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HOW EFFECTIVE IS SIMULATION-BASED EDUCATION FOR IMPROVING THE NURSES' KNOWLEDGE ON PEDIATRIC IV INSERTION: A SYNTHESIS FROM AWAL BROS HOSPITAL GROUP IN INDONESIA

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ABSTRACT

Background: *Simulation-based nursing education has been growing rapidly and becomes one of the most popular teaching methods for improving patient safety and patient care. One of the difficult Nursing skills to achieve is IV insertion. Due to the high complaints in the number of IV insertion attempts in the paediatric patients, the Nursing Corporate of Awal Bros Hospital Group organized an educational program emphasizing the team training, clinical decision-making and communication skills. These were the first internal education sessions using live rabbits and mannequins. This study aimed to evaluate the attitude of the participants, the self-confidence level and their change in the knowledge on clinical performance in Paediatric IV Insertion after attending the educational program.*

Methods: *The training and education sessions were conducted at Awal Bros Hospitals in Bekasi Barat and Tangerang during March and April 2019. The participants included a total of 52 Nurses. Pre- and Post-tests consisting of 20 multiple choice questions were administered to the participant before and after the 3-day simulation-based training workshop in Bekasi Barat and after the 2-day simulation-based training workshop in Tangerang. The workshop also utilized rabbits for the participants to practice their hands-on skills.*

Results: *A total of 52 Nurses working in different Nursing units were enrolled. The mean pre-test and post-test scores were 43.81 and 87.52 respectively. In the Statistics Test table, the value of Asymp. Sig (2-tailed) was 0,000. Because the value of sig 0,000 < 0.05 was according to the statistical tests we used, then there are significant differences between before training and after training.*

Conclusions: *Participants had positive attitude toward this new training program. They stated that this technique was more exciting and effective compared to the "traditional" techniques such as lecture, power point presentations or Q&A that they attended. Significant improvement of the knowledge on clinical performance in Nurses participating in these training and education session was observed after the participation in this simulation-based educational program. Many expressed their higher self-confidence in doing IV insertion to the future patients, especially babies and children. More simulation-based education using pre- and post-tests are recommended.*

Keywords: *Education, Nursing, IV Insertion*

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INTRODUCTION

Safety is a fundamental principle of patient care and a critical component of quality management [1]. Since 2009, the Joint Commission (JC) has required the leadership of all health care organizations that it accredits to "create and maintain a culture of safety" (Joint Commission, 2008) [2]; in which higher culture of patient safety has been shown to be associated with better patient outcomes [3]. As four out of fourteen Awal Bros Group hospitals are Joint Commission accredited, the group corporate has decided that such high standard of the Joint Commission on culture of safety be applied in all of their hospitals.

One of the biggest challenges in ensuring patient safety is related to Intravenous (IV) insertion. Cannulation of a vein is one of the most important procedures that paediatric nurses need to perform with precision and minimal discomfort to the children. Cannulation not only involves placing the intravenous cannulas at an appropriate location but also requires the nurses to monitor and maintain access to the circulatory system [4]. For the past months, the number of complaints on IV insertion, especially on pediatric patients has been raising across the board in this group. Even though each hospital has its IV team, pediatric IV insertion has become every Nurses' responsibility especially when the IV team is not available due to high census or patients calls. The Awal Bros hospitals do not have medical-surgical pediatric wards; the pediatric patients are admitted into wards according to the patients' needs; pediatric patients who need critical care will be admitted to the Pediatric Intensive Care Unit (PICU) or Neonatal Intensive Care Unit (NICU). Therefore, all Nurses in all wards are expected to be skilled in IV insertion technique including for babies and children. To tackle this issue, a simulation-based education was held for the Nurses. In recent years, simulation-based medical education has been growing rapidly and becomes one of the most popular teaching methods for the improvement of patient safety and patient care [5]. Some studies have demonstrated the effectiveness of simulation in the teaching of basic science and clinical knowledge, procedural skills, teamwork, and communication as well as assessment at the undergraduate and graduate medical education levels [5] [6] [7] [8].

The group's corporate Nursing teamed up with Aesculap Academy Indonesia, one of the leading medical education forum which is part of the B Braun Medical Group of companies, organized simulation-based education programs for the Nurses in two different hospital locations called "Nurse Training Program on Safe Infusion Therapy" in the period of March-April 2019. The workshop put emphasis on the team training, critical thinking, clinical decision-making and communication skills [5]. This study was conducted to determine if such simulation-based educational program was an effective means to enhance clinical performance for Nursing personnel. After completion of the workshop, the participants were expected to 1) apply Nursing knowledge relevant to the specific Infusion Therapy materials 2) demonstrate procedural skills relevant to the pediatric IV insertion; 3) compare different strategies of decision-making in handling pediatric patients. The objective of this study was to evaluate the attitude of the participants, the self-confidence level and their change in the knowledge on clinical performance after attending this new training workshop.

METHODS

This was a one-group pre-test and post-test design. The subjects were enrolled from Nurses working in both Specialty and Non-Specialty units. At Awal Bros Hospitals, Specialty units included The Emergency Room (E.R), Operating Room (O.R) and Critical Care Units; while the Non-Specialty unit were the Medical/Surgical unit and Polyclinics. They were nominated by the Nursing Managers throughout the 6 Awal Bros Hospitals. Two identical workshops were held in March and April 2019. The first workshop was held at The Awal Bros Bekasi Barat Hospital and the other one was held at the Awal Bros Tangerang Hospital. This was a joint training program sponsored by the Aesculap Academy Indonesia. Each workshop enrolled 26-28 Nurses currently working in both units. They were led by 5–6 facilitators who were Nurses with formal training by professionally recognized training centers on using simulation as the teaching method.

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At the beginning of the workshop, the participants were required to complete the pretest assessment which consisted of 20 multiple choice questions with 5 options (Table 1). The questions focused not only on the clinical knowledge about common acute IV insertion problems but also teamwork, communication skills in difficult situations and models of decision-making relevant to the IV insertion process. The content validity of the pre- and post-test was accomplished by the tool that was devised and reviewed by a group of Aesculap Academy specialists and senior nurses who were experienced trainers in their own right.

Table 1. Multiple choice questions (The options of each question were omitted for simplicity)

No.	Question
1	What fluid can last long intravascularly and is very suitable for patients with indications of hypovolemic shock?
2	What is the total body water of an adult male?
3	In intravenous therapy, medical personnel must pay attention to the type of fluid given to the patient to determine the location/area of the IV catheter installation. Which is not characteristic of hypertonic fluid?
4	Which is not the location of the IV peripheral installation?
5	Nurse A checked Mr. A who complained that the hand where IV was placed, felt numb and painful. The nurse saw that; the skin looks pale, edema > 6 inches, cold to the touch. What is the scale of the patient's infiltration?
6	Which Infusion set statement is wrong?
7	What is the purpose of using transparent dressing in the installation of IV peripherals?
8	The composition of fluid in the human body is?
9	Which is not a colloidal liquid?
10	Which is not prevention of infiltration and extravasation?
11	Which is not the vein lining?
12	Patients aged 30 years old with 56kg BW, 170cm Height. What is the fluid required?
13	What are the complications of peripheral IV installation caused by the catheter's position change that causes fluid to enter the tissue?
14	What are the signs of lack of fluids?
15	How do you handle extravasation patients?
16	Which are not signs and symptoms of extravasation in patients receiving chemotherapy?
17	A male patient aged 25 years old was treated with NaCl3% 500cc/24h on left hand branch with a RL 500cc/8hr three-way infusion. After 4 hours of infusion, redness and hematoma appear in the insertion area. On what lining Hematoma occurs?

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No.	Question
18	What are the criteria for crystalloid fluids?
19	Patient Mr. B 25 years old with 55kg BW 165cm height came to the ER with a complaint of burning from stove fire yesterday with an area of 20% burn. The patient stated that before, his BW was 60kg. How much crystalloid is needed in a day?
20	Ms. V, 45y.o, was taken to the hospital with grade 2 burns. The condition at the time: the patient was agitated, screaming in pain, blistering wound on the arm of the hand and part of the right chest. The doctor advised RL 2000L/6h infusion fluid therapy and 30mg IV Toradol injection. The nurse's emergency action was to seek venous access. Which peripheral puncture should be done?

After the pre-test assessment, the participants were divided into groups of 5–6 and rotated through different scenarios which comprised of acute, high-stake clinical situations encountered in daily practice of pediatric patient scenes. Each scenario was followed by a debriefing session led by the facilitators. Interactive lectures were conducted in between the scenarios. The topics included teamwork, critical thinking, decision making and communication skills for difficult situations which were all essential components for forming an effective and efficient Nursing care. The participants then had the opportunity to insert IV to the rabbits provided for the simulation-based education. Rabbits were chosen due to their thin and small veins which were suitable for comparison to those of the babies and children. The Instructors also gave the participants several arm and hand mannequins to practice on. Inserting needle on rabbits was as challenging as doing so on babies and children due to their charming looks and fragile veins. After the workshop, the participants were asked to complete the post-test assessment which was identical to the pre-test assessment. The marking system was same as that of the pre-test. The participants were also invited to fill in a course evaluation form which consisted of 10 items with the lowest mark at 1 and the highest mark at 5. The course evaluation form was specially designed for this workshop. It would be used as a template for other similar simulation-based education programs organized by this academy in the future.

Statistical Analysis
The Statistical Package for Social Science (SPSS) version 21.00 for Windows was used for statistical analysis. Descriptive statistics, namely range of scores, mean scores and standard deviation, was used for the description of data distribution. Data on the scoring grades were tabulated using frequency and percentage. The hypothesis test used in this study was the nonparametric statistical method. This nonparametric statistical method is often also called the free distribution method because the statistical test model does not specify certain conditions regarding the distribution of population parameters. The Wilcoxon Test was employed for the test in this study. The decision making to accept or reject Ho in the Wilcoxon signed rank test was based on: If the probability (Asymp.Sig) < 0.05 then Ho is rejected and Ha is accepted. If the probability (Asymp.Sig) > 0.05 then Ho is accepted and Ha is rejected.

RESULTS
Based on table 1, from 52 nurses who attended the Aesculap Academy workshop, 26 people (50.0%) was from D3 (vocation), while 25 people (48.1%) was from undergraduate and 1 person (1.9%) was from postgraduate. The males were 3 people (5.8%) while 49 (94.2%) of them were females. Based on the location of the hospital, 46 people (88.5%) were in Java and 6 people (11.5%) were outside Java with 33 people (63.5%) from Non-Specialty Unit and 19 people (36.5%) from Specialty Unit.

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Table 2. Distribution of Nurses who participated in AESCULAP Academy Training

Variables	Categories	n = 52 (%)
Education	D3	26 (50.0%)
	Undergraduate	25 (48.1%)
	Postgraduate	1 (1.9%)
Sex	Male	3 (5.8%)
	Female	49 (94.2%)
Hospital Location	Java	46 (88.5%)
	Outside Java	6 (11.5%)
Unit	Non Specialty	33 (63.5%)
	Specialty	19 (36.5%)

Analysis Before Conducting Training

Table 3. Difference Test Results Before Conducting Training

Variables	Categories	N	Mean	Std. Error	F	Sig.	95% Confindence Interval for Mean	
							Lower	Upper
Sex	Male	3	51.33	6.333	0.906	0.346	24.08	47.43
	Female	49	43.35	2.032			39.26	78.58
Unit	Non Specialty	33	41.24	2.276	3.115	0.084	36.61	45.88
	Specialty	19	48.26	3.450			41.02	55.51
Education	D3	26	46.46	2.510	1.645	0.203	41.29	51.63
	Undergraduate	25	41.80	3.000			47.99	47.99
	Postgraduate	1	25.00	-			-	-
Location	Java	46	41.96	1.807	7.791	0.007	38.32	45.60
	Outside Java	6	58.00	8.181			36.97	79.03

Based on the table above, there were 3 male respondents with a mean of 51.33 while the females were 49 people with a mean of 43.35 standard errors in male was 6.333 confidence intervals of 24.08-47.43, the female was 43.35 confidence intervals of 39.26-78.58, F count value was 0.906 with a significance of 0.346 > 0.05, which means there is no significant difference in sex before conducting the training. 33 people were from Non-Specialty Unit with a mean of 41.24 standard errors of 2.276 confidence intervals of 36.61-45.88 and 19 people were from Specialty unit with a mean of 48.26 standard errors of 3.350 confidence intervals of 41.02-55.51, F count value was 3.115 with significance 0.084 > 0.05 which means that there is no significant difference in the units between Non-specialty and Specialty. Based on the education, 26 people were from D3 with a mean of 46.46 standard errors of 2.510 confidence intervals of 41.29-51.63, 25 people were from undergraduate with a mean of 41.80 standard errors of 3.000 confidence intervals of 47.99-47.99 and there was 1 person from postgraduate with a mean of 25.00, the F value was 1.645 and a significance of 0.203 > 0.05, which means that there is no difference in education between D3, undergraduate and postgraduate. Based on the location of the hospital, those in the Java island were 46 people with a mean of 41.96 standard errors of 1.807 confidence intervals of 38.32-45.60 and from outside Java were 6 people with a mean of 58.00 standard errors of 8.181 confidence intervals of 36.97-79.03, F count value was 7.791 with a significance of 0.007 < 0.05 in other words, there is a significant difference between those who live in Java island and outside Java island.

Analysis After Training

Table 4. Difference Test Results After Training

Variables	Categories	N	Mean	Std. Error	F	Sig.	95% Confindence Interval for Mean	
							Lower	Upper
Sex	Male	3	87.52	3.512	0.008	0.930	72.89	103.11
	Female	49	88.00	1.407			84.66	90.32
Unit	Non Specialty	33	86.33	1.989	1.379	0.246	82.28	90.39
	Specialty	19	89.58	1.114			87.24	91.92
Education	D3	26	86.77	2.032	0.402	0.671	82.58	90.95
	Undergraduate	25	88.00	1.812			84.26	91.74
	Postgraduate	1	95.00	.			.	.
Location	Java	46	88.00	2.309	0.017	0.898	84.46	90.45
	Outside Java	6	87.52	1.336			82.06	93.94

Based on the table above there were 3 male respondents with a mean of 87.52 standard errors of 3.512 confidence intervals of 72.89-103.11. The female respondents were 49 people with a mean of 88.00 standard errors of 1.407 confidence intervals of 84.66-90.32, F count value was 0.008 with the significance of $0.930 > 0.05$, which means there is no significant difference in sex after training. 33 people were from Non-Specialty Unit with a mean of 86.33 standard errors of 1.989 confidence intervals of 82.28-90.39 and from Specialty code unit were 19 people with a mean of 89.58 standard errors of 1.379 confidence intervals of 87.24-91.92, the F count was 1.379 with a significance of $0.246 > 0.05$, which means that there is no significant difference in unit codes between Non-specialty and Specialty. From the nurses' education, 26 people were from D3 education with a mean of 86.77 standard errors of 2.032 confidence intervals of 82.58-90.95, 25 people were from undergraduate education with a mean of 88.00 standard errors of 1.812 confidence intervals of 84.26-91.74 and 1 person was from Postgraduate education with education of 95.00, the F count value was 0.402 with a significance of $0.671 > 0.05$, which means that there is no difference in education whether those from D3, Undergraduate, or Postgraduate education. In the location of the hospital, 46 people were in Java with a mean of 88.00 standard errors of 2.309 confidence intervals of 84.46-90.45 and 6 people were from outside Java with a mean of 87.52 standard errors of 1.336 confidence intervals of 82.06-93.94, the F count value was 0.017 with a significance of $0.898 > 0.05$, in other words, there is no significant difference between those who live in Java or outside Java.

Table 5. Mean Differences Before and After Training

Pair	N	Mean	t hitung	df	Sig.
Pre	52	43.81	-18.155	51	0.000
Post	52	87.52			

From the above table from 52 nurses showed that there were differences in the mean that increases after conducting Aesculap Academy training with scores before conducting training at 43.81 and after conducting training at 87.52. This was evidenced by the value of t count of $-18.155 >$ t table -2,000 or with a significant of $0.000 < 0.05$, which means that there are significant differences before conducting training with after conducting training.

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In the pre and post data there were 52 nurses who participated in Aesculap Academy Training with the mean score before training was 43.81 and after training was 87.52. Then we can find the Mean Rank of 26.50 and Sum of Rank of 1378.00 from the number of Positive Ranks.

Table 6. Wilcoxon Signed Ranks Test: Ranks

		N	Mean Rank	Sum of Ranks
Post - Pre	Negative Ranks	0[a]	.00	.00
	Positive Ranks	52[b]	26.50	1378.00
	Ties	0[c]		
	Total	52		

a. Post < Pre
b. Post > Pre
c. Post = Pre

Table 7. Wilcoxon Signed Ranks Test: Test Statistics

	Post - Pre
Z	-6.278[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test
b. Based on negative ranks.

In the Statistics Test table, the value of Asymp. Sig (2-tailed) was 0,000. Because the value of sig 0,000 < 0.05 was according to the statistical tests we used, then there are significant differences between before training and after training.

DISCUSSION

Differences before conducting training on sex category, F count value was 0.906 with a significance of 0.346 > 0.05, which means there is no significant difference in sex before conducting training. In the Non Sepcialty Unit, the F value was 3.115 with a significance of 0.084 > 0.05, which means that there is no significant difference in the units between Non-specialty and Specialty. In the nurse education, F count value was 1.645 with a significance of 0.203> 0.05, which means there is no difference in education whether from D3, undergraduate or postgraduate education. Based on the location of the hospital, the F count value was 7.791 with a significance of 0.007 <0.05, in other words, there is a significant difference between those who live in Java or outside Java.

After conducting training, in sex category, F count value was 0.008 with the significance of 0.930 > 0.05, which means there is no significant difference in sex after training. In the Code Non Specialty Unit, the F count was 1.379 with a significance of 0.246 > 0.05, which means that there is no significant difference in unit codes between Non-specialty and Specialty. In the nurse education, the F count value was 0.402 with a significance of 0.671> 0.05, which means that there is no difference in education whether those from D3, Undergraduate, or Postgraduate education. In the location of the hospital, the F count value was 0.017 with a significance of 0.898 > 0.05, in other words, there is no significant difference between those who live in Java or outside Java.

From 52 nurses showed that there were differences in the mean that increase after conducting Aesculap Academy training with scores before conducting training at 43.81 and after conducting training at 87.52. This was evidenced by the value significant of 0.000 < 0.05, which means that there are significant differences before conducting training with after conducting training.

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The objective of this study was to evaluate the attitude of the participants to the new training program, the self-confidence in handling the patients in the future and the change in the knowledge on clinical performance. This study found the workshop could improve knowledge and the participants were positive about the course. The participants performed significantly better on the post-test assessment after attending the simulation-based training workshop on clinical performance as shown by the statistically significant result in the paired *t*-test analysis [5].

Most of the participants in this group found that simulation-based education was more appropriate for them and the debriefing session was a good way of reflective learning. Although not specified how this was more appropriate for them, it was believed that the characteristics of adult learning proposed by Knowles et al explained why such simulation-based training method was well received by our participants [9]. Adults needed to see the value and relevance of what they learnt. They liked to be actively involved in the learning process. Also, adults needed opportunity for reflection and feedback for improvement. This finding coincided with the survey of educators conducted by Paige et al [10]. They found that debriefing, a specific form of feedback, was the most important part of training using simulation, and a respondent called it 'heart and soul' of simulation-based training. The simulation-based teaching method has been used successfully in many other educational activities. Coupled with deliberate practice, it has been proven an effective means of educational method in terms of acquisition and retention of knowledge and skills [11] [12]. Overall, they were satisfied with this format of teaching and would recommend others to join the workshop.

Simulation-based trainings are most successful when they are incorporated into the standard curriculum instead of an additional component [13]. It will be increasingly used as an assessment tool for accreditation for licensure and maintenance of certification [14] [15]. It might be integrated into the formal curriculum of the Nursing education training in Awal Bros Group in the future.

There were several limitations in this study. First, the pre-test and post-test instruments were the same, potentially introducing testing bias. Second, the use of multiple choice questions as the instrument of assessment only tested the knowledge of the participants on general patients not necessarily paediatric patients. Third, the skills and behaviour were measured by how they practice the knowledge to the rabbits, not real paediatric patients. Most of them admitted they were more nervous handling babies and children in front of the parents than rabbits. In this particular event, a simulation-based education using pre- and post-tests is considered more effective compared to the "traditional" teaching method such as classroom lecture. A lecture-based training, while strong in its ability to efficiently transfer large quantities of information, has serious limitations in helping students acquire real practical skills [16]. In the future workshop, a variety of validated assessment tools could be incorporated in the pre-test and post-test assessment to more truly reflect the change in the knowledge, skills and behaviour of the participants [5].

Further assessment was necessary to test the retention of the knowledge and skills after the workshop in the future. Lastly, the sample size was small in this study. As the workshop continues to be run in the future, more participants can be accumulated to increase the data pool and validate the study.

CONCLUSION
After conducting research on 52 Nurses, it showed that before the training there are differences based on the hospital location category; while after conducting training there is no difference. In general, there is a difference in the mean that increases after conducting Aesculap Academy training with scores before conducting training at 43.81 and after conducting training at 87.52. This was evidenced by the value of t count of -18.155 > t table -2,000 or with a significant of 0.000 <0.05, which means that there are significant differences between before conducting training and after conducting training.

In conclusion, this 2 to 3day-simulation-based training workshop improved the knowledge of clinical performance of the participants and was well received. Future studies could focus on how the improvement of knowledge on clinical performance could lead to enhancement of the patient care and safety and how this type of training might be integrated into the formal curriculum of the Nursing Training and Education department not only in Awal Bros Group but other hospital as well.

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