

Effect of Evidence Based Guideline on Neonatal Nurse's Adherence Regarding Prevention and Management of Intravenous Infiltration and Extravasation

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Abstract

Infiltration and Extravasation injury resulting from administration of intravenous therapies via peripheral intravenous catheters or central venous catheters, newborns and children are more exposed to infiltration and extravasation injuries. **Aims:** Evaluate the effect of evidence based guideline for prevention and management of infiltration and extravasation on neonatal nurses Adherence. Evaluate the effect of implementing evidence based guideline on the incidence rate of intravenous infiltration and extravasation among studied neonate . **Setting,** The study was conducted at (neonatal intensive care units) at Shebin EL Kom teaching hospital and Tala central hospital at Menoufia Governorate. **Sample:** Convenience sample of 30 nurses and Purposive sample of 30 neonates were obtained from the previously mentioned neonatal intensive care units. **Tools ,** four tools were used for data collection **tool one:** Structured Interview Questionnaire. was utilized to identify nurses' knowledge about intravenous infiltration and extravasation, **tool two** was an clinical practices guideline adherence scale to assess nurses practices about prevention and management intravenous infiltration and extravasation, **tool three** include the intravenous infiltration assessment scale, **tool four** include extravasation assessment scale. **The results** of this study showed, the highest percentage of nurses had significantly high knowledge and practices regarding adherence to evidence base guideline of prevention and management of intravenous infiltration and extravasation on posttest than pre test ,in addition, marked decrease in the incidence rate of Infiltration and extravasation between neonates on the posttest than pretest with no statistical significant differences . **Conclusions** implementation of evidence-based clinical practices guideline regarding prevention and management of intravenous infiltration and extravasation significantly increases nurses' knowledge and practices regarding adherence to evidence base guideline, Also, it decreased the incidence rate of intravenous infiltration and extravasation among studied neonate. **Recommendation:** continuous training of evidence based clinical practices guideline should be established in each neonatal unite to enhance nurses' adherence regarding intravenous infiltration and extravasation prevention and management.

Keywords: Clinical practice guidelines, Infiltration and extravasation, nurse's adherence.

Introduction

Infiltration and extravasation (I/E) injury is remaining an important cause of iatrogenic injury in neonatal intravenous (IV) extravasation among intensive care, it is resulting from IV therapies. The incidence of neonates is approximately 12.6 per 100 peripheral intravenous catheter days and 38 per 1,000 neonates, respectively, also

Neonates were particularly at risk for extravasation (28.4%). Also longer hospitalization young children who have peripheral intravenous catheter have greater risk to extravasation and infiltration (Fonzo -Christe et al., 2018)

Extravasation injuries is the unintentional leakage of medications or vesicant fluids from the vein into the surrounding tissue, while the infiltration is the accidental leakage of non-vesicant solutions out of the vein into

the surrounding tissue. This can occur with many antibiotics, dextrose solutions, or even normal saline (Özalp et al .,2018)

Newborns and children are more exposed to infiltration and extravasation injuries than adults due to more factors such as developmental and physiological factors, increased skin and vein fragility, inability to report pain, inability to visualize insertion sites , limbs with peripheral IV cannulas or central venous access devices being covered or unable to be visualized, prolonged intravenous therapy ,volume, pH, osmolarity and chemical composition of the fluid being infused. (Tofani et al ., 2012).

Infiltration and extravasation occur with the following symptoms swelling , redness or whiteness at catheter site, pain, an increase or decrease in temperature at the infiltration site, or a change in the quality of pulse under the infiltration site(Chan et al .,2020).

Extravasations are iatrogenic injuries that can have major consequences for neonate, including skin necrosis ,they may induce long-term injuries that need surgical intervention and grafts , the soft-tissue injuries , which resulting from extravasation are solution is related to osmolality cytotoxicity or vasoconstrictive properties (Kostogloudis et al ,2015)

The nurses have a major role in reducing IV intervention adverse event and complications. To prevent extravasation nurses should perform the injection, with relevant skills and management abilities of understanding the properties of the injected drug. , and should ensuring patient safety by utilizing their knowledge and skills to IV interventions , nurses are expected to early detect the symptoms and findings related to I/E and follow the most important nursing

intervention in I/E and create a management plane to reduce possible damage in tissues , in addition, one of the primary role in nursing intervention in I/E is prevention.(Taylor, 2015).

Most of studies have emphasized that the risk of I/E development is reduced through training nurses and more frequent observation of the I/E area. Children IV administration safety can be ensure by stay current and knowledgeable concerning changes in medications and treatment of pediatric conditions, implementation of educational guidelines program of medication safety administration improves pediatric nurses' performance and reduce iatrogenic injuries of medication administration (Zein Eldin et al., 2018).

Further more, Chan et al (2020) recommended that the implementation of the evidence based clinical practices guidelines, definitely reduced the rate of intravenous extravasation and infiltration. The evidence-based clinical practices guideline, it was developed by a panel of experts, including pediatricians, nurse consultants, pharmacists, ward managers. advanced practice nurses, and neonatal nurses after an extensive review of the literature and critical appraisal of the available sources of the evidence. It was included 27 recommendations for prevention and management of I/E, 11 recommendations about prevention and 16 about E/I management. The delivery of an educational nursing program to improve nurses' knowledge and practice was a prerequisite for successful nursing intervention. Nurses' adherence is the extent to which nurses follows an agreed set of actions in healthcare, Adherence is considered an important outcome measure healthcare (Chapman ,2018).

Significant of the study

Neonates usually receive intravenous therapy, which is accompanied by the incidence of extravasation injuries, which sometimes reach 18–46%. extravasation complications include necrosis and ulceration, which develop in 2.4–4% of neonates, contractures, deformities, loss of limb function, and unfavorable scar formation (Hackenberg et al.,2021). therefore, using evidence-based practice guidelines for the prevention and management of infiltration and extravasation is necessary to improve the quality of care and healthcare outcomes for neonates. also, there is an intense need to carry out adherence to guidelines to reduce the incidence rate of infiltration and extravasation among hospitalized neonates.

Operational definition:

Clinical practices guideline for Infiltration and extravasation: The clinical practices guideline, it was operationally defined as a group of 27 recommendations, 11 recommendations were about prevention of extravasation and infiltration and, 16 recommendations were about management extravasation and infiltration as guided by Chan et al(2020)

Nurses' adherence: Adherence in this study is meant the extent to which neonatal nurses followed clinical practices guideline of prevention and management of I/E and make a reasonable adjustments in their knowledge and practices.

Aims of the study were to:

- Evaluate the Effect of Evidence Based guideline on neonatal nurses Adherence regarding prevention and management of intravenous Infiltration and Extravasation.
- Evaluate the effect of implementing evidence based guideline on the incidence rate of intravenous infiltration and extravasation among studied neonates.

Hypotheses:

- Nurses who received education about evidence base guideline of prevention and management of intravenous infiltration and extravasation would have higher knowledge to guidelines posttest than pretest.
- Nurses who received education about evidence base guideline of prevention and management of intravenous infiltration and extravasation would have higher practices regarding adherence to guidelines posttest than pretest.
- The incidence rate of infiltration and extravasation would be reduced posttest than pretest.

Methods:

Research design: Quasi experimental design was used (pre posttest).

Settings: The study was conducted at (neonatal intensive care units)at Shebin EL Kom Teaching Hospital and Tala central hospital at Menoufia Governorate.

Sample:

- Convenience sample of all nurses provide direct care to neonates (30) nurses in previously mentioned setting.
- Purposive sample of (30 control &30 study) neonates obtained from the previously mentioned neonatal intensive care units. The sample size was estimated using G *Power (version 3.1.9.7). The minimum sample size was 50 based on power analysis of 0.95 ($\beta=1-0.9$ $\alpha=0.5$) at alpha .05(one –sided) with large effect size (0.5) was used as the significance.

Inclusion criteria for neonate

- All Neonate with peripheral or central venous line access

Exclusion criteria for neonate

- Premature baby: before 28 weeks of gestation
- Neonate with obvious health skin condition

Tools : Four tools were utilized for data collection.

Tool one: structured interview questionnaire. It was designed by the researcher after reviewing related literatures. This tool was divided into two parts:

Part one:

- a- Characteristic of studied nurses. It included questions about nurses age, level of education and years of experience in pediatric department.
- b- Characteristic of studied neonate It included questions about, neonate maturity, causes of hospitalization, weight, week of gestation.

Part two: Structured questionnaire to identify nurses' knowledge about extravasation and infiltration. It was developed by the researchers guided by Chan et al. (2020). It included 15 questions about extravasation and infiltration risk factor, medication and fluid cause I/E, nursing intervention to prevent I/E, and method of prevention (Confirm correct central venous catheter (CVC) catheter tip position , assess peripheral IV site every 10 minutes, Assess peripheral IV site every 10 minutes for phenytoin administration, Assess peripheral IV device patency prior to medication administration, Identify possible signs and symptoms of extravasation from a central line(ECL)&Recognize ECL presentation). Each incorrect answer is scored 0, and each correct answer is scored 1. The total scoring system of nurses' knowledge about extravasation and infiltration was

calculated by dividing the total number of correct answers by the total number of questions and multiplied by 100.

Scoring items	Score
unsatisfactory knowledge $\leq 60\%$	0- 9
Satisfactory Knowledge $> 60\%$	9-15

Reliability

The reliability of the instruments was done to determine the extent to which items in the questionnaire were related to each other by Cronbachs co-efficiency alpha for the questionnaire ($\alpha = 0.83$).

Tool two: a clinical practices guideline adherence scale . it was adopted from Chan et al. (2020) to assess nurses performance on management and prevention of I/E: it included 27 items . 11 items about method of prevention of I/E and 16 items on management. All items were covered assessment, management and prevention of I/E and rated by observation, or by asking nurses about the items.

The items were scored as (satisfactory performance), (unsatisfactory performance), The rate was obtained by dividing the total number of satisfactory performance items by the total number of items and multiplied by 100 (range: 0–100).

Scoring items	%
unsatisfactory performance	$\leq 60\%$
satisfactory performance	$> 60\%$

Reliability

The reliability of the instruments was ($\alpha=0.88$) by Cronbachs co-efficiency alpha

Tool three: IV Infiltration Assessment Scale it was adopted from Infusion Nurses Society (2016).The scale which evaluated the infiltration site. It contained ratings on a scale from 0 to 4 as follows: Grade 0 = No symptoms; Grade 1 = Skin blanched, edema

(2.54 cm); Grade 2 = Skin blanched, edema (2.54 to 15.24 cm); Grade 3 = Skin blanched, gross edema (15.24 cm), Grade 4 = Skin blanched, bruised, swollen, gross edema > (15.24 cm).

Tool four : IV extravasation Scale it was adopted from National Cancer Institute. (2016) to evaluates the extravasation site by rating it on a scale from 0 to 5 (Grade 1 = No symptoms; Grade 2 = Erythema; Grade 3 = Ulceration; Grade 4 = Life-threatening consequences; Grade 5 = Death).

Validity:

For validity assurance, instruments were provided to a jury including one professor of pediatric nursing, one assistant professors of pediatric nursing, Faculty of Nursing, Menoufia University and one assistant professors in pediatrics. Menoufia university. The modifications were done to ascertain their relevance and completeness.

Ethical consideration:

- An approval of the faculty of nursing institution ethical research committee was obtained.
- A written formal consent for acceptance was obtained from the nurses.
- An initial interview was done to inform nurses about the purpose of the study and explain that participation in the study was voluntary and the participants could withdraw from the study at any time

Pilot study :

It was conducted on 3 nurses 3 neonate to test the applicability, clarity, feasibility of the instruments, and to detect the obstacles and problem that may be encountered during data collection. It also helped to estimate the time needed to fill in the tool, The pilot sample was excluded from the total sample.

Procedure:

- A formal letter was directed from the Dean of the faculty of Nursing ,Menoufia University to the directors of Shebin El-kom Teaching Hospital. And El Tala hospital explaining the purpose of the study and data collection method.
- Data collection for this study was conducted for a period of 7 months extending from the 1st of May 2021 to the end of November 2021
- The researcher introduced herself to the nurses who shared in the study, explained the purpose of the study and methods of data collection.
- tool one was distributed between nurses (pretest). Each data collection interview lasted between 15 to 20 minutes. It took about 4 weeks for all nurses to fulfill the pretest instrument.
- Assess nurses performance & adherence to treatment and prevention of I/E was rated by observation or by asking nurses about the items using tool two (pretest)
- Assess neonates for incidence rate of extravasation and infiltration by using tool three & tool four . IV infiltration was graded by a neonatal nurse. while IV extravasation grade(2 - 4) was rated by consensus between neonatal nurse and neonatologist. (pretest)
- Nurses were divided into small groups. Each group included about 2 to3 nurses. They received about 4 sessions within 4 weeks (1 sessions per week) .Each session lasted for 30 minutes. group discussions oral presentations, booklet, feedbacks were used for health education, all sessions were conducted in the nursing room in the previously mentioned settings.

- The first session included information about definitions extravasation causes , risk factors, definitions infiltration , causes and risk factors,
- The second session included information about method of prevention extravasation and infiltration, types of medication increase risk of extravasation and infiltration , degree of extravasation and infiltration.
- The third session included over description to clinical practices guideline. The aim of these guidelines was to minimize the side-effects of IV injection, raise the medical team's awareness of extravasation, improve patient outcome. These clinical practices guidelines consist of 27 recommendations about basic knowledge about extravasation and infiltration, extravasation and infiltration management, method of and prevention, antidotes, drugs with high osmolarity, special drug management, and drugs with pH are provided as supplement files.
- These recommendation divided into 11 recommendation for prevention including(Assess signs and symptoms of Peripheral intravenous extravasation, (PIVE), assess signs and symptoms of PIVE, identify high-risk drugs/infusate for PIVE, administer high-risk drugs/ infusates via a CVC, administer parenteral nutrition via a CVC, assess patency of peripheral intravenous devices prior to drug administration, secure peripheral intravenous device with transparent dressing, splint extremities with a peripheral intravenous device in situ and assess patient for ECL and Confirm) and 16 recommendations for treatment including (Initiate actions for managing PIVE at once, Grade PIVE severity with infiltration scale, Implement management of Grade 1 and 2 PIVE, notify physician for Grade 3 and 4 PIVE, Administer Hyaluronidase for PIVE caused by non-vasopressor, inject Hyaluronidase for PIVE caused by non-vasopressor, inject Phentolamine for PIVE caused by vasopressor, initiate non-pharmacological pain relief, Offer pharmacological pain, Observe PIVE with intact skin hourly for 12 hours, Remove the CVC for ECL, Initiate nursing interventions to manage ECL , Initiate nursing interventions to manage ECL, Consult wound nurse for wound management and Document PIVE or ECL on extravasation record.
- The fourth session were conducted to train nurses about how scoring the degrees of extravasation and infiltration, how to apply the clinical practices guideline recommendation with each degree.
- posttest was done 3months later by the researchers after the completing implementation of the clinical practices guideline to ensure that all nurses were participants by using the previous tools for nurses and neonates.

Data analysis:

Data was coded and transformed into specially designed form to be suitable for computer entry process. Data was entered and analyzed by using SPSS (Statistical Package for Social Science) version 22. Quantitative data were presented by mean (X) and standard deviation (SD). It was analyzed using Student t- test for normally distributed quantitative variables to measure mean and standard deviation. Pearson correlation test was done to study

correlation between one qualitative variable and one quantitative variable or two quantitative variables. Qualitative data were presented in the form of frequency distribution tables, number and percentage. It was analyzed by chi-square (χ^2) test.

Results:

Table (1): Shows characteristics of studied nurses. It was obvious from the table the mean age of nurses was (30.47 ± 8.059). Regarding education level, more than half of nurse (56.6%) were graduated from nursing institute.

Table (2): Shows characteristics of studied neonates. As illustrated in the table, regarding the mean weight neonates on pre and posttest was ($2.68 \pm .467$ & $2.72 \pm .429$) respectively

Figure (1): Clarifies causes of neonates hospitalization. As revealed from this figure near half (47%) of studied neonates hospitalized for prematurity and other diseases on pre intervention.

Table (3): Displays frequency and percentage distribution of nurses knowledge about intravenous infiltration and extravasation pre and posttest. This table reveals that the highest percentage of nurses have a higher knowledge regarding prevention of extravasation, management of extravasation and risk factor of neonatal extravasation posttest than pretest with statistically significant differences between nurses' knowledge posttest than pretest ($p<0.00$)

Figure (2): Shows total level of the studied nurses' knowledge about IV extravasation and Infiltration pre and posttest. As revealed from this figure 93.3% of the studied nurses had a satisfactory level of total knowledge post-intervention instead of 50.0% preintervention.

Table (4): Shows frequency and percentage distribution of the nurse adherence to guidelines of prevention of intravenous infiltration and extravasation pre and post test.

It was obvious from this table the highest percentage of nurses had higher adherence to recommendations of prevention by assess signs and symptoms of peripheral intravenous extravasation, administer parenteral nutrition via a CVC, assess peripheral IV site/s every 10 minutes for high-risk drugs/infuse than posttest than pretest. So there were statistical significant difference between nurses on pre and post test ($p<0.001$).

Table (5): Shows frequency and percentage distribution of the nurse adherence to guidelines of management of intravenous infiltration and extravasation pre, post test. It was obvious from this table the highest percentage of nurses had higher adherence to recommendations of management by initiate actions for managing PIVE at once, administer phentolamine for PIVE caused by vasopressor, initiate non-pharmacological pain relief, observe PIVE with intact skin hourly for 12 hours, document PIVE or ECL hours, document PIVE or ECL and report extravasation injury to parents posttest than pretest. So there were statistical significant difference between nurses on pre and posttest ($p<0.001$).

Table (6): Displays total levels of nurses practices regarding adherence to guidelines of prevention and management of intravenous infiltration and extravasation pre and post test. It was obvious from this table the majority of nurses (97.0%) had satisfactory practices adherence to guidelines posttest. So there were statistical significant difference between nurses pre and post test ($p<0.001$).

Table (7): Identifies frequency and percentage distribution of infiltration and extravasation incidence rate among the studied neonates pre and posttest. The table represented that (63.3% & 83.3%) respectively of studied neonate had no symptom of infiltration and extravasation post intervention

Figure (3): Clarifies Pearson correlation between total nurses' knowledge and

practices regarding adherence to guidelines of prevention and management of intravenous infiltration and extravasation on post test. As

revealed from this figure there was positive correlation.

Table (1) Characteristics of Studied Nurses.

Items	No (N= 30)	%
Education		
Secondary education	7	23.3%
Nursing institute	17	56.7%
University	6	20.0%
Nurses age X±SD	30.47±8.059	
Years of experience X±SD	9.33±7.331	
Total	30	100

Table (2) Characteristics of Studied Neonates

Items	Pre (n=30)		Post(n=30)		X² and P – value
	No	%	No	%	
Neonates Maturity					
Pre term	14	46.7	10	33.36	.000 ^{ns}
Full term	16	53.3	20	6.6	1.000
Week of gestation X±SD	38.27± 1.818		39.67± 1.826		-.850 ^{ns} .399
Weight X±SD	2.68±.467		2.72±.429		-.357 ^{ns} .722

ns= not significant ($p>0.05$) ^(S) = ($p<0.05$) ^(HS)=($p<0.001$)

Figure :1 Causes of Neonate Hospitalization

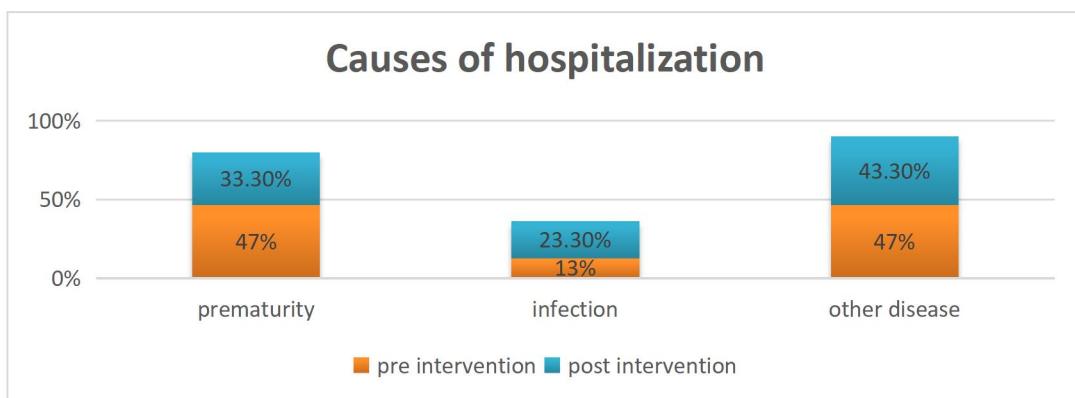


Table (3): Frequency and Percentage Distribution of Nurses Knowledge about Intravenous Intravenous Infiltration and Extravasation Pre And Posttest.

Knowledge items	Pre (n=30)		Post (n=30)		X ² 1 and P1 – value
	No	%	No	%	
Prevention of Extravasation Injuries					
Confirm correct CVC catheter tip position correct	30	100.0	30	100.0	1.000 ^{ns}
assess peripheral IV site every 10 minutes	13	43.3	6	20.0	3.77 ^{HS}
In correct	17	56.7	24	80.0	.052
Correct					
Assess peripheral IV site every 10 minutes for phenytoin administration	20	66.7	9	30.0	8.07 ^{ns}
In correct	10	33.3	21	70.0	.004
Correct					
Assess peripheral IV device patency prior to medication administration	3	10.0	0	0.0	3.15 ^{ns}
In correct	27	90.0	30	100.0	.076
Correct					
Identify possible signs and symptoms of ECL	25	83.3	11	36.7	13.61 ^{HS}
In correct	5	16.7	19	63.3	.000
Correct					
Recognize ECL presentation	23	76.7	10	33.3	11.38 ^{HS}
In correct	7	23.3	20	66.7	.001
Correct					
Management of Extravasation Injuries					
Administer hyaluronidase for PIVE caused by parenteral nutrition	29	96.36	12	40.0	22.61 ^{HS}
In correct	1	3.3	18	60.0	.000
Correct					
Discontinue IV infusion therapy at once on detection of Grade 3 PIVE	13	43.3	3	10.0	8.52 ^s
In correct	17	56.7	27	90.0	.004
Correct					
entity most appropriate nursing interventions for Grade two PIVE	5	16.7	1	3.3	2.96 ^{ns}
In correct	25	83.3	29	96.7	.085
Correct					
Give hyaluronidase on phenytoin related PIVE	27	90.0	10	33.3	20.37 ^{HS}
In correct	3	10.0	20	66.7	.000
Correct					
appropriate actions when ECL presents with pericardial effusion	23	76.7	4	13.3	24.31 ^{HS}
In correct	7	23.3	26	86.7	.000
Correct					
Risk Factors for Neonatal Extravasation Injuries					
appropriate actions when ECL presents with pericardial effusion	11	36.7	5	16.7	3.068 ^{ns}
In correct	19	63.3	25	83.3	.080
Correct					
Identify the physical characteristics of neonates that are prone	15	50.0	0	0.0	20.00 ^{HS}
In correct	15	50.0	30	100.0	.000
Correct					
Administer acyclovir via a PIVC is at a high risk of PIVE	22	73.3	12	40.0	6.78 ^s
In correct	8	26.7	18	60.0	.009
Correct					
Identify high-risk medications for PIVE	15	50.0	4	13.3	9.320 ^{HS}
In correct	15	50.0	26	86.7	.002
Correct					

ns = not significant ($p > 0.05$) s = significant ($p < 0.05$) Hs = highly significant ($p < 0.001$)

Abbreviations: (CVC) Central venous catheter, (ECL) Extravasation from a central line, (PIVC) Peripheral Intravenous Catheter, (PIVE) Peripheral intravenous extravasation

Figure (2): Total level of the Studied Nurses' knowledge about Intravenous Extravasation and Infiltration Pre And Posttest.

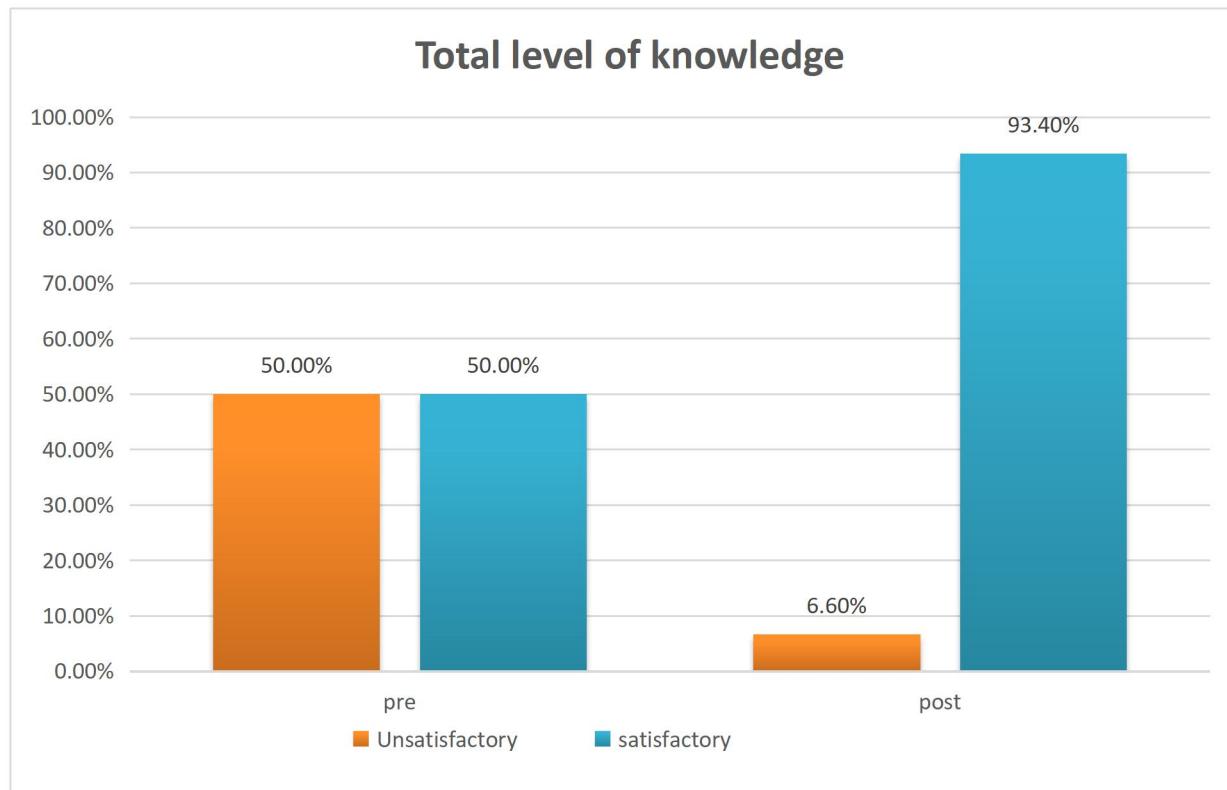


Table (4): Frequency and Percentage Distribution of the Nurse Adherence to Guidelines Of Prevention of Intravenous Infiltration and Extravasation Pre and Post Test.

Nurses' adherence to method of prevention (11 recommendations)	Pre (n=30)		Post (n=30)		χ^2 1 and P1 – value
	No	%	No	%	
Assess signs and symptoms of PIVE					
unsatisfactory performance	9	30.0	1	3.3	7.68 s .006
satisfactory performance	21	70.0	29	96.7	
Assess peripheral IV infusion site/s hourly					
unsatisfactory performance	15	50.0	5	16.7	7.50 s .006
satisfactory performance	15	50.0	25	83.3	
Identify high-risk drugs/infuse for PIVE					
unsatisfactory performance	3	10.0	1	3.0	3.15 ns .076
satisfactory performance	27	90.0	29	97.0	
For high-risk drugs/infusates, assess peripheral IV site/s every 10 minutes					
unsatisfactory performance	14	46.7	4	13.3	7.937s .005
satisfactory performance	16	53.3	26	86.7	
Administer high-risk drugs/infusates via a CVC					
unsatisfactory performance	10	33.3	3	10.0	4.812 s .028
satisfactory performance	20	66.7	27	90.0	
administer parenteral nutrition via a CVC					
unsatisfactory performance	11	36.7	0	0.0	13.4 Hs .000
satisfactory performance	19	63.3	30	100.0	
Assess patency of peripheral IV device/s prior to drug administration					
unsatisfactory performance	3	10.0	0	0.0	3.15 ns .076
satisfactory performance	27	90.0	30	100.0	
Secure peripheral IV device with transparent dressing					
unsatisfactory performance	13	43.3	7	23.3	2.70 ns .100
satisfactory performance	17	56.7	23	76.7	
Splint extremities with a peripheral IV device in situ					
unsatisfactory performance	22	73.3	10	33.3	9.64 s .002
satisfactory performance	8	26.7	20	66.7	
Assess patient for ECL					
unsatisfactory performance	4	13.3	3	10.0	.162 ns .688
satisfactory performance	26	86.7	27	90.0	
Confirm correct position of CVC tip					
unsatisfactory performance	11	36.7	2	6.7	7.95 s .005
satisfactory performance	19	63.3	28	93.3	

ns= not significant ($p>0.05$) s= significant ($p<0.05$) Hs= highly significant ($p<0.001$)

Abbreviations: (CVC) Central venous catheter, (ECL) Extravasation from a central line, (PIVC)Peripheral Intravenous Catheter, (PIVE) Peripheral intravenous extravasation

Table (5): Frequency and Percentage Distribution of the Nurse Adherence to Guidelines Of Management of Intravenous Infiltration and Extravasation Pre, Post Test

Nurses' adherence to management (16 recommendations)	Pre (n=30)		Post (n=30)		X ² 1 and P1 – value
	No	%	No	%	
Initiate actions for managing PIVE at once	14	46.7	5	16.7	6.23s
unsatisfactory performance	16	53.3	25	83.3	.012
satisfactory performance					
Grade PIVE severity with infiltration scale	15	50.0	7	22.3	4.593s
unsatisfactory performance	15	50.0	23	79.7	.032
satisfactory performance					
Implement management of Grade 1 and 2 PIVE	14	46.7	6	23.3	3.59s
unsatisfactory performance	16	53.3	24	76.7	.058
satisfactory performance					
Notify physician for Grade 3 and 4 PIVE	16	53.3	7	23.3	5.71s
unsatisfactory performance	14	46.7	23	76.7	.017
satisfactory performance					
Administer Hyaluronidase for PIVE caused by non-vasopressor	21	70.0	8	26.7	11.27 Hs
unsatisfactory performance	9	30.0	22	73.3	.001
satisfactory performance					
Administer Phentolamine for PIVE caused by vasopressor	17	56.7	5	16.7	10.33 Hs
unsatisfactory performance	13	43.3	25	83.3	.001
satisfactory performance					
initiate non-pharmacological pain relief	16	53.3	1	3.3	18.468 Hs
unsatisfactory performance	14	46.7	29	96.7	.000
satisfactory performance					
Offer pharmacological pain	10	33.3	4	13.3	3.354 ns
unsatisfactory performance	20	66.7	26	86.7	.067
satisfactory performance					
Observe PIVE with intact skin hourly for 12 hours	11	36.7	5	16.7	3.06 ns
unsatisfactory performance	19	63.3	25	83.3	.080
satisfactory performance					
Remove the CVC for ECL	30	100	30	100.	/
unsatisfactory performance					
satisfactory performance					
Initiate nursing interventions to manage ECL	6	20.0	1	3.3	4.043s
unsatisfactory performance	24	80.0	29	96.7	.044
satisfactory performance					
Consult wound nurse for wound management unsatisfactory performance	12	40.0	3	10.0	7.200s
satisfactory performance	18	60.0	27	90.0	.007
Document PIVE or ECL on extravasation record	12	40.0	0	0.0	15.00 Hs
unsatisfactory performance	18	60.0	30	100.	.000
satisfactory performance					
Report extravasation injury to parents'	23	76.7	5	16.7	21.69 Hs
unsatisfactory performance	7	23.3	25	83.3	.000
satisfactory performance					
Update progress of extravasation injury to parents	17	56.7	2	6.7	17.33 Hs
unsatisfactory performance	13	43.3	28	93.3	.000
satisfactory performance					
Incident reporting	3	10.0	1	3.3	1.07 ns
unsatisfactory performance	27	90.0	29	96.7	.301
satisfactory performance					

ns = not significant ($p > 0.05$) s = significant ($p < 0.05$) Hs = highly significant ($p < 0.001$)

Table (6): Total Levels of Nurses Practices Regarding Adherence to Guidelines Of Prevention and Management of Intravenous Infiltration and Extravasation Pre and Post Test.

Adherence level	Pre(n=30)		Post(n=30)		χ^2 P –value
	No	%	No	%	
Unsatisfactory practices adherence	14	46.7	1	3.0	18.26^{HS} P<0.001
Satisfactory practices adherence	16	53.3	29	97.0	

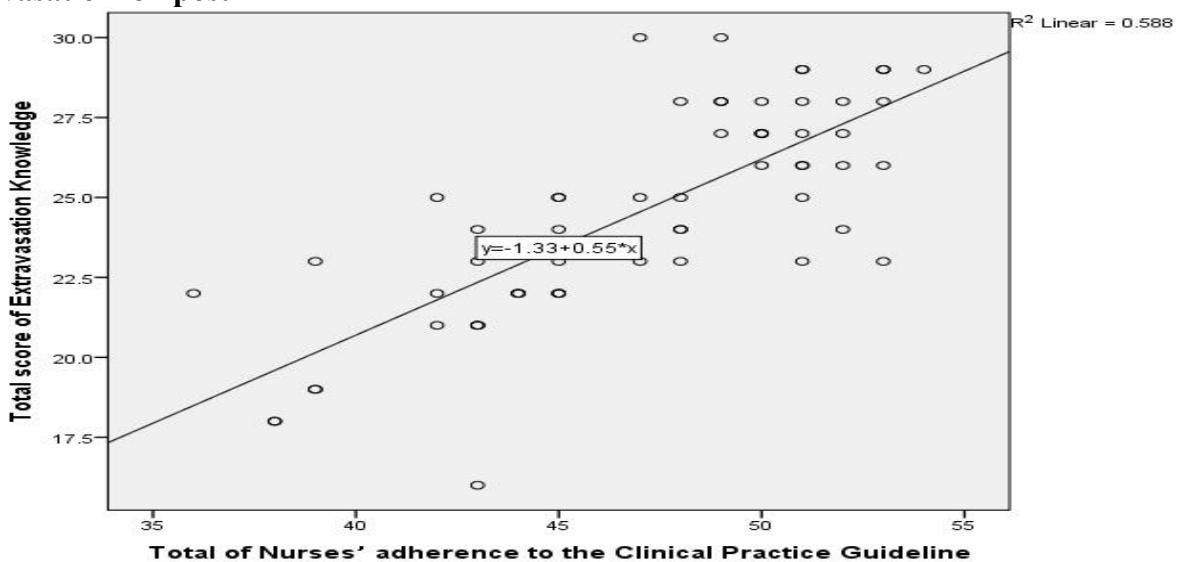
Hs= Highly significant ($p<0.001$)

Table (7): Frequency and Percentage Distribution of Infiltration and extravasation incidence rate among the studied neonates pre and posttest.

Items	Pre (n=30)		Post(n=30)		χ^2 and P – value
	No	%	No	%	
Infiltration Scale					
No symptoms Grade 1	6	20.0	19	63.3	3.143^{ns} .370
	16	53.3	9	30.0	
Grade 2	7	23.3	2	10.0	
Grade 3	1	3.3	0	0.0	
Grade 4	0	0.0	0.0%		
Extravasation Scale					
No symptoms Grade 1	19	63.3	25	83.3	2.631^{ns} .268
	9	30.0	5	16.6	
Grade 2	2	6.7	0	0.0	
Grade 3	0	0.0	0	0.0	
Grade 4	0	0.0	0	0.0	

(ns= not significant ($p>0.05$)

Figure (3): Pearson Correlation Between Total Nurses' knowledge and Practices Regarding Adherence to Guidelines Of Prevention and Management of Intravenous Infiltration and Extravasation on post



test.

Discussion

The rate of IV infiltration and extravasation is marked high among neonates which reach to 45.6% for peripheral venous catheters insertion, which 19.7% had stage I and 11.7% had stage IV (Atay et al.,2018). Neonates are at definitely high risk for extravasation because of their immature and skin with small diameter of their peripheral veins. The current study hypothesized that Nurses who received education about evidence based guideline of prevention and management of IV infiltration and extravasation would have higher knowledge to guidelines posttest than pretest. Also, Nurses who received education about evidence based guideline of prevention and management of IV infiltration and extravasation would have higher practices regarding adherence to guidelines posttest than pretest, In addition, the incidence rate of IV infiltration and extravasation would be reduced posttest than pretest.

In relation to hypothesis one. The results of the current study support the first hypothesis. For this, the current study

revealed significant improvement of nurses knowledge about nearly all items related to prevention and management of IV infiltration and extravasation post intervention than pre intervention.

Regarding total level of the studied nurses' knowledge about IV extravasation and infiltration pre and posttest, the highest percentage (93.3%) of the studied nurses had satisfactory level of total knowledge post-test instead of (50.0%) pretest , this reflect positive effect of evidence-based clinical practices guidelines , this result was consistent with Hussin et al. (2020) they stated that there was a need for structuring a permanent education program for management of extravasation due to nurse's knowledge was poor . Furthermore, this finding was consistent with Atay et al. (2021) they found that it was essential to develop guidelines for the management of extravasation, also, recurrent in-service training programs should be provided on the administration of vesicant drugs.

Besides, this finding was in agreement with Kahraman et al. (2020) they found an improved nurses' knowledge about

infiltration and extravasation management, and reduced infiltration and extravasation rates as well after the education program. also, improved nurses' knowledge led to an improvement in quality of care and increased patient safety. Also, Özalp et al. (2018) they found that The infiltration and extravasation prevalence was highly occurrence among pediatric patients, so training programs and implementation strategies should be set for pediatric nurses to prevent infiltration and extravasation. Also, Chau et al. (2021) mentioned that use of inquiry-based learning program was effective in enhancing nurses' knowledge of the prevention and management of neonatal extravasation injury.

In relation to hypothesis two: Nurses who received education about evidence based guideline of prevention and management of IV infiltration and extravasation would have higher practices regarding adherence to guidelines posttest than pretest. The finding of the current study showed that highest percentage of nurses had satisfactory practices regarding adherence to guidelines posttest than pretest, including (11) recommendation of method of prevention and (16) recommendations of management with statistical significant difference, this could be attributed to the fact that evidence-based clinical practices guidelines increased nurses' knowledge and in turn changed their practice and attitude. This study comes in agreement with Chan et al. (2020) they found that the implementation of an evidence-based clinical practices program of prevention and treatment of infiltration and extravasation, led to improved nurses' knowledge and practice and increased nurse's adherence to the evidence guidelines.

Also Yan et al. (2017) they found that extravasations were treated by using systematic implementation of intervention that alleviating the extravasation injuries and improving the patients' outcome, in addition, the finding of the present study is consistent with Boyar & Galiczewski (2021) they

concluded that, the overall rate of adherence to the peripheral intravenous catheter securement guideline was between 80% and 98%. between studied nurses' group, which associated with a marked decrease in prevalence of extravasation. Furthermore, the finding was in line with El-Hamed et al. (2017) they found that significant improvement in nursing staff knowledge and performance after implantation of prevention and management of chemotherapy extravasation guideline.

About hypothesis three: the incidence rate of infiltration and extravasation would be reduced posttest than pretest. The finding of the current study showed a marked decrease in the incidence rate of infiltration and extravasation posttest than pretest with no statistical significant difference, this reflects the positive effect of evidence based clinical evidence-based practices guidelines and effective nurses' adherence to clinical practices guidelines. This result comes in agreement with Chan et al. (2020) they found that the implementation of an evidence-based clinical practice guideline significantly reduced the rate of peripheral intravenous extravasation in neonates.

In the same context, Boyar and Galiczewski (2021) they found that The prevalence of extravasations was decreased from 73 preintervention to 40 postintervention as a reflection of the implementation of quality improvement projects for the prevention and management of extravasation. Also, Odom et al (2018) they found that the initial treatment approach, which provided by nursing, had been effective in the reduction of the majority of grade 3 and 4 peripheral infiltration injuries. in the same line Kim et al. (2020) found that the medical team's continued education on extravasation was essential. The practical use of these guidelines would reduce the occurrence rate of extravasation and improve care outcomes.

Also, it contributed to a decreased in incidence rate of IV infiltration and extravasation among studied neonates.

Conclusion:

Based on the finding of the present study and the research hypotheses, it was concluded that implementation of evidence-based clinical practices guideline regarding IV infiltration and extravasation significantly increased nurses' knowledge and practices regarding adherence to guideline posttest than pretest.

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