 2021**).

Given the high demand on information and technological resources, nurses must be qualified to ensure patient safety and make more assertive decisions. For this reason, it is imperative that these nurses possess the necessary knowledge and abilities to provide assistance. The purpose of training has evolved to encompass professional development, acquiring knowledge, and the teaching and practicing of new skills. The EVD system must be correctly levelled and closed to CSF drainage for an appropriate amount of time to provide a precise ICP reading, which is required to assess the brain's health (**Liu et al, 2020**).

Nurses who are competent in the assessment and care of patients with both neurological and drain conditions should keep a close eye on patients who need an EVD. Monitoring for symptoms and signs connected to changing ICP should be part of the patient assessment process. The registered nurse should conduct and record neurological examinations on an hourly basis. This includes measuring the mean ICP, CSF drainage, color, and clarity (**Kumar et al, 2021**).

For patients with EVD, nurses are responsible of catheter and system care. In addition to preventing potential consequences, assessment, prevention, control, and identification of risk situations that may arise with the EVD system are taken into consideration. At least once every four hours, the drainage system should be assessed. This involves looking for fluid leaks from the insertion site and examining for cracks in the drainage system as well as the EVD from the insertion site along the whole drainage system (**Alrashidi et al., 2023**).

Significance of the study:

It is crucial to associate nursing interventions that support the maintenance of an appropriate therapeutic environment with the variety of care approaches associated with patients undergoing EVD. The multidisciplinary team, particularly the nursing staff, plays an important role for providing patients care. In order to reduce nosocomial infection rates and, in turn, death rates or length of stay in critical care beds, it is necessary to continuously attempt to meet standards of nursing practice (**Sakamoto et al, 2021**).

Neurosurgical patients are more vulnerable to infections related to medical care due to their requirement for surgically inserted devices like ventriculostomies and their extended hospital stays. Introduction of a foreign device can result in infection due to insertion technique as well as post-insertion management. Establishing protocols of ventriculostomy drain management tools to raise nurse awareness and adherence to the most recent standards of care may greatly lower the risk of health care-associated infection in the neurosurgical population (**Van der Jagt & Short, 2021**).

Nursing competency has significance for nursing practice because it directly affects patients' health and safety, whereas lacking competency may have detrimental medical effects. Although applying competency is still not fully reached in nursing practice, it enhances nurses' proficiency and independent work while protecting their integrity and promoting safe care (**Mrayyan, et al., 2023**). Thus, continuing nursing education is essential for nurses managing patients with an EVD in order to keep up to date knowledge and to build nursing competency (**Kumar et al., 2021**).

Aim of the study:

The aim of this study was to determine the effect of a nursing development competency program on nurses' knowledge and practices regarding external ventricular drainage.

Research hypothesis:

- Implementing of a nursing development competency program would affect positively on nurses' knowledge and practices regarding external ventricular drain compared with pre-program scores.

Definition of the Variable:**Theoretical Definition of Nursing Competency**

Nursing competency includes core skills necessary to perform one's job well as a nurse. Competency is a behavioral trait that is learned from experience and education, and it is determined by an individual's drive, attitude, and interests as well as experiences. Additionally, it is a desirable behavioral quality that probably results in success (**El-Sayed, 2021**).

Operational Definition of Nursing Development Competency Program

The nursing development competency program encompasses a predetermined set of objectives to acquire knowledge and competent practice in managing external ventricular drains. Following the implementation of this program, nurses are expected to utilize their newly acquired knowledge and practical skills to provide care for patients with external ventricular drains. To ensure the provision of safe and competent nursing care to patients, it is crucial for skilled nurses to possess both motivation and the ability to effectively apply their practice.

2. Methods

Study design: A quasi-experimental (one group, pre & post-test) research design was used in this study. An empirical research that assesses the causal impact of an intervention on its target population is known as a quasi-experimental design (**Gopalan, Rosinger & Ahn, 2020**).

2.1 Setting:

The study was conducted at the neurosurgery departments at Mansoura University Hospital, Mansoura, Egypt. There are two neurosurgery departments which are located on the first floor at the Main Mansoura University Hospital building. Department (1) for females and department (4) for males. Department (4) contains an intermediate care unit.

2.2. Subjects:

A convenient sample of all nurses who were working at the above-mentioned setting, irrespective of their years of experience and age were recruited in the study.

2.3. Sample size and technique

The study included 55 nurses who represent all nurses working in the above setting. After adjustment for a dropout 10% for the pilot study, the sample size was 50 nurses.

2.4. Tools for data collection:

The data were collected through the following tools:

Tool I: Self-administered Questionnaire for nurses about EVD

This tool was developed and consisted of two parts:

Part 1: Demographic characteristics was used to assess nurses' demographic characteristics. This included (age, gender, qualifications, period of experience, marital status and attending training courses). It was composed of (6) closed ended questions.

Part 2: Knowledge Questionnaire regarding EVD was adopted from **McDaniel, (2014)** to assess nurses' knowledge about external ventricular drain. This part was composed of (13) main questions including definition, indications, contraindications, complications and management of external ventricular drain

The questionnaire items were used as the basis for a scoring system, and the key response that the researcher had created was used to assess the respondents' (nurses') responses. Every correct response received a point, while every wrong response received a zero. Knowledge items that had a "Yes" response was given a score of one, while those that received a "No" response was given a score of zero. A total of 29 points were awarded for all questions pertaining to the nurse's knowledge. After summing the scores and converting them into a percentage score, the overall scoring scheme was categorized as follows based on **Ahmed & Ali, (2023)** cut off point.

- Satisfactory level of knowledge ($\geq 85\%$) means (≥ 24.6 points)
- Unsatisfactory level of knowledge ($<85\%$) means (<24.6 points)

Tool II: Competency Observation Checklist for nursing practices regarding EVD

It was adopted from **Jung, & Yi, (2016)** to assess the nurses' practices regarding external ventricular drain as follows; levelling the EVD system (4 steps), dressing changes (27 steps), EVD

removal (7 steps), obligatory checks (7 steps), hourly documentation (7 steps), and ICP monitoring (2 steps), CSF Sampling (2 steps) and ICP documentation (2 steps).

Scoring system:

A scoring system was graded as follows: done correctly = (1) and not done = (0). Total correct score of all practices were 58 grades. Total score represented 100%. Total score of all practices was summated and distributed the cut-off score of adequate practice according **Ahmed & Ali, (2023)**.

- Competent level of practice ($\geq 85\%$) means (≥ 49.3 points)
- Incompetent level of practice ($< 85\%$) means (< 49.3 points)

2.5. Validity and reliability:

Tools content validity was ascertained by 5 professors; four professors in medical surgical nursing from Mansoura University and Benha University, and one professor of neurosurgery at Mansoura University to check the relevancy, clarity, comprehensiveness, and applicability of the questions and minor modifications were done.

The internal consistency of the developed tools was measured using the Cronbach's Alpha test, which was used to estimate their reliability. The Cronbach's alpha test was used to assess the reliability of the knowledge questionnaire and observational checklists. The results of the test showed that (0.908) and (0.913) respectively.

2.6. Pilot study:

To assess the applicability and clarity of the data collecting methods, a pilot study including five nurses (10%) of the study subjects, was conducted. Nurses involved in the pilot study were excluded from the total study subjects.

2.7. Field work:

This study's fieldwork was actually conducted at the start of May 2023 to the end of November 2023. The study comprised the following phases:

Preparatory phase

Preparatory phase started from the beginning of May 2023 to the beginning of June 2023, (a period of one months). It included developing data collection tools and the nursing development competency program based on the review of related literature. The study tools were subjected to translation from English to a simple Arabic language. The selection of the sample was based on the predefined study criteria as determined by the researchers. Based on recent literature, the researchers created the nursing competency program in Arabic language to offer the nurses information regarding external ventricular drain in a straightforward manner using basic language and supplemented by photos for more illustration, then the experts' opinions validated the validity of the program.

Implementation phase

The implementation phase commenced at the start of June 2023 to the end of July 2023 in period of two months three times a week (Saturday, Tuesday and Thursday) including pre nursing program and program implementation.

Initially, before beginning to gather the necessary data, each nurse was interviewed, given a thorough explanation of the study's background and objectives, and given a chance to ask questions.

Pre-program data was collected by researcher from each participant, the interviewing questionnaire (Tool I) was completed by the nurses in 15 to 20 minutes, while the researchers checked each observational checklist (Tool II) during actual nursing care in 10 to 15 minutes each procedure.

The nursing development competency program was carried out over 5 weeks, and comprised of four sessions. Each studied nurse received two theoretical sessions which was conducted through lectures and group discussions, and two practical sessions through audio visual demonstration and re-demonstration delivered to the participants. The first session was theoretical which covered the educational objectives of the program and general knowledge about EVD, including its definition, indications, and contraindications. The second session involved theoretical information about preparation of the patient before EVD, how it is placed, duration, removal of EVD, side effects of EVD, medical and nursing measures to prevent infection.

The third session was practical and involved nursing practices regarding mandatory check of EVD, EVD system levelling, hourly documentation, and changing dressing. Finally, the fourth session included nursing practices regarding monitoring of ICP, CSF Sampling, ICP documentation and removal of EVD. These educational sessions were done in groups, two groups in the same day from both departments during morning and evening shift. Each group composed of 5-10 nurses based on the number of nurses in each department. Each session lasted about 30-45 minutes with a discussion throughout the session and summary was done at the end of each session.

Evaluation phase

Post program evaluation was applied two times to each nurse (immediately post program and three months post program). This phase began from the end of July 2023 to the end of November 2023. The researchers evaluated nurses' knowledge using Tool I, part 2 and nurses' practices using Tool III.

2.8 . Ethical Considerations:

An ethical approval was obtained from the Research Ethical Committee of the Faculty of Nursing, Mansoura University, Egypt (**Ref. No. P.0462**). In addition, an informed consent was obtained from each participant prior to data collection. The researchers informed the participants that their participation was entirely optional. Throughout the whole study, anonymity, privacy, safety, and secrecy were guaranteed. Participants might withdraw from the research at any time. The questionnaire did not contain names or other identifying information about the participants.

2.9. Statistical Design:

Version 25 of the statistical software for social science (SPSS) was used to analyze the data. Numerical data were expressed as mean and standard deviation, whereas qualitative data were expressed as frequency and percentage. To investigate the variation between the qualitative variables, the chi-square test was employed. The Pearson product-moment correlation coefficient and the spearman correlation for categorical variables were used to examine the correlation between various numerical variables. P-values less than 0.05 were regarded as significant, and less than or equal 0.001 as highly significant.

3. Results

Table (1) shows demographic characteristics among studied nurses, where 90.0% were aged <30 years, with a mean age of 26.02 ± 2.88 . Regarding gender, 90.0% of them were female and 66.0% were married, besides 56.0% attained technical institute degree, with <5 years of experience among 72.0%. Moreover, 98.0% didn't attend any previous courses about external ventricular drain.

Table (2) reveals difference between studied nurses' knowledge regarding definition, indications, contraindications, complications and management of external ventricular drain. There were

significant differences in these knowledge items between pre-program and both immediate post program and post three months of implementing nursing program, where 24.0% had satisfactory level of overall knowledge pre-program to be (96.0% and 94.0%) immediately post program and after 3 months respectively. Furthermore, 90.0 % of studied nurses had unsatisfactory knowledge level pre-program regarding complications, whereas during immediate and post three months period (90.0% and 88.0%) of nurses respectively had satisfactory knowledge regarding definition of external ventricular drain and its contraindications.

Figure (1) demonstrates the difference between studied nurses' overall knowledge regarding external ventricular brain drain, where there was a significant difference between preprogram period with both immediate and three months periods post program ($p= 0.041^*$ & 0.019^* respectively).

Table (3) shows difference between studied nurses' practice of external ventricular brain drain at 3 phases of nursing program, which was significant during immediate and post three months of implementing nursing program. Moreover, 92.0% had incompetent level of practice pre-program regarding hourly documentation, whereas competent level during immediate post period was observed among 82.0% regarding leveling of EVD system, as well as during three months period post program among 80.0% regarding leveling of EVD system and dressing change.

Figure (2) illustrates the difference between studied nurses' overall external ventricular drain practice, where 74% of the studied nurses had incompetent overall practice level pre-program to be (82.0% and 80.0%) competent level immediately post program and after 3 months respectively. Moreover, there were significant differences between pre-program period with both immediate and three months periods post program ($p= 0.014^*$ & 0.050^* respectively).

Table (4) displays here was no statistically significant relation between the study nurses' overall knowledge during the pre-program phase and their demographic characteristics during the pre-program phase. On the other hand, during post program periods, there was a statistically significant relation with qualifications and years of experience with p value = ($<0.001^{**}$, & 0.004^* , respectively) during immediate post period and p value = ($<0.001^{**}$, & 0.002^* , respectively) during three months period post program.

Table (5) shows that overall practice of the studied nurses and their demographic characteristics have not a statistically significant relation during pre-program period. While, during post program periods, there was a statistically significant relation with qualifications, years of experience and attendance of previous courses with p value = ($<0.003^{**}$, 0.039^* & 0.031^* , respectively) during immediate post period and p value = (0.002^{**} , 0.027^* & 0.043^* , respectively) during three months period post program.

Table (6) clarifies the correlation between nurses' knowledge and practice regarding external ventricular brain drain. Also, there was a positive not significant correlation during pre-program period $p=0.083^{n.s}$, while a positive highly significant correlation during immediate and three months periods with p value at ($<0.001^{**}$).

Table (1): Distribution of the studied nurses based on their demographic characteristics (n= 50).

Demographic characteristics	(No.)	%
Age		
- <30	45	90.0
- ≥30	5	10.0
Mean ± SD	26.02 ± 2.88	
Gender		
-Male	5	10.0
-Female	45	90.0
Marital status		
- Single	12	24.0
- Married	33	66.0
- Divorced	4	8.0
- Widowed	1	2.0
Qualifications		
-Technical nursing institute	28	56.0
- Bachelors of nursing	22	44.0
Years of experience		
- < 5 years	36	72.0
- ≥5 years	14	28.0
Mean ± SD	3.58 ± 2.10	
Attending any previous course		
- Yes	1	2.0
- No	49	98.0

Table (2): Difference between studied nurses' knowledge regarding external ventricular drain throughout nursing program phases (N=50)

Knowledge items		Pre-nursing program (n=50)		Immediately Post nursing program (n=50)		3 months Post nursing program (n=50)		X ² P value (1)	X ² P value (2)
		No	%	No	%	No	%		
Definition of external ventricular drain	Satisfactory	23	46.0	45	90.0	44	88.0	4.638 0.031*	5.692 0.017*
	Unsatisfactory	27	54.0	5	10.0	6	12.0		
Indications	Satisfactory	16	32.0	42	84.0	38	76.0	4.482 0.034*	4.064 0.044*
	Unsatisfactory	34	68.0	8	16.0	12	24.0		
Contraindications	Satisfactory	22	44.0	45	90.0	44	88.0	4.278 0.039*	5.250 0.022*
	Unsatisfactory	28	56.0	5	10.0	6	12.0		
Complications	Satisfactory	14	28.0	41	82.0	38	76.0	4.183 0.041*	6.018 0.014*
	Unsatisfactory	36	72.0	9	18.0	12	24.0		
External ventricular drain management	Satisfactory	5	10.0	45	90.0	42	84.0	5.556 0.018*	5.444 0.020*
	Unsatisfactory	45	90.0	5	10.0	8	16.0		
Total	Satisfactory ≥85%	12	24.0	48	96.0	47	94.0	6.597 0.010*	5.981 0.014*
	Unsatisfactory < 85 %	38	76.0	2	4.0	3	6.0		

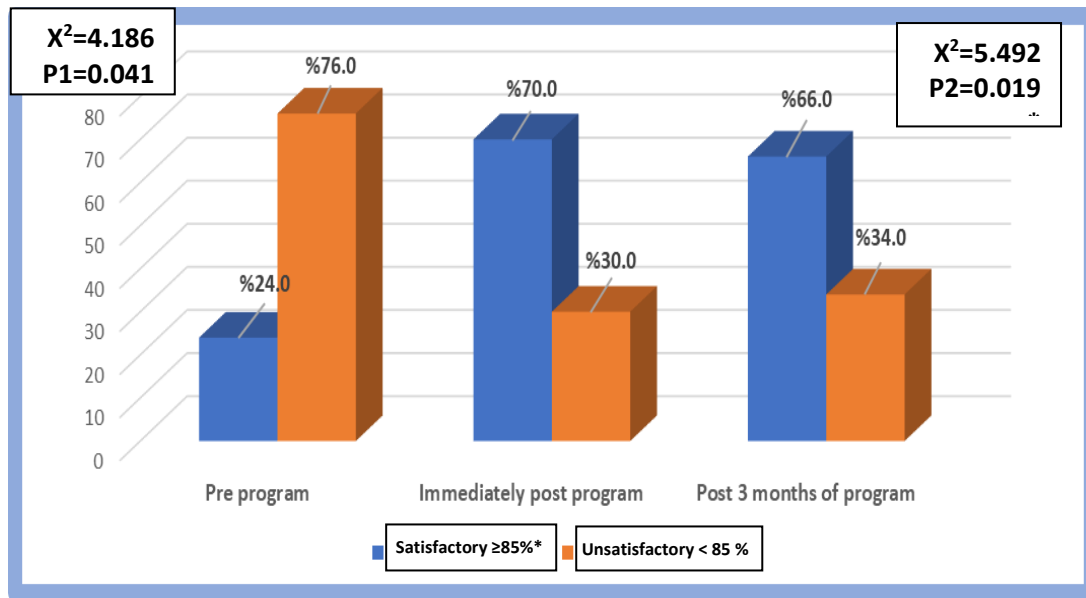
* Significant at p ≤0.05.

** Highly Significant at p ≤0.001

(1) Difference between knowledge pre nursing program and immediately post nursing program

(2) Difference between knowledge pre nursing program and three months post nursing program

Figure (1): Difference between studied nurses' overall knowledge regarding external ventricular brain drain throughout nursing program phases (n=50)



* Significant at $p \leq 0.05$

(P1) Difference between overall knowledge pre nursing program and immediately post nursing program

(P2) Difference between overall knowledge pre nursing program and three months post nursing program

Table (3): Difference between studied nurses' practice regarding external ventricular brain drain throughout nursing program phases (N=50)

Nurses' practice regarding external ventricular brain drain		Pre-program (n=50)		Immediately Post program (n=50)		3 months Post program (n=50)		X ² P value (1)	X ² P value (2)
		No	%	No	%	No	%		
Mandatory checks	Competent	8	16.0	36	72.0	38	76.0	5.828	4.853
	Incompetent	42	84.0	14	28.0	12	24.0	0.016*	0.028*
Hourly documentation	Competent	4	8.0	31	62.0	28	56.0	4.035	4.910
	Incompetent	46	92.0	19	38.0	22	44.0	0.045*	0.027*
Leveling the EVD system	Competent	9	18.0	41	82.0	40	80.0	3.984	3.984
	Incompetent	41	82.0	9	18.0	10	20.0	0.046*	0.046*
Dressing change	Competent	9	18.0	40	80.0	40	80.0	4.486	4.486
	Incompetent	41	82.0	10	20.0	10	20.0	0.034*	0.034*
Removal of EVD	Competent	10	20.0	40	80.0	39	78.0	5.053	5.637
	Incompetent	40	80.0	10	20.0	11	22.0	0.025*	0.018*
Monitoring ICP	Competent	7	14.0	38	76.0	38	76.0	4.190	4.190
	Incompetent	43	86.0	12	24.0	12	24.0	0.041*	0.041*
Sampling CSF	Competent	8	16.0	38	76.0	39	78.0	4.853	4.387
	Incompetent	42	84.0	12	24.0	11	22.0	0.028*	0.036*
ICP documentation	Competent	10	20.0	40	80.0	37	74.0	5.053	6.859
	Incompetent	40	80.0	10	20.0	13	26.0	0.025*	0.009*

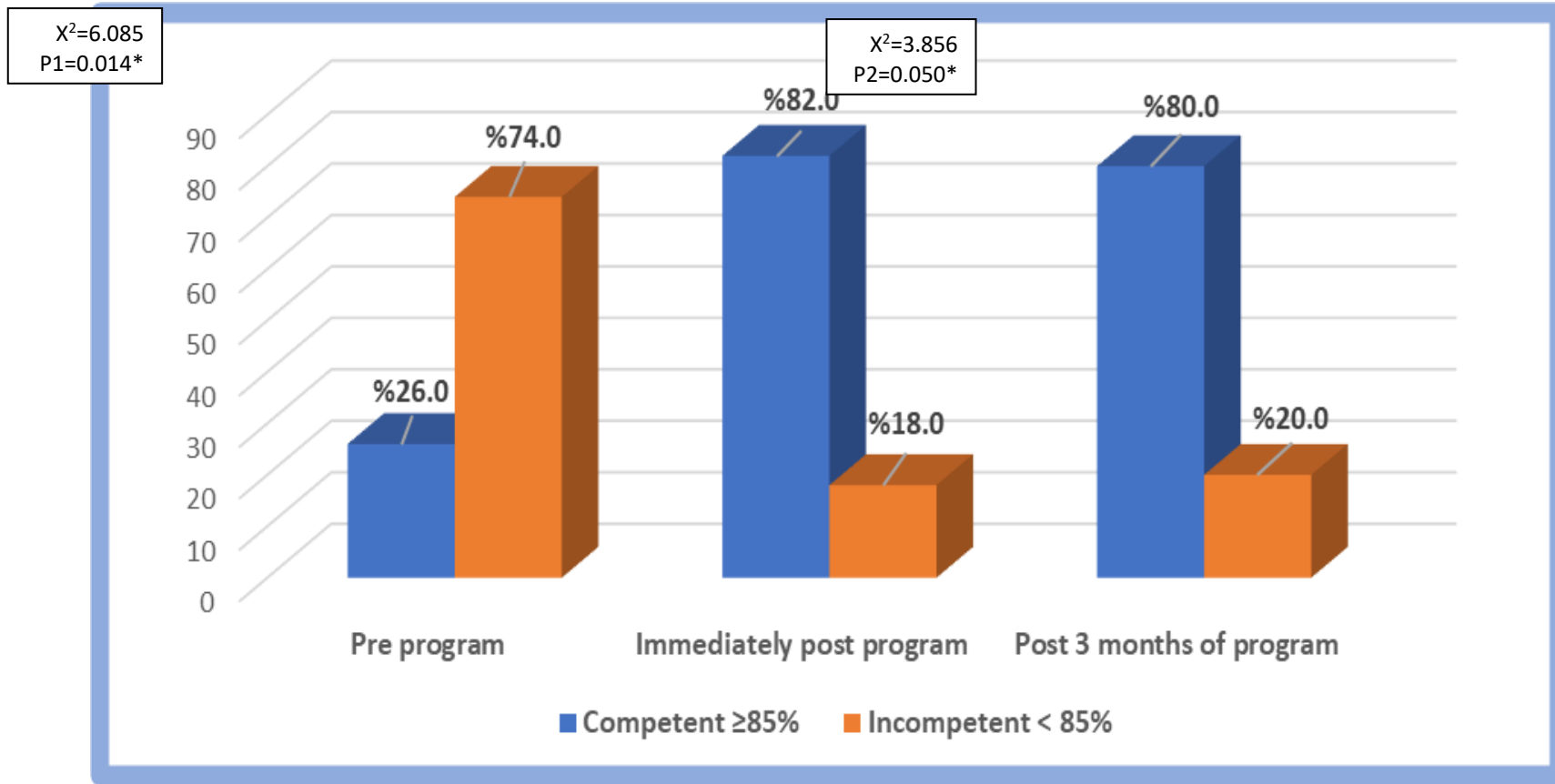
* Significant at $p \leq 0.05$

** Highly Significant at $p \leq 0.001$

(1) Difference between practice pre nursing guidelines and immediately post nursing guidelines

(2) Difference between practice pre nursing guidelines and three months post nursing guidelines

Figure (2): Difference between studied nurses' overall practice regarding external ventricular brain drain throughout nursing program phases (n=50)



(P1) Difference between overall practice pre nursing program and immediately post nursing program
 (P2) Difference between overall practice pre nursing program and three months post nursing program

Table (4): Relationship between nurses' overall knowledge level and their demographic characteristics throughout nursing program phases (n=50)

Demographic characteristics	Overall Knowledge (pre nursing program) (n= 50)		X ² P value	Overall Knowledge Immediately post nursing program (n= 50)		X ² P value	Overall Knowledge (3 months post nursing program) (n= 50)		X ² P value
	Satisfactory (n=12)	Unsatisfactory (n=38)		Satisfactory (n=35)	Unsatisfactory (n=15)		Satisfactory (n=33)	Unsatisfactory (n=17)	
	No (%)	No (%)		No (%)	No (%)		No (%)	No (%)	
Age (in year)									
< 30	10(83.3)	35(92.1)	0.780	31(88.6)	14(93.3)	0.265	29(87.9)	16(94.1)	0.485
≥ 30	2(16.7)	3(7.9)	0.377 n.s	4(11.4)	1(6.7)	0.607n.s	4(12.1)	1(5.9)	0.842 n.s
Gender									
Male	0(0.0)	5(13.2)	1.754	3(8.6)	2(13.3)	0.265	3(9.1)	2(11.8)	0.089
Female	12(100.0)	33(86.8)	0.185 n.s	32(91.4)	13(86.7)	0.607 n.s	30(90.9)	15(88.2)	0.765 n.s
Marital status									
Single	2(16.7)	10(26.3)	2.652	8(22.9)	4(26.7)	0.541	7(21.2)	5(29.4)	0.980
Married	10(83.3)	23(60.5)	0.449 n.s	23(65.7)	10(66.7)	0.910 n.s	22(66.7)	11(64.7)	0.806 n.s
Divorced	0(0.0)	4(10.5)		3(8.6)	1(6.7)		3(9.1)	1(5.9)	
Widowed	0(0.0)	1(2.6)		1(2.9)	0(0.0)		1(3.0)	0(0.0)	
Qualifications									
Technical nursing institute	5(41.7)	23(60.5)	1.317	13(37.1)	15(100.0)	16.837	11(33.3)	17(100.0)	20.238
Bachelors of nursing	7(58.3)	15(39.5)	0.251 n.s	22(62.9)	0(0.0)	<0.001**	22(66.7)	0(0.0)	<0.001**
Years of experience									
< 5 years	9(75.0)	27(71.1)	0.070	21(60.0)	15(100.0)	8.333	19(57.6)	17(100.0)	10.017
≥ 5 years	3(25.0)	11(28.9)	0.791 n.s	14(40.0)	0(0.0)	0.004*	14(42.4)	0(0.0)	0.002*
Attending any previous courses									
Yes	0(0.0)	1(2.6)	0.322	1(2.9)	0(0.0)	0.437	0(0.0)	1(5.9)	1.981
No	12(100.0)	37(97.4)	0.570 n.s	34(97.1)	15(100.0)	0.508 n.s	33(100.0)	16(94.1)	0.159 n.s

n.s Not significant at p > 0.05.

*Significant at p ≤0.05

** Highly Significant at p ≤0.001

Table (5): Relationship between nurses' overall practice level and their demographic characteristics throughout nursing program phases (n=50)

Demographic characteristics	Overall practice (pre nursing program) (n= 50)		X ² P value	Overall practice Immediately post nursing program (n= 50)		X ² P value	Overall practice (3 months post nursing program) (n= 50)		X ² P value
	Competent (n=13)	Incompetent (n=37)		Competent (n=41)	Incompetent (n=9)		Competent (n=40)	Incompetent (n=10)	
	No (%)	No (%)	No (%)	No (%)	No (%)	No (%)			
Age (in year)									
< 30	8(61.5)	28(75.7)	0.954	36(87.8)	9(100.0)	1.220	36(90.0)	9(90.0)	0.000
≥ 30	5(38.5)	9(24.3)	0.329 n.s	5(12.2)	0(0.0)	0.269n.s	4(10.0)	1(10.0)	1.000 n.s
Gender									
Male	1(7.7)	4(10.8)	0.104	4(9.8)	1(11.1)	0.015	4(10.0)	1(10.0)	0.000
Female	12(92.3)	33(89.2)	0.747 n.s	37(90.2)	8(88.9)	0.902 n.s	36(90.0)	9(90.0)	1.000 n.s
Marital status									
Single	3(23.1)	9(24.3)	2.907	10(24.4)	2(22.2)	0.367	10(25.0)	2(20.0)	0.426
Married	8(61.5)	25(67.6)	0.406 n.s	27(65.9)	6(66.7)	0.947 n.s	26(65.0)	7(70.0)	0.935 n.s
Divorced	1(7.7)	3(8.1)		3(7.3)	1(11.1)		3(7.5)	1(10.0)	
Widowed	1(7.7)	0(0.0)		1(2.4)	0(0.0)		1(2.5)	0(0.0)	
Qualifications									
Technical nursing institute	7(53.8)	21(56.8)	0.033	19(46.3)	9(100.0)	8.624	18(45.0)	10(100.0)	9.821
Bachelor's of nursing	6(46.2)	16(43.2)	0.856 n.s	22(53.7)	0(0.0)	0.003*	22(55.0)	0(0.0)	0.002*
Years of experience									
< 5 years	8(61.5)	28(75.7)	0.954	27(65.9)	9(100.0)	4.268	26(65.0)	10(100.0)	4.861
≥5 years	5(38.5)	9(24.3)	0.329 n.s	14(34.1)	0(0.0)	0.039*	14(35.0)	0(0.0)	0.027*
Attending any previous course									
Yes	0(0.0)	1(2.7)	0.359	0(0.0)	1(11.1)	4.649	0(0.0)	1(5.9)	4.082
No	13(100.0)	36(97.3)	0.549 n.s	41(100.0)	8(88.9)	0.031*	33(100.0)	16(94.1)	0.043 *

n.s Not significant at p > 0.05.

*Significant at p ≤0.05

** Highly Significant at p ≤0.001

Table (6): Correlation coefficient between nurses' overall knowledge and practice regarding external ventricular brain drain throughout nursing program phases (n=50).

Variables	Study periods	Knowledge	
		r- test	p-value
<i>Practice</i>	Pre nursing program	0.248	0.083 n.s
	Immediately post program	0.712	<0.001**
	Three months post program	0.707	<0.001**

n.s Not significant at $p > 0.05$ ** **Highly Significant** at $p \leq 0.001$.

4. Discussion

One of the most basic procedures used in neurosurgical departments is external ventricular drainage (EVD). Patients who require an EVD should be closely monitored by nurses trained and competent in assessment and management of both the drain and the neuroscience patient population (Solou et al., 2023). In essence, nurses are currently responsible for maintenance and EVD complication monitoring. Patients may have better prognosis if they receive accurate and adequate nursing care (Magid et al., 2022).

The findings of the current study indicate that most of the nurses examined were under 30 years old, with a mean age of 26.02 ± 2.88 . Additionally, almost half of the nurses had obtained a Bachelor's degree in nursing and had less than 5 years of work experience. This comes in agreement with Al-Rafay, Hassan & Abdelhamid, (2021) who conducted a study in Egypt that entitled "Assessment of Nurses Performance Regarding External Ventricular Drain" and emphasized that the age group of 25 to 35 years comprised over half of the nurses included in the study, with mean age 26.3 ± 5.97 years. Furthermore, approximately 50% of these nurses had less than 5 years of professional experience.

Regarding gender, most of studied nurses were females and near two thirds were married. This conclusion could be explained by the fact that more girls than males graduate from nursing schools in Egypt, where the majority of nurses work. These results are supported by those of Maarouf & Faltas, (2020) in Egypt at a study titled "External Ventricular Brain Drain: Effect of Nursing Guidelines on Internship Nursing Students' Performance" and Vieira, (2022) observed that most of the participants were female in a study done at Brazil entitled "External Ventricular Drains: Development and Evaluation of a Nursing Clinical Practice Guideline".

According to current study, the vast majority of nurses didn't attend any previous courses about external ventricular drain. These results are incongruent with the findings of Souza et al., (2020) who studied "Retaining knowledge of external ventricular drain by nursing professionals" in Brazil and stated that more than three fifths of nurses aged 30 to 39 years of age with over 10 years of experience and one half of them attended previous courses about external ventricular drain.

The findings of the present study showed that more than three quarters of studied nurses had unsatisfactory overall knowledge level at pre nursing program, whereas the majority of them had

satisfactory overall knowledge level at immediate post program and three months post program. From the researchers' point of view, this can be attributed to the absence of EVD-related topics in their curriculum, as well as their recent graduation and limited practical experience. Additionally, the absence of a comprehensive procedure book, policies, and guidelines pertaining to the care of external ventricular drain systems within the hospital further compounds this problem. These findings were corresponding with those of **Al-Rafay, Hassan & AbdELhamid, (2021)** who found about two thirds of studied nurses have unsatisfactory knowledge score regarding EVD, while the rest of them have satisfactory knowledge score.

This study's results clarified significant differences of nurses' overall knowledge level between pre nursing program period with both immediate and three months post program. This is in accordance with **Alomar et al., (2023)** who studied "The Impact of Nursing Education on Emergency Bedside External Ventricular Drain Insertion for Patients with Acute Hydrocephalus" in Saudi Arabia and illustrated that the level of knowledge significantly improved after EVD bundle application.

With regard to nurses' subtotal practices regarding external ventricular brain drain at pre nursing program, the majority of nurses in this study had incompetent level of subtotal practice regarding hourly documentation, leveling of EVD system, dressing change and Monitoring ICP. From the researchers' point of view, this is probably owing to a lack of relevant practical experience among most nurses, lack of proper training for nurses in the care of patients with EVD and limited participation in managing patients and assisting physicians during EVD insertion. This is in line with **Maarouf & Faltas, (2020)** who discovered that the majority of study subjects didn't make EVD-leveling, removal EVD correctly, and didn't document ICP value.

In light of this, a study entitled "Nursing Assistance in Patient Care with External Ventricular Drain: A Scoping Review" and conducted in Brazil. by **Sakamoto et al., (2021)** highlighted the importance of nursing care regarding EVD and recommended that nurses have the responsibility of monitoring cerebrospinal fluid (CSF), performing sterile dressing changes, and managing the EVD system and drain. Another recent study by **Liu et al., (2020)** in California that entitled "Intracranial Pressure Monitoring via External Ventricular Drain: Are We Waiting Long Enough Before Recording the Real Value?" concluded that it is the responsibility of nurses to carefully observe, monitor, and document the status of the EVD system on an hourly basis. This task requires skill and training to accurately record the intracranial pressure (ICP) values.

In this study, nearly three quarters of studied nurses had incompetent overall level of practice pre-program, while majority of them had competent level of overall practice during immediate post program and three months period post program. **Zafar et al., (2022)** reinforced that in a study carried out at Pakistan that entitled "Effect of Nursing Guidelines On Practices of Nurses Caring for Traumatic Brain Injury Patients in A Tertiary Care Hospital Lahore" and indicated that before educational intervention, a majority of nurses demonstrated inadequate practices, while only a minority exhibited competent practices. However, following the implementation of an educational intervention, the proportion of nurses with competent practices increased to nearly two-thirds.

Furthermore, **Aslam et al., (2022)** whose study in Pakistan entitled " Effect of External Ventricular Drain Care Guidelines on Nursing Practice and Complications among Patients with Post-Traumatic Hydrocephalus" observed that prior to the intervention, the majority of participants displayed incompetent practices, while only a minority demonstrated competent practices. However, after the educational sessions, the proportion of participants with competent practices increased to approximately four-fifths.

In this regard, the present findings demonstrated significant differences between pre-program period with both immediate and three months periods post program in nurses' overall and subitems practices. This result is matched with those of **Maarouf & Faltas, (2020)** who mentioned that before and after the guidelines were implemented, there was a statistically significant change in the external ventricular brain drain practices of nurses.

The current study results illustrated that there was no significant statistical relation during pre-program period between overall knowledge of the studied nurses' and their all demographic characteristics. Whereas, there was a statistically significant relation between overall knowledge with only qualifications and years of experience during immediate post period and during three months period post program.

This finding was confirmed by **Souza et al., (2020)** whose study clarified that socio-demographic variables between groups had no correlation of the knowledge level with the subjects' age, gender and training. In contrast with the current results, **Alomar et al., (2023)** represented that years of experience were not associated with nurses mean knowledge score after EVD educational bundle.

In this study, there was no significant statistical relation during pre-program period between overall practice of the studied nurses' and their demographic characteristics. This is consistent with the findings of **Al-Rafay, Hassan & AbdELhamid, (2021)** who found no statistically significant difference between the characteristics of nurses and their total patient-care practices with EVD. While, during post program periods, there was a statistically significant relation with qualifications and years of experience and attendance of previous courses during immediate post period and during three months period post program. This contradicted with **Souza et al., (2020)** who noticed that age group influenced total nurse' practice after educational intervention about external ventricular drain.

In terms of the correlation between nurses' knowledge and practice regarding external ventricular brain drain. This study displayed that there was a positive not significant correlation during pre-program period, while a positive highly significant correlation was observed during immediate post program and three months post program. **Maarouf & Faltas, (2020)** agreed this and noted that following the implementation of the guidelines, there was a positive association between the total knowledge and total practice of nurses. While, **Alomar et al., (2023)** showed no relation between participants EVD level of practice and knowledge scores.

The study's result reinforced the hypothesis that implementing of a nursing development competency program would affect positively on nurses' knowledge and practice regarding external ventricular drain compared with pre-program scores.

5. Conclusion

Upon the findings of the current study, it can be concluded that the nursing development competency program exhibited significant improvements in the levels of nurses' knowledge and practices regarding external ventricular drain immediately post and three months post program at p . value <0.05 .

6. Recommendations

The current study's findings suggest the following recommendations:

- Development of educational guidelines that are rooted in evidence-based nursing practices to promote high-quality nursing care and ensure excellence in the context of external ventricular drain (EVD) nursing care.
- Implement continuous training courses to enhance nurses' performance regarding external ventricular drains.
- Provide nurses with user-friendly illustrated booklets and posters that cover essential aspects of nursing care for external ventricular drains.
- Replication of the study using a larger sample size and across multiple hospitals to validate and generalize the findings.

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8. References

1. Ahmed, R. A., & Ali, S. A. (2023). Efficiency of Competency Training Program on Intensive Care Nurses Performance Regarding the Electrocardiogram Interpretation. *Egyptian Journal of Nursing and Health Sciences*, 4(3), 8-38.
2. Alomar, S. A., Bandah, S. T., Noman, G. A., Kadi, M., Abulnaja, G. A., Abdullah, G., & Noman, G. (2023). The Impact of Nursing Education on Emergency Bedside External Ventricular Drain Insertion for Patients With Acute Hydrocephalus. *Cureus*, 15(1).
3. Alrashidi, Q., Al-Saadi, T., Alhaj, A. K., & Diaz, R. J. (2023). The Role of Nursing Care in the Management of External Ventricular Drains on the Neurosurgical Ward: A Quality Improvement Project. *World Neurosurgery*.
4. Al-Rafay S. S., Hassan S. E. & AbdEL-hamid A. (2021). Assessment of Nurses Performance Regarding External Ventricular Drain among Children with Brain Tumor. *Egyptian Journal of Health Care*, 12(3), 945-955.
5. Aslam, H., Afzal, M., Sarwar, H., & Khan, S. (2022). Effect of External Ventricular Drain Care Guidelines on Nursing Practice and Complications among Patients with Post-Traumatic Hydrocephalus. *Pakistan Journal of Medical & Health Sciences*, 16(02), 1128-1128.
6. Chau, C. L. Craven, A. M. Rubiano et al., "The evolution of the role of external ventricular drainage in traumatic brain injury," *Journal of Clinical Medicine*, vol. 8, no. 9, p. 1422, 2019.
7. Gopalan, M., Rosinger, K., & Ahn, J. B. (2020). Use of quasi-experimental research designs in education research: Growth, promise, and challenges. *Review of Research in Education*, 44(1), 218-243.
8. Gu, J. C., Wu, H., Chen, X. Z., Feng, J. F., Gao, G. Y., Jiang, J. Y., & Mao, Q. (2020). Intracranial pressure during external ventricular drainage weaning is an outcome predictor of traumatic brain injury. *BioMed Research International*.
9. El-Sayed, R. I. (2021). Core Competencies Elements among First Line Nurse Managers At Port-Said Governmental Hospitals. *Port Said Scientific Journal of Nursing*, 8(3), 303-326.
10. Jung, W. K., & Yi, Y. H. (2016). Development of Nursing Practice Guideline for External Ventricular Drainage by Adaptation Process. *Journal of Korean Clinical Nursing Research*, 22(3), 294-304.
11. Kato, Y., Zhang, X., Dai, J., & Ansari, A. (2021). *Recent Progress in the Management of Cerebrovascular Diseases*. Shanghai Jiao Tong University Press; Springer. Pp: 62.
12. Kumar, M., Malhotra, N., & Bhatia, P. (2021). Review of "Clinical Anesthesia by Paul G Barash" South Asian Adaptation. In: Gupta N, Gupta A, SAE editors. Wolters Kluwer; 2021. p. 2056. ISBN: 9789389859911.
13. Liu, X., Griffith, M., Jang, H. J., Ko, N., Pelter, M. M., Abba, J. & Hu, X. (2020). Intracranial pressure monitoring via external ventricular drain: are we waiting long enough before recording the real value?. *The Journal of neuroscience nursing: journal of the American Association of Neuroscience Nurses*, 52(1), 37.
14. Magid, J., Girard, R., Polster, S., Srinath, A., Romanos, S., Awad, I. A., & Sansing, L. H. (2022). Cerebral hemorrhage: pathophysiology, treatment, and future directions. *Circulation research*, 130(8), 1204-1229.
15. McDaniel, J. N. (2014). Introduction of a Best Practice for Ventriculostomy Management in the Neuroscience Critical Care Unit.
16. Maarouf, D., & Faltas, S. (2020). External Ventricular Brain Drain: Effect of Nursing Guidelines on Internship Nursing Students' Performance. *Egyptian Journal of Health Care*, 11(2), 500-510.
17. Mrayyan, M. T., Abunab, H. Y., Khait, A. A., Rababa, M. J., Al-Rawashdeh, S., Algunmeeyn, A., & Saraya, A. A. (2023). Competency in nursing practice: a concept analysis. *BMJ open*, 13(6), e067352

18. Sakamoto, V. T. M., Vieira, T. W., Viegas, K., Blatt, C. R., & Caregnato, R. C. A. (2021). Nursing assistance in patient care with external ventricular drain: a scoping review. *Revista Brasileira de Enfermagem*, 74.
19. Shay, A. C., APRN-CNS, F. C. N. S., Powers, J., Doescher, T. A., & CNS-BC, C. C. R. C. (Eds.). (2021). Adult-Gerontology Clinical Nurse Specialist Certification Review, Pp. 218.
20. Solou, M., Ydreos, I., Papadopoulos, E. K., Demetriades, A. K., & Boviatsis, E. J. (2023). Management of neurological complications related to aneurysmal subarachnoid hemorrhage: A comparison of the bedside therapeutic algorithms. *The Surgeon*.
21. Souza, R. C. S., Siqueira, E. M. P., Meira, L., Araujo, G. L., & Bersaneti, M. D. R. (2020). Retaining knowledge of external ventricular drain by nursing professionals. *Revista Cuidarte*, 11(1).
22. Sweet V., Foley A., (2019). Emergency Nurses Association. *Sheehy's Emergency Nursing: Principles and Practice*. Elsevier Health Sciences. 7th Ed, Pp:256.
23. Van der Jagt, E. W., & Short, S. R. P. (2021). Healthcare-Associated Infections. *Pediatric Critical Care: Text and Study Guide*, 1105-1143.
24. Vieira, T. W., Sakamoto, V. T. M., Araujo, B. R., Pai, D. D., Blatt, C. R., & Caregnato, R. C. A. (2022). External Ventricular Drains: Development and Evaluation of a Nursing Clinical Practice Guideline. *Nursing Reports*, 12(4), 933-944.
25. Zafar, S., Shahzadi, U., Rehman, S. A., Khurshid, U., Bashir, F., & Khurshid, Z. (2022). Effect of Nursing Guidelines On Practices of Nurses Caring for Traumatic Brain Injury Patients in A Tertiary Care Hospital Lahore, Pakistan: Nursing Guidelines On Practices of Nurses Caring for Traumatic Brain Injury Patients. *Pakistan Journal of Health Sciences*, 91-94.

الملخص العربي

التصريف الخارجي للبطين الدماغى: تأثير برنامج تطوير الكفاءة التمريضية على معرفة وممارسات الممرضين

مقدمة: يعتبر العناية التمريضية بالتصريف الخارجى للبطين الدماغى دورا تمريزيا هام ومتقدم في رعاية مرضى جراحة المخ والاعصاب. ولذلك تعليم وتدريب الممرضين ضروريان لضمان تطور ادائهم من خلال تحديث المعلومات والمهارات بأحدث التطورات في رعاية المرضى والحصول على أفضل مستوي من الكفاءات اللازمة.

الهدف من الدراسة هو تحديد تأثير برنامج تطوير الكفاءة التمريضية على معلومات وممارسات الممرضين فيما يتعلق بالتصريف الخارجى للبطين الدماغى.

التصميم: تم استخدام تصميم شبه تجريبي في هذه الدراسة و تم اختيار عينة ملائمة تشمل 50 من الممرضين، تم استخدام أداتين لجمع البيانات؛ الاداه الأولى: استبيان ذاتي للممرضين حول تصريف البطين الدماغى الخارجى وتضمن الجزء الأول: الخصائص الديموغرافية و الجزء الثاني هو استبيان خاص بمعرفة الممرضين تجاه التصريف الخارجى للبطين الدماغى. أما الاداة الثانية عبارة عن قائمة الملاحظة لممارسات الممرضين فيما يتعلق بالتصريف الخارجى للبطين الدماغى.

النتائج: أظهرت هذه الدراسة تحسناً ذا دلالة إحصائية في معلومات وممارسات الممرضين قبل وبعد البرنامج مباشرة ، وأيضاً بعد ثلاث أشهر من تطبيق البرنامج.

الخلاصة: كان لبرنامج تطوير كفاءة التمريض تأثير إيجابي على مستويات معلومات الممرضين وممارساتهم فيما يتعلق بالتصريف الخارجى للبطين الدماغى. **التوصيات:** يوصى بوضع إرشادات تعليمية قائمة على الأدلة لتعزيز الرعاية التمريضية عالية الجودة للتصريف الخارجى للبطين الدماغى..