Structured Educational Program and Peripheral Intravenous First-Time Insertion Rate in Saudi Arabia

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Abstract

Peripheral intravenous insertion (PIV) is one of the most common clinical procedures which nurses receive little formal training. It is said that more than a quarter of first-time insertion rate (FTIR) fail (Hess 2010), thus, patient experience is at risk if this is not performed by a trained staff. This study aimed to explore if a Structured Educational Program (SEP) was effective to increase a hospital's FTIR which has a failing international benchmark scores. It used a quasi-experimental design and pre-experimental one-group pretest post-test to examine the pre and post-test data set among 160 respondents. It was found out that the most of respondents are Filipinos in their 30's who have bachelor's degree. They have a decade or less of experience; have had no PIV training in their home country; and have less than five daily insertions. It was revealed that the SEP was effective knowledge and skills improvement. Ages, nationality, years of experience, and specialization were found to be related to improve knowledge; while nationality, licensure exam ratings, frequency of PIV insertions, and relevant trainings were associated on an enhanced skill.

Keywords

First-time insertion success, intravenous insertion, structured educational program, quasi-experimental, Saudi Arabia

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Introduction

Structured Educational Program (SEP) is a type of systematic program where scope is comprehensive, has an adjustable content, and responsive to the individual's clinical and psychological needs with consideration to his/her educational and cultural background (NICE, 2003). This is particularly beneficial on acquiring new knowledge and skills in a clinical setting; and that is performed efficiently by trained interdisciplinary teams to groups of people with the same field of experience. Peripheral intravenous (PIV) therapy is one of the most common clinical procedures in a healthcare facility (De Lima Jacinto, Avelar, & Pedreira, 2011). PIV insertion is the quickest, simplest, and cheapest way to gain access to the vein, and it is used for intravenous fluid replacement, medications, and administration of blood products and contrast dyes. It is the most common clinical procedure that accounts to 7 out of 10 hospital patients receiving a vascular access device (VAD) or a cannula. The nurse, as a healthcare provider, is responsible and accountable for ensuring that this procedure is safe and effective (Amjad, Murphy, Nylander, Housholder, & Ranft, 2011; Anson, Edmundson, & Teasley, 2010; De Lima Jacinto et al., 2011; Doellman et al., 2009; Walsh & Schad, 2012).

First-time insertion success rates (FTIR) refers to the proportion of first-time intravenous success of insertion to the total number of insertions. This ranges from 18 to 98% in the literature (Jacobson, Winslow, 2005; Sabri, Szalas, Holmes, Labib, Mussivand, 2013). Both the inserter and patient factors contribute to difficult PIV cannulation. Interestingly, previous PIV insertion experience plays the major role in its success. Patient factors that are associated with higher failure rates include low blood volume, recent chemotherapy and IV drug use. Anatomical factors also contribute to a very high or low body mass index, shade of the skin, and the quantity and size of visible and palpable veins. PIV insertion is frequently considered simple but can exhaust a clinician's time. It is acknowledged that two failed attempts can be considered a 'difficult insertion'. Peripheral intravenous catheter failures and its complications are expensive for hospitals and managers. The average cost of a short peripheral intravenous catheter insertion costs between 105 and 135 Saudi Riyals (Php 1,400 and Php 1,800) for straightforward "first-stick" insertions (Rickard, Webster & Wallis, 2012). But, the expenses can change significantly, depending on geographic factors, the type of cannula inserted, and the stabilization supplies such as dressings and connectors or tubings which are taken into account when a failed catheter has to be changed. As King Abdullah bin Abdulaziz University Hospital (KAAUH) opened its door to Princess Nourah bint Abdulrahman University's faculty, staff, and their dependents back in 2017, nursing skill- related issues emerged with PIV insertion in particular. Safety events and patient experience reports from the hospital's patient safety department revealed that there were around 20 incidents related to multiple PIV attempts/failures of insertion of nurses per month which was relatively high compared to few patient visits. The were 65% and 60% as average FTIR of adult and pediatric respectively in which this average waswas below the international accepted FTIR of adults (75%) and children (70%) (Carr et al., 2015).

As a result, the Nursing Department has trained their nurses in busy government hospitals in Riyadh and hired IV expert nurses from the Philippines in an attempt to

improve its FTIR. There were a couple of short-lived quality projects on PIV insertion among staff nurses between 2017 and 2018 but these were deemed to be ineffective band-aid solutions. In this regard, the researchers wanted to impart a more systematic and continuous department-wide research and educational program to explore ways to solve this perennial problem. This study was designed to address performance gaps between the nurses' performances and FTIR because of the failing rates.

The general objective of the study was to determine the effectiveness of the SEP on FTIR. The study aimed to (1) describe the socio-demographic characteristics of the respondents; (2) determine and compare the pre-test and post-test scores of the respondents from the Knowledge-based Questionnaire (KBQ); (3) determine and compare the FTIR before and after the SEP; (4) find out the significant relationship between the respondents' socio-demographic profile and their post-test scores in the KBQ and socio-demographic profile and their FTIR after the SEP; (5) find out if there is a difference between the respondents' pre-test and post-test in the KBQ and FTIR before and after the SEP; and (6) to develop and enhance the procedures from the existing SEP based on the study's findings.

Literature Review

Peripheral intravenous (PIV) insertion is one of the most common nursing procedures performed in a hospital, but most nurses receive little formal training in this area. Many studies have revealed that more than a quarter of first-insertion attempts fail (Lapostolle et al., 2007). Moreover, pediatric first time insertion rates were even more disturbing were it spiked to above 50% (Hess, 2010). It was documented in some studies that there was a 14% failure rate among adults. However, most of the respondents, who are patients, have white skin tones and almost normal body weights. Failure rates soared as age gets lower.

One of the hospital programs to improve the nurses' proficiency in PIV insertion is a test-enhanced learning. Test-enhanced learning a teaching strategy that has shown potential in previous studies evaluating acquisition of knowledge; however, there is limited evidence on the effectiveness of pre and post-evaluation scores using knowledge-based questionnaire for procedural skills. But some researchers also cited the importance of pre-instruction and post- instruction evaluation scores to determine and improve the performance of nurses who inserted a peripheral IV (Hossain, 2016). Meanwhile, a blended test and skills-based program can be effective. A study by Keleekai in 2016 indicated noticeable development on nursing skills upon completing the training program. A blended learning program, which included a mixture of both online and simulation-based instruction, significantly improved nurses' knowledge, confidence, and skills in the PIV insertion process in a simulated environment. The results of this study were encouraging and support additional research and its impact on direct patient care and, ultimately, PIV complications.

Socio-demographic profile and how it affects the respondents' performance of PIV insertion is still an area that needs to be examined much further. This could be a great tool to improve the overall FTIR. A study of Ahmed (2016) discovered that there was highly significant relationship between demographic characteristic of the study group (age, educational qualification, experience, sex) and knowledge level on the prevention of infection or general information of complication and selection of the vein. Meanwhile, the

findings from the study of Ho, Siew, and Tang (2016) showed higher mean scores of the respondents from the specialty areas as compared to the medical surgical wards in terms of knowledge and practice towards PIV. Several researches had also supported these correlations however; there are no current and consistent findings to support this research. Knowledge of human anatomy and physiology aspects of peripheral vascular access is an important factor to a successful PIV insertion (Hadaway, 2012). Retention of information, long-term memory, and application of new knowledge and skills are a part of a sophisticated human thought process. Thus, pre-test and post-test scores are integral in improving PIV insertion skills.

Methodology

Research design, respondents, and sampling procedure

This research used a pre-experimental one-group pretest post-test under the quasi-experimental design. It is where one case is studied or observed at two points in time, the first before and the second is after the treatment (Nieswiadomy, 2012). Using this type of research design, the researchers measured the scores before and again following a treatment, then compared the difference between the pre-test and post-test scores. Changes in the outcome of interest were presumed to be the result of the intervention. No control or comparison group was necessary. In this study, the treatment/intervention was the SEP and outcomes were the FTIR and post-test scores. Additionally, this research used descriptive and correlation methods. Both designs were presumed to be helpful in describing the respondents' profile and correlated these data set to determine what variables were correlated.

The study's respondents were the staff nurses in KAAUH. This hospital is a tertiary care facility in Riyadh, Kingdom of Saudi Arabia. The study used purposive sampling technique as sampling procedure. The study had only targeted unit respondents with more than three years of clinical experience and those who were recommended by their managers (due to staffing and scheduling). *Intravenous Access Volunteers, the* IV access volunteers were nurses who provided their veins for research purposes. The researchers advertised the program to all unit managers and nurses. This advertisement included recruiting and engaging clinical nurses to be part of the IV access volunteers. This was done to enable respondents to practice their skills on an actual vein. It is important to note that there were the same volunteers in the pre- instruction/pre-test and post-instruction/post-test to strengthen the study's external validity. The 160 respondents needed 10 IV access volunteers, yielding to about 3,200 insertions that were divided in pre and post instruction parts.

Research framework

This research study was anchored on the theory of George Miller (1990). Miller's Pyramid is a useful framework to guide and assess the competence of a clinician's skill in education. This could also help health educators to gauge learning outcomes or clinical competencies. This is an extremely useful tool in this study as it provides a structured approach to the assessment of nursing competence. This theory also proposed a four-level

structure, and each of level encompasses precise assessment methods (the levels are "Knows," "Knows How," "Shows How," and "Does"). This explains that the study has similar procedure to enhance the learning process by introducing interventions such as Knowledge-based Questionnaire (KBQ), practice and skills check, demonstration, and return demonstration to make nurses competent on PIV insertion. Moreover, the study was also anchored with the principles of the Four Levels of Education Evaluation (1959) by Donald Kirkpatrick. This framework explains the use of simulation results on improving knowledge and performance. This is true with the study's objectives where there were reactions and learning stages (knowledge and skills section) before a behavioral change (or the improvement of knowledge and skills) could happen.

This study determined the socio-demographic factors of the respondents, their FTIR, and post test scores which are the components of the educational program. These data were analyzed using the inferential statistics and other data management tools in order to investigate if the program is effective to increase the respondents' PIV insertion knowledge and skills. Ultimately, the output of this research aimed to develop a comprehensive SEP that would be based on the study's findings. This conceptual framework was anchored on the theories of Miller (1990) wherein the pre-test instruction and FTIR embodied the "Knows", Know-how", and "Show-how" before they "does". This is also true with Kirkpatrick's Theory (1959) wherein the research had addressed the reaction and learning of the respondents first (pre-test and intervention) before the behavioral change occurs (output). Based on the said framework, theories, and models discussed, the researchers were able to design the conceptual paradigm:

Figure 1. *The conceptual framework of the study*
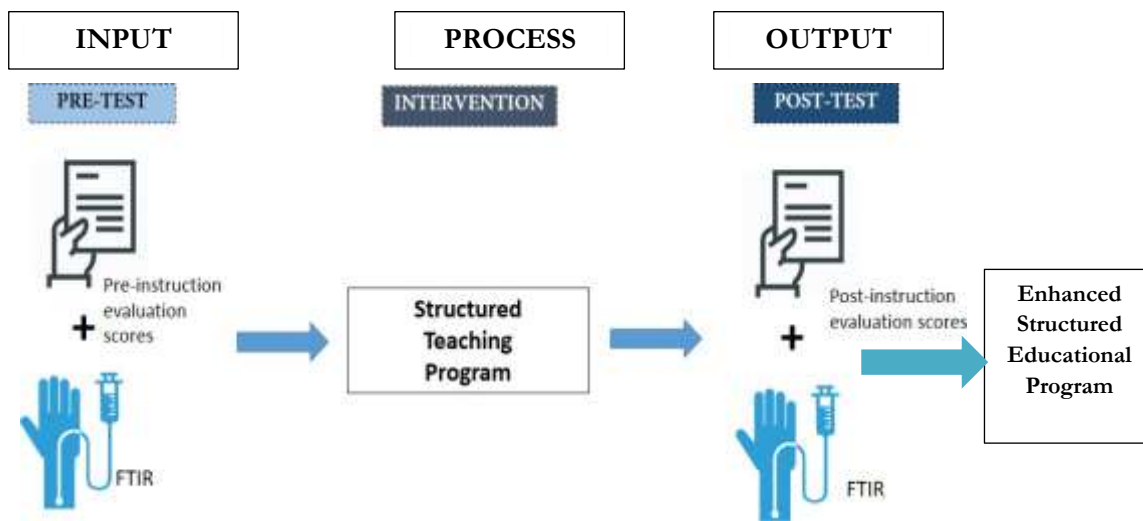
Research instruments

The researchers used a significant, structured, and self-made instrument that helped gather accurate and reliable data. The research instrument has three parts, namely: Part I.

Socio-demographic Profile, this part was made by the researchers which comprised of the age, gender, educational attainment, clinical unit, and years of clinical experience. Part II. ***FTIR Monitor,*** the FTIR was also measured accurately, hence a form was used. This monitoring tool includes socio-demographic questions essential for statistical analysis in order to examine significant relationships between their profile, FTIR and the evaluation scores. This also includes a table which consists of the name of the volunteer, their clinical unit, if the insertion was a success or not, and the signature of the evaluator. Part III. ***Knowledge-Based Questionnaire (KBQ),*** this questionnaire was used to evaluate the pre and post instruction knowledge of the respondents. This 30-item exam includes questions on insertion, equipment and supplies, complications of IV therapy and its evidence-based guidelines. ***Program Evaluation,*** there were eight questions pertaining to program evaluation as a subjective response to the effectiveness of the program. This was answered after the lecture.

Data collection technique

Prior to the data collection, a Peripheral Intravenous Care Module and instructional plan were made. Afterwards, a written permission was obtained and a proposal review was presented to KAAUH - Nursing Affairs Evidence-Based Performance Unit. Thereafter, the researchers requested for an ethical clearance from the university's Institutional Review Board. The staff nurses from different areas were selected based on the inclusion criteria. Then, the purpose of the study was explained and a written consent had been taken before starting the study.

The data on FTIR were measured as the success index of the respondents' skills. FTIR is the proportion of first time successful peripheral IV insertion made by a nurse (number of first time success PIV insertion over the total number of insertions multiplied by 100%). The IV access volunteers have been instrumental in applying the respondents' knowledge in an actual scenario.

Structured Educational Program (SEP), the structured educational program is a 12-day long educational program led by the researchers. The data collection technique has three parts: (1) Pre-instruction evaluation. As part of the pre-evaluation, the respondents have had inserted ten VADs to the same number of IV access volunteers over a five-day period. FTIR was measured accordingly. A pre-test was given during the first day with the use of a knowledge evaluation questionnaire to assess their knowledge. (2) Theoretical Part. After measuring the pre FTIR and pre KBQ results, theoretical part came next. This was a two-day pure lecture that was led by the researcher with his team of PIV experts. The learning environment was suited according to the respondents' need and had included simulation equipment to supplement their learning. There were practice sessions at the end of the lecture in order to facilitate the respondents' dexterity on PIV insertion. (3) Post-instruction evaluation. After the lecture, the respondents repeated the PIV insertion to the same access volunteers over a five-day period. FTIR was measured ditto. Finally, a post-test was answered by the respondents with the use of the same evaluation form that was used in the pre-test. This part enabled the researchers to acquire post FTIR and KBQ results.

Data analysis

After a complete data collection, the researchers started summarizing and evaluating the responses of the respondents using frequency distribution, percentages, weighted mean, and Independent Samples t -test to examine if the socio-demographic profile was related to FTIR, post-test exam scores, and if FTIR as well as pre-test and post-test were different from each other. Also, Pearson Product Moment Correlation was used to measure the strength and direction of the relationship between variables.

Findings

Socio-demographic characteristics

Ages, majority of the respondents were in the range of 31-40 (46.25%). The mean age of the respondents was 33 with a standard deviation of 4.94. This means that most of the nurses in this study are in the young working population group. Young working population especially nurses tend to work overseas for better pay. A fairly large proportion of them work in the Middle East or western countries like the US and the UK because of the huge employment and healthcare benefits. In the present, a high percentage of young people work for their healthcare sector, particularly nurses, encompassing other age groups. Although these young people are attracted to work in Saudi hospitals because of non-taxable income, better pay, and free housing services, new interns experience negative perceptions from Saudi society, which sometimes leads some nursing interns to withdraw from the field (Khankeh et al., 2014).

Sex, based on the data gathered, it was found that most of the respondents were females (81.25%). Apparently, most hospitals lean on employing more female nurses as they are less restricted to handle patients (especially female) compared to men (Farmer, 2015). Gender sensitivity in the culture of Saudi Arabia has an impact on job performance at KAAUH. Gender diversity in a healthcare setting, especially in the Kingdom could also affect the performance of the nurses in providing care to the patients and their job satisfaction as well. Furthermore, male nurses tend to face resistance in the workplace from females since there are a number of limitations for male nurses in Saudi especially on performing clinical or nursing procedures such as restricting a male nursing staff to perform female urinary catheterization.

Nationality, the data shows that 131 (81.88%) of the respondents were Filipino nurses. This implies that Filipino nurse make up a significant portion of the immigrant nursing population in their countries of destination. This is because of Saudi's industrialization and slow school infrastructure in the past decades, Saudi Arabia has been sluggish to produce an adequate number of healthcare workers; and a large number of healthcare professionals continue to be non-Saudis. This opened opportunities for nurses to work in the kingdom, offering good compensation and benefits such as free housing, food allowances, and paid annual leaves. Philippines, as one of the top producers of nurses

internationally, has become a major supplier of experienced healthcare workers that had filled in the needed workforce of large hospitals in the kingdom.

Educational attainment, findings revealed that 143 (90%) of nurses in KAAUH have BSN degrees which garnered the greatest number of respondents. The highest percentage, BSN, can be explained because majority of the respondents are Filipino nurses. They are mandated by Commission of Higher Education to complete a four-year bachelor's degree before taking the professional licensure examination for nurses. Meanwhile, other countries such as South Africa and some parts of India require a diploma level before their nursing registration.

Type of nursing school, a higher proportion was in favor of state-funded schools with 83 which is more than a half of the total while those who graduated from privately-owned schools were 77 (48.13%). These scores have been determined of their nursing schools and not of their post-graduate schools. Though there is a higher cost related to studying in a private nursing school, there are also some advantages such as their training on both private and government health facilities whereas government-run schools are required to do their nursing training at public hospitals. Nevertheless, Saudi government does not discriminate nursing schools in employment process.

Board exam rating, there was exactly similar values on the range of scores of 71-80 and 81-90. These ranges both have the frequency of 72 (45%). Board examination ratings differ from country to country. The board exam in the Philippines is a 500-item multiple choice exam to test basic nursing level competency where a candidate must obtain a general average of at least seventy five percent (75%) with a rating of not below sixty percent (60%) in any of five test subjects. However, this is entirely different from India in which one takes a relevant nursing course, satisfies its criteria then admitted to their nursing school. After practical exams, they register with their relevant nursing registration council which appraises and screens their documents. They could take nursing examination board to become a registered nurse or on the other hand, finish a four-year course in a university. Meanwhile, all nurses who work in Saudi should successfully meet the passing rate of 50 percent in Saudi Prometric Exam. These ratings are imperative as theoretical knowledge is a crucial factor to obtain a Saudi nursing license and successfully pass core nursing competencies before a nurse could train and handle patients in special hospital areas or even in a ward.

Years of experience, most of the respondents have less than a decade or a decade of relevant experience with 87 (54.38%). The salary in Gulf countries where Saudi Arabia is a part, depend on nurse's qualifications, area of specialty, years of experience, and other skills a nurse may have to suit the position. Technically, the more experience the nurse is, the more salary they get. This also accounts to the skill of nurses, as nursing is a highly skilled profession which means nurses build their skills and knowledge over time. Mastery of nursing procedures requires hours or even years to perfect competently.

Clinical unit, the next socio-demographic profile is the Clinical Unit where almost all the units such as Intensive Care Unit, Pediatric Ward, Neonatal Intensive Care Unit, Women's Health Ward, Labor and Delivery, Medical Ward, and Surgical Ward received an equal distribution with 15 (9.38%).

Frequency of PIV insertion, it is evident that nurses have five or less insertions per day. This accounts to 107 (66.88%). Majority of the nurses working in wards have fewer PIV

insertion cases as they have less acutely ill patients requiring PIV therapy. Unlike in the Emergency Department which has a greater influx of people demanding intravenous access according to their physiological needs. PIV insertion is one of the many skills that improve over time and goes proportionally with frequency of performance which would translate that nurses who do more insertions in a regular basis is more skilled than those who do not.

Training in PIV therapy (home country), training in PIV therapy in their Home Country is also less different from each other. Those without training in their home country is 86 (53.75%) while 74 (46.25%) had attended a training. In the Philippines, only the Association of Nursing Service Administrators of the Philippines (ANSAP) is certified by the national nurses' organization to conduct PIV training. However, there are local trainings sponsored by a number of hospitals for their own, employed nurses. In other countries, private and public trainings are widely available to train nurses and healthcare practitioners on IV therapy. It is noted that continuing education IV course improved the knowledge and skills of experienced nurses. Improvement in knowledge was shown immediately after PIV therapy courses. On the other hand, training in Saudi Arabia on PIV insertion is limited to theoretical courses with no particular practical examination. Training in PIV therapy (Saudi Arabia), as seen in Table 1, those who had training on PIV insertion were only 70 (43.75%) while 90 (56.25%) of the nurses had no relevant training attended on PIV insertion.

Specialization courses, most of the nurses or 145 (90.63%) have no specialization in nursing. Only a few respondents or 15 (9.38%) holds a nursing specialization. These specializations are diverse in kind. Nurses can be specialized in a variety of fields such as of maternity or care of mother and child, emergency nursing, neonatal nursing, intensive or trauma care, or even nursing research. Although there maybe few courses that offer specialization in nursing in the Philippines as a post graduate course, countries such as South Africa and Commonwealth countries encourage registered nurses to engage in specialization courses after their nursing degree/diploma. These certificate courses lead their career path into a more specific area of specialty and would increase their knowledge and skills to perform their nursing role (e. g., nursing specialization on vascular surgery would be experts on central or difficult PIV insertions).

Table 1. *Socio-demographic profile of the respondents*

Socio-demographic Profile	Frequency	Percentage %
Age		
21 – 30	70	43.75
31 – 40	74	46.25
41 – 50	15	9.38
51 – 60	1	0.63
Mean 32.94 ≈ 33		
SD 4.94		
Sex		
Male	30	18.75
Female	130	81.25

Table 1. Continued…

Nationality		
Filipino	131	81.88
Arab	10	6.25
South African	15	9.38
Indian	4	2.50
Educational Attainment		
Bachelor Degree	143	89.38
Diploma Certificate	12	7.50
Master's Degree	5	3.13
Nursing School		
Private	77	48.13
Government	83	51.88
Board Exam Rating		
60 – 70	16	10.00
71 – 80	72	45.00
81 – 90	72	45.00
91 – 100	0	0.00
Years of Experience		
01 - 10	87	54.38
11 - 20	65	40.63
21 - 30	7	04.38
31 – 40	1	0.63
Clinical Unit		
Emergency Department	15	9.38
Intensive Care Unit	15	9.38
Frequency of PIV Insertion		
Less than 5	107	66.88
5 – 10	41	25.63
11 – 20	12	7.50
Greater than 20		
Training/s Attended in Home Country		
with Training	74	46.25
without Training	86	53.75
Training/s Attended in Saudi Arabia		
with Training	70	43.75
without Training	90	56.25
Specialization		
With	145	90.63
Without	15	9.38

N=160

Pre-test and post-test scores

Table 2 shows the comparison of pre-test and post-test scores of the respondents from the Knowledge-based Questionnaire. In the pre-test, the minimum score was 18 with a maximum of 29. The mean score in the pre-test was 23.40 while its standard deviation was 2.62. This was different during the post-test where it was fairly higher with a minimum of 25 and a maximum of 30. The mean score of this test was 28.48 and has a standard deviation of 1.32.

Table 2. *Pre-test and post-test scores*

	Minimum	Maximum	Mean	SD
Pre-test	18	29	23.40	2.62
Post-test	25	30	28.48	1.32

n=160

The standard deviation scores in the pre-test was SD= 2.62 which was more distributed than that of post-test (SD=1.32). This means that the respondents have better and consistent scores in the post-test, inferring that their theoretical knowledge has improved after the two-day lecture. This improved because the education program has introduced lectures that were helpful to improve their knowledge on PIV insertion. This was delivered through multitude of techniques such as discussion, open discussions, and audio-visual lectures. Additionally, the minimum score in the post-test is more than the acceptable passing rate of the course. The researchers used this pre-test and post-test to examine and compare if there are any associated changes in their knowledge on the lecture as part of the SEP. A one-group pretest–posttest is used to determine the effect of a treatment or intervention on a given sample (Cook & Campbell, 1979). However there maybe threats to internal validity using pre-test and post-test. The researchers ensured that these threats are removed such as history and instrumentation. Several institutions use pre-test and post-test especially on evaluating the effectiveness of their training program such as the Johns Hopkins Bloomberg School of Public Health (Brieger, 2006) and certain nursing and allied health programs in King Fahad Medical City, Saudi Arabia (Al-Tannir, 2018).

FTIR before and after the SEP

Table 3 presents and compares the FTIR before and after the Structured Educational Program. Before the program, the minimum rate of first-time insertion of respondents was 20% while the maximum was 100%. This means that the lowest FTIR before the SEP was 2 successful PIVs out of 10 insertions. After the program, the minimum FTIR became 40% with a maximum of 100% which means the lowest FTIR after the SEP was 4 successful PIVs out of 10 insertions.

Table 3. *FTIR before and after the structured educational program*

	Minimum	Maximum	Mean	SD
FTIR before	20	100	56.06	17.09
FTIR after	40	100	77.56	14.70

n=160

The average rate from before the SEP was 56.06% and surged to 77.56% after the program. The standard deviation on FTIR before was SD=17.09 while this decreased after the program at SD=14.70. The data above indicates that there was an increase in the performance of FTIR of the respondents after the intervention. The rate of the minimum score has also doubled while the maximum stayed the same at 100%. Meanwhile, the average FTIR climbed to approximately 20% proving that there was a significant rise in the performance of peripheral intravenous insertion. Overall, the SEP brought an improvement in the respondents' skills as clearly seen from the rise of first-time insertion rates. This program was regarded effective because it has seen an obvious improvement in the skills of the nurses who participated in the SEP. It shows that the SEP did not only bring an enhancement in their knowledge, but also enhance their skills. Several educational and training programs have also experienced the same results. The results justify the study of Jayalaxmi (2016) where it was revealed that their structured teaching program on peripheral intravenous cannulation has been an effective program to improve their staff nurses' PIV knowledge and practice. This was also true in the study of Higgins, Keogh & Rickard (2015) on a Pilot Educational Program on PIV wherein the course was a success especially on giving them the latest evidence-based guidelines on PIV insertion. It has used a pre-test and post-test as an evaluation method.

Relationship between the respondents' socio-demographic profile and their post-test scores from the KBQ

Table 4 presents the relationship between respondents' socio-demographic profile and their post-test scores from the Knowledge-based Questionnaire. It can be discerned that variables such as age (r = 0.163, p < 0.05), nationality (r = -0.172, p < 0.05), years of experience (r = 0.195, p < 0.05), and specialization (r = 0.208, p < 0.01) were found to have significant relationship to the post-test scores. There are variables that were not related but some of them have shown significant relationship. Therefore, null hypothesis is hereby rejected. It deduces therefore that as the respondent ages and has more years of experience; his post-test score becomes higher compared to those young and newly hired respondents. This finding showed that there was a statistical significant relation between total studied nurses' knowledge in pre and post educational program and their demographic characteristics.

Table 4. *Relationship between the respondents' socio-demographic profile and their post-test scores from the KBQ*

Socio-demographic Profile	FTIR After	
	r	p-value
Age	0.163*	0.039
Sex	-0.019	0.812
Nationality	-0.172*	0.030
Educational Attainment	-0.096	0.229
Nursing School	0.047	0.556
Board Exam Rating	0.095	0.233
Years of Experience	0.195*	0.013
Clinical Unit	0.087	0.273
Frequency of PIV Insertion	-0.108	0.173
Relevant Training in Home Country	0.034	0.666
Relevant Training in Saudi Arabia	0.016	0.840
Specialization	0.208**	0.008

**. Correlation is significant at the 0.01 level (2-tailed)*
*.   *Correlation is significant at the 0.05 level (2-tailed)*

On the other hand, data reveals that Filipino respondents perform better in the post-test compared to other nationalities. One possible explanation to this finding is Filipino nurses are certified and trained on the standards of the Association of Nursing Service Administrators of the Philippines (ANSAP). Since ANSAP is a member of the Infusion Nurses Society (INS), it is apparent that ANSAP has been following the 2016 INS Standards which is the theoretical resource material of this program. Therefore Filipino nurses are more orientated with the program's knowledge-based questions compared to other respondents (South Africans and Indians) who would base their previous knowledge on peripheral intravenous therapy on their own country's PIV standards, although there would be a slight difference. More so, highly-significant association exists when respondents have specialization that they tend to score higher compared to those without nursing specialty. This is true with several studies that prove specialization in nursing yields to better outcome not only in skills but in theory as they have required more training and knowledge on a specific nursing area compared to their counterpart who have general background knowledge.

Relationship between the respondents' socio-demographic profile and their FTIR after the SEP

Table 5 shows the association between respondents' socio-demographic profile and their FTIR after the Structured Educational Program (SEP). It can be seen that variables such as nationality (r = -0.284, p < 0.01), board exam rating (r = 0.259, p < 0.01), frequency of PIV insertion (r = 0.299, p < 0.01), and relevant training in home country (r = 0.162, p < 0.05) were found to have significant relationship to the FTIR. There are variables that were

not related but some of them have shown significant relationship. Therefore, the null hypothesis is hereby rejected.

Table 5. *Relationship between the respondents' socio-demographic profile and their FTIR after the SEP*

Socio-demographic Profile	FTIR After	
	r	p-value
Age	0.146	0.066
Sex	-0.036	0.649
Nationality	-0.284**	0.000
Educational Attainment	0.124	0.118
Nursing School	0.011	0.895
Board Exam Rating	0.259**	0.001
Years of Experience	0.098	0.219
Clinical Unit	-0.138	0.083
Frequency of PIV Insertion	0.299**	0.000
Relevant Training in Home Country	0.162*	0.040
Relevant Training in Saudi Arabia	0.042	0.594
Specialization	0.083	0.298

**. Correlation is significant at the 0.01 level (2-tailed)
*. Correlation is significant at the 0.05 level (2-tailed)

The data discloses that Nationality has a significant relationship with FTIR after the SEP. This means that Filipino respondents have better FTIR compared to other nationalities. This is because most of the nurses KAAUH are Filipino nurses. These Filipinos worked for a longer period of time than any other nationality and this has helped them to upskill in the nursing profession over time. Also, one possible explanation to this finding is that some hospitals in the Philippines often require their nurses to undergo a knowledge and skill training on PIV insertion from ANSAP which is increasingly made as a requirement before a nurse can practice in the hospital. Another reason is that nurses from the Philippines perceived themselves efficient and effective in cognitive competencies and skills. The results of the study of Daisy, et al (2015) indicated in their study that Filipinos are confident on performing a wide variety of nursing skills (e.g. PIV insertion) and that they take cultural background into consideration.

Additionally, highly-significant relationship exists to FTIR scores when respondents have higher board exam rating. This means that the higher the board exam rating of the nurse is, the higher their success on FTIR. These ratings are considered private and confidential information among the respondents. Additionally, ratings are not a pre-requisite for landing a job in Saudi Arabia as there is no information that this is significantly related to performance in the eyes of an employer. Although there is a scant evidence of a direct relationship of exam scores to PIV insertion performance, such an examination can help to gauge the competencies of a professional who is presumed to have learned the knowledge, skills, and attitude in the practice of their profession. The frequency of PIV insertion is also highly significant with FTIR scores. It means that the more frequent respondents insert a PIV device, the more they are skilled on performing the procedure. It means that as nurses

gain more and more experience on PIV insertion day in day out, it increases their FTIR. This could also massively improve their self-confidence and cannula implementation when they perform this skill in a continuous basis.

Difference between the pre-test and post-test on the knowledge-based questionnaires

Table 6 shows that using a paired-sample t-test, the results revealed that there was a significant difference between the respondents' pre-test and post-test on the Knowledge-based Questionnaires (t (1,159) = -22.87, p < 0.01) indicating that respondents performed better in the post-test. Result denoted that the intervention which was the SEP has considerably increased their knowledge in PIV insertion which influenced their test performance on the KBQ. Therefore, the null hypothesis that there is no difference between the pre-test and post-test is hereby rejected.

Table 6. *Difference between the pre-test and post-test on the knowledge-based questionnaires*

Parameters	Df	Mean Difference	SD	t-value	p-value
Pre-test Post-test	159	-5.08	2.81	-22.87**	0.000

**. Correlation is significant at the 0.01 level (2-tailed)

This finding was the same with the findings of Subin (2018) wherein his study's post-intervention knowledge scores reveal that almost all the respondents reported an increased knowledge after introducing a structured teaching program. It was found out that more than half of the respondents had reported a good level of knowledge level regarding intravenous cannulation and its complications compared to previous levels.

Difference between the respondents' FTIR before and after the SEP

Table 7 also used a Paired-sample t-test at 0.01 significance level to analyze the difference between the respondents' FTIR before and after the Structured Educational Program.

Table 7. *Difference between the respondents' FTIR before and after the SEP*

Parameters	Df	Mean Difference	SD	t-value	p-value
FTIR before FTIR after	159	-21.50	18.97	-14.33**	0.000

**. Correlation is significant at the 0.01 level (2-tailed)

Similar with the previous table, preliminary assumption testing to check for normality and homogeneity of variance between the variables was conducted and no serious violation was noted. Paired-sample t-test found highly significant difference between the respondents' FTIR before and after the Structured Educational Program ($t(1,159) = -14.33$, $p < 0.01$) indicating that respondents performed better after the Structured Educational Program. This means that the nurses who participated in the SEP have improved their skills on PIV insertion. This finding means that the educational program is effective on increasing the FTIR of nurses. Therefore, null hypothesis stating that there is no difference between the respondents FTIR before and after the SEP is hereby rejected. The study agrees with the findings of a training program launched at Gloucestershire Royal Hospital. A year-long clinical skills project has been provided to examine how training in insertion and management of peripheral intravenous cannulation could be developed using a self-directed approach. The said program had positive results which not only improved their insertion skills but the care of the peripheral IV catheter (Snelling, 2002).

Program evaluation

The researchers have also conducted a short course program evaluation at the end of the SEP. It was found out that majority of the participants rated the program as excellent with weighted mean of 3.89 out of 4.00 (Table 8). Comments include the following: structured and easy to understand, gained new skills, refreshed skills on a real vein, timely, excellent lecturers, and excellent open discussion between participants. Suggestions were also noted such as break time need, and scheduling and time constraints. Respondents also commented on inconsistent and non-standardized supplies. They also commented to remove PIV complications in the lecture part and allow more practice time.

Table 8. *Program evaluation results*

Program Evaluation Questions	4	3	2	1	Weighted Mean
1. The objectives of the training were met	148	10	2	0	3.91
2. The presenters were engaging and prepared	149	5	5	1	3.89
3. The presentation materials were relevant	145	9	6	0	3.87
4. The content of the course was organized and easy to follow	140	16	4	0	3.85
5. The course length was appropriate	142	18	0	0	3.89
6. The venue was appropriate for the event	150	10	0	0	3.94
Overall Weighted Mean					3.89

n=160

Enhancement of the SEP from the study's findings

The researchers obtained extremely useful information to enhance the SEP after the data management using inferential statistics and discussion of findings from related

literature. There are also a number of valuable comments and suggestions from program evaluation that were used to improve the SEP: (1) Breaks should be given for at least ten minutes every two hours as theory explanation could stress them and lessen their concentration; (2) the FTIR monitor pre and post the SEP which required respondents to insert ten VADs be lessened from five days to three days (this was because they have completed the required insertions in three days); this has also decreased the SEP from 12 to 8 days; (3) common complications of PIV insertion in the lecture should be removed from the theory as this was not significant in the skills; and (4) increase the time allotment practice sessions in the second day of lecture so that respondents can effectively work at their own pace.

        Table 9 presents the existing and the new SEP. This shows the improvement of SEP after the study's findings whereby it includes the reduction of program days, lectures and enhancement of course content.

Table 9. *Existing and new SEP*

Existing SEP	New SEP
12 Days	8 Days
11 Activities/Lectures	10 Activities/Lectures
2 hours practice session	5 hours practice session
One lunch break and one breaks in morning and afternoon sessions	Lunch break and every two hours breaks
Module given days before the program	Modules given two weeks before the program
	Older and more experienced nurses in PIV insertion to be distributed in different groups

Complications on PIV were also removed from the course as this was evaluated to be unnecessary, bringing the practice session from only two to five hours. This would encourage the respondents to be more adept on insertion skills. Another change from the existing and new SEP is the introduction of breaks every two hours of the lecture. Lastly, the modules should be given at least two weeks before the program to let them prepare for the required exams.

Conclusion and Recommendations/Implications

        It was found out that majority of the respondents' age is between 31 and 40. Most of them are female and came from the Philippines. The largest proportion of these nurses have bachelor's degree from a government nursing school. Their board exam ratings range between 71-80 and 81-90; and have less than ten years of clinical experience. Majority of them have less than five insertions per day and had no PIV therapy training in their home country, and no specialization courses whatsoever. The study also revealed that there was a significant increase in the minimum scores in the KBQ after the intervention. The average score on pre-test was 23 versus a high average score of 28 in the post-test. Overall, this concludes that the SEP was effective in enhancing the theoretical knowledge of the respondents after the lectures given.

The minimum FTIR of respondents has increased to 20% after the intervention. The average rate also climbed considerably from 56.06% to 77.56% after the SEP. Overall, it means that the SEP has improved the PIV insertion skills of the respondents. Ages, nationality, years of experience, and specialization were found to have significant relationships to the post-test scores. It therefore means that post-test scores soar as age and experience gets higher. Moreover, nurses who have specialization have also performed better in the exams. It is an interesting finding that Filipino respondents perform better in the post-test than other nationalities. Nationality, board exam rating, frequency of PIV insertion, and relevant training in home country were found to have significant relationships to the FTIR. Thus, it can be discerned that Filipinos are most likely to perform better in other nationalities on PIV insertion; and that the higher their board rating is, the more successful they are on PIV insertion which equates to a higher FTIR. Those who are frequent inserters of VADs and previously trained tend to have higher FTIR than nurses who inserts less frequently/no relevant training.

There was a significant difference between the respondents' pre-test and post-test on the KBQ indicating that respondents performed better in the post-test. The results showed that the intervention made a big influence on their test performance in the KBQ. There was a highly significant difference between the respondents' FTIR before and after the SEP indicating that respondents performed better after the said program. This means that the SEP is effective on improving not only knowledge but the PIV insertion skills. This program is clearly an effective way to reduce multiple insertions and improve patient outcomes due to consistent failure rates.

It is recommended that the selection process of nurses internally and internationally would be based on merits and experience. It is also suggested that the Nursing Affairs Department perform pre-test and post-test on introducing educational programs in order to ascertain if there were any improvements associated with their intervention. Presently, the nursing education has no systematized approach on the evaluation of their educational programs. Another recommendation is that skills part of the SEP must be retained. Further research in the future can examine if the results of FTIR will change when the number of insertions is modified. Currently, this study has had ten insertions. Modifying the numbers would be an interesting future research. Another recommendation is that the organization's budget for education be spent to obtain a long-term effect on nurses' knowledge and skills. One effective way is to sponsor nurses in a specialization course as it has proven efficient and effective to improve clinical performance. Pre-test and post-test is strongly emphasized on every education program to ensure that knowledge part is evaluated. It is also recommended that pre-test post-test questions are changed in a regular basis in order limit answer key leaks which happens in any institution if same tests are administered in a long period of time. Further research can also investigate other formats of exams such as essays or video-assisted exams. It is finally recommended that the SEP be adopted by the hospital as a regular educational/training program given to all nurses and should start in the orientation phase of newly-hired nurses. This program should have an adequate preparation as resources necessary for the course are limited.

References

Ahmed, S. (2016). *Nurse's knowledge and practice regarding peripheral cannulation procedure in almak nemer hospital in Shendi. National Ribat University, Sudan.* http://repository.ribat.edu.sd/showRepositoryDetails/509?language

Al-Tannir, M., Abu-Shaheen, A., AlSumaih, S., AlMukaibil, N. F., AlHarbi, R., Heena, H., Sallout, L., Mahha, A., Marran, N. M., & AlFayyad, I. (2018). Research knowledge and skills among medical and allied health students attending a summer research course: A pretest and posttest analysis. *Cureus, 10*(8), e3132. https://doi.org/10.7759/cureus.3132.

Amjad, I., Murphy, T., Nylander-Housholder, L., & Ranft, A. (2011). A new approach to management of intravenous infiltration in pediatric patient: Pathophysiology, classification, and treatment. *Journal of Infusion Nursing, 34*, 242-2 4.

Anson, L., Edmundson, E., & Teasley, S. (2010). Implications of evidence-based venipuncture practice in a pediatric health care Magnet facility. *Journal of Continuing Education in Nursing, 41*, 179-18.

Association of Nursing Service Administrators (2015). *Basic intravenous therapy training.* manila, Philippines. http://ansapinc.com/

Brieger, W. (2006) *Evaluating training programs, Johns Hopkins Bloomberg School of Public Health.* Retrieved March 2019 at. http://ocw.jhsph.edu/courses/TrainingMethodsContinuingEducation/PDFs/Lecture12.pdC

Cook, T. D., & Campbell, D. T. (1979). *Quasi-experimentation: Design & analysis issues in field settings.* Boston, MA: Houghton Mifflin.

Daisy, A. V., Adnan, A. A., Fred, B. R., & HATIM, A. E. (2015). Affective competency of Filipino nurses working in the hospitals of Taif City Kingdom of Saudi Arabia. *International Journal of Nursing and Midwifery, 7*(4), 46–53. https://doi.org/10.5897/IJNM2014.0142.

De Lima Jacinto, A., Avelar, A., & Pedreira, M. (2011). Predisposing factors for infiltration in children submitted to peripheral venous catheterization. *Journal of Infusion Nursing, 34*, 391-398. doi:10.1097/NAN.0b013e318230649

Department of Health-UK (2005). *Structured patient education in diabetes: Report from the Patient Education Working Group : Department of Health - Publications.* https://webarchive.nationalarchives.gov.uk/20130105204013/http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_4113195

Farmer, R. (2015). *Why gender diversity in the workforce matters.* https://minoritynurse.com/why-gender-diversity-in-the-workforce-matters/

Hess, Ha. (2010).A biomedical device to improve pediatric vascular access success. *Pediatric Nursing, 36*(5), 259.

Hadaway, L. (2012). Short peripheral intravenous catheters and infections. *J Infus Nurs, 35*(4), 230-40.

Higgins, N., Keogh, S., & Rickard, C. (2015). Evaluation of a pilot educational program on safe and effective insertion and management of peripheral intravenous catheters. *Journal of the Association for Vascular Access*, *20*(1), 37–42.

Ho, S, Siew L.S., & Tang, W. M. (2016). Nurses' knowledge and practice in relation to peripheral intravenous catheter care. *Medicine & Health*, 11(2), 181–188. https://doi.org/10.17576/MH.2016.1102.07.

Hossain, M. A. (2016). Assessment of the level of knowledge and practice on intravenous cannulization among staff nurses of selected tertiary care hospital in Dhaka city. *MOJ Public Health*, *4*(5). https://doi.org/10.15406/mojph.2016.04.00095

Infusion Nurses Society (Ins). (2011a). Infusion nursing standards of practice. *Journal of Infusion Nursing*, *34*(1S), S66-S67.

Infusion Nurses Society (INS). (2011b). *Policies and procedures for infusion nursing* (4th ed.). Norwood, MA.

Jacobson, A. F., & Winslow, E. H. (2005). Variables influencing intravenous catheter insertion difficulty and failure: an analysis of 339 intravenous catheter insertions. *Heart & Lung: The Journal of Critical Care*, *34*(5), 345–359. https://doi.org/10.1016/j.hrtlng.2005.04.002.

Jayalaxmi, N., Devi, M. B., & Monika, N. (2016). Effectiveness of structured teaching programme on knowledge and practice regarding intravenous cannulation among the staff nurses. *International Journal of Nursing Education*, *8*(2), 46–49. https://doi.org/10.5958/0974-9357.2016.00045.3

Keleekai, N. L., Schuster, C. A., Murray, C. L., King, M. A., Stahl, B. R., Labrozzi, L. J., … Glover, K. R. (2016). Improving nurses' peripheral intravenous catheter insertion knowledge, confidence, and skills using a simulation-based blended learning program. *Simulation in Healthcare*, *11*(6), 376–384.

Khankeh, H., Khorasani-Zavareh, D., Hoseini, S. A., Khodai-Ardekandi, M. R., Ekman, S. L., Bohm, K., … Castrén, M. (2014). The journey between ideal and real: Experiences of beginners psychiatric nurses. *Iranian Journal of Nursing and Midwifery Research*, *19*(4), 396–403.

Kirkpatrick, D. L. (1959). Techniques for evaluation training programs. *Journal of the American Society of Training Directors, 13*, 21-26.

Lapostolle, F., Catineau, J., Garrigue, B., Monmarteau, V., Houssaye, T., Vecci, I., & Adnet, F. (2007). Prospective evaluation of peripheral venous access difficulty in emergency care. *Intensive Care Medicine 33*, 1452– 1457.

Miller, G. (1990). The assessment of clinical skills/ competence/performance. *Acad Med.* 1990; *65*(9 suppl):S63–S67.

National Institute for Clinical Excellence. (2003). Technology appraisal guidance 60. Guidance on the use of patient education models for diabetes.

Nieswiadomy, R. M. (2012). *Foundations of nursing research* (6th ed.). Boston: Pearson.

Rickard C. M., Webster, J. , Wallis, M. C. (2012). *Routine versus clinically indicated replacement of peripheral intravenous catheters: a randomized controlled equivalence trial.* Lancet, *380* (9847), 1066-1074.

Sabri, A., Szalas, J., Holmes, K. S., Labib, L., & Mussivand, T. (2013) *Failed attempts and improvement strategies in peripheral intravenous catheterization*. *Biomed. Mater. Eng*, *23*, 93–108.

Snelling, P. (2002). *Developing self-directed training for intravenous cannulation senior lecturer.* University of the West of England, Gloucester.

Subin S (2018).   A pre-experimental study to assess the effect of structured teaching program on knowledge regarding intravenous cannulation and its complications among staff nurses working in a selected hospital of Bhopal, M.P. *Ind J Holist Nurs, 9*(1), 1-4.

Walsh, K., & Schad, T. (2012). *Nursing practice & skill intravenous therapy: Preventing and treating infiltration.* http://ceu.cinahl.com/course

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