INJ INTERNATIONAL NEUROUROLOGY JOURNAL

EFFECT OF PRACTICAL GUIDELINES ON NURSES PERFORMANCE REGARDING INSULIN PUMP FOR CHILDREN WITH TYPE 1 DIABETES IN A LIMITED RESOURCES SETTING

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Abstract

Background: Insulin pump therapy is proven safe and effective for individuals with diabetes, including children, adolescents, and adults. It has become the cornerstone of advanced insulin delivery methods and gained popularity, particularly among youth with type 1 diabetes at the turn of the century. Studies consistently demonstrate its ability to reduce HbA1c levels and the occurrence of hypoglycemia without increasing BMI z-scores. Aim: This study aims to evaluate the effect of using insulin pump guidelines on nurses' performance in caring for children with type 1 diabetes. Setting: This study was conducted at the specialized diabetes outpatient clinic for pediatric patients, pediatric and adolescent diabetes unit, Children Hospital. In Shams University's Children's Hospital. Sampling A purposive sample consisted of 100 nurses working in the previously mentioned settings with more than 6 months of experience who were allowed to perform care for children with type 1 diabetes .Tools: Three tools were used in this study for data collection. First: A structured interview questionnaire. (Pre/post application of the guideline) divided into two parts: Part I demographic characteristic data for nurses, Part II nurses knowledge regarding the insulin pump for children with type 1 diabetes. Second: Children's observational checklists based on International Society for Pediatric and Adolescent Diabetes (ISPAD) guidelines: (pre- and post-guideline implementation).Third: Likert attitude scale to assess nurses' attitude regarding the use of insulin pumps for children with type 1 diabetes. Results: Showed that there was a statistically significant improvement in the total level of nurses' knowledge about using the insulin infusion pump for children with type 1 diabetes mellitus post-educational program compared with pre-educational program ($p<0.05$*). Illustrates that there was a statistically significant improvement in total practice parts post-intervention compared with pre-intervention, as evidenced by the fact that 76.0% of them had incompetent total practice levels about the use of insulin pumps based on the ISPAD strategy pre-intervention, which improved to 83.0% of them having competent total practice post-intervention. Reveals that there was a highly statistically significant improvement in total nursing attitude about using the insulin infusion pump for children with type 1 diabetes mellitus post-educational program compared with pre-educational program ($p<0.001$**). Only 36.0% of them had a positive attitude pre-intervention, which improved to 64.0% of them having a positive attitude post-intervention. Conclusion: Intervention of program targeting nurse's performance and practice on using insulin pump had a positive effect on overall nurses' performance, knowledge and practice. Recommendations: Regular training programs targeting both health care professionals and allied care professional should be part of the clinical practice to improve outcomes and adherence to treatment.

Keywords: Insulin pump, Intervention Program, Nurses Performance

Introduction

Overall, insulin pump technology is evolving at an extraordinary rate, with new technologies being developed every year. The integration of insulin pumps with continuous glucose monitoring (CGM) systems has drastically expanded the insulin pump market with "smarter" insulin pumps that suspend insulin for hypoglycemia or even automate some insulin delivery [1]. Insulin pump therapy is a current method for subcutaneous insulin infusion treatment for children and adolescents with type 1 diabetes. Insulin pumps can provide greater flexibility in insulin administration and meal planning as compared with multiple insulin injections, and they may be particularly suitable for the pediatric age group. Many young people with diabetes have integrated insulin pumps into their daily practice [2].

Insulin pump therapy, also known as continuous subcutaneous insulin infusion (CSII) therapy, is an evolving form of insulin delivery that has been shown to be highly effective in maintaining hypoglycemia and providing patients

with flexibility in their lives. It provides the patient with a continuous subcutaneous infusion of rapid-acting insulin and allows the patient to administer boluses throughout the day for food and the correction of high glucose levels [3].Insulin treatment that closely mimics normal physiological patterns remains the cornerstone of type 1 diabetes management. Since the last guidelines were published in 2020, the changes have been modest with respect to insulin treatment, but the different modes have been refined, especially when it pertains to using an insulin pump as a continuous subcutaneous insulin infusion [4].

The aim of the current study is to assess the impact of implementing educational guidelines for insulin pump on the overall performance of nurses caring for children with type 1 Diabetes using insulin pump in a limited resources setting.

Subjects And Methods

Research design and settings: **A quasi-experimental analytical research design** with pre- post-assessments was conducted at the specialized diabetes outpatient clinic for pediatric patients, the diabetic inpatient unit, and the emergency unit, which are affiliated with Ain Shams University's Children's Hospital, Cairo Governorate.

Subjects: A purposive sample consisted of 100 nurses working in the previously mentioned settings with more than 6 months of experience who were allowed to perform care for children with type 1 diabetes and all of them agree to participate in the study.

Data collection tools: Data collection tools consisted of a knowledge questionnaire and an observation checklist for managerial skills.

- ***First tool: Knowledge questionnaire:*** The data was collected before and after the educational intervention given to nurses addressing *2 parts:*
  Part 1: This part collecting data a concerned with the characteristics of nurses, including gender, age, marital status, educational level, years of experience, and attendance at previous training courses about type 1 diabetes.
  Part II: This part evaluated overall nurses' knowledge level about diabetes, including: definition, high-risk people, risk factors, manifestations, diagnoses, laboratory investigation, normal rate of cumulative sugar, manifestation and management of hypoglycemia, complications and management of type 1 diabetes mellitus, and insulin pump (58 items).For scoring, each correct answer was scored one and the incorrect, zero. For each of the eight dimensions of knowledge and for the total questionnaire, the scores of the items were summed up and converted into percentage scores. Knowledge was considered Poor, if score was < 50% equal 0 < 29 point, average if the score was 50–80%, it would equal 29 < 46 points. And Good if the score was > 80%, equal 46 < 58 points.
- ***Second tool: Observation checklist: this was developed by the researcher based on (ISPAD, 2018[5]. and Donaghue et al., 2018) [6].(pre- and post-guideline implementation)***
  Part 1: Evaluating the clinical practice of nurses includes observational checklist filled by nurse before doctor visit and assess the technical experience with the pump include observed the following steps for the children before the doctor, such as: insulin pump based on the ISPAD strategy before, during, and after installation of the insulin pump; using the insulin pump to prevent emergency conditions; setting the alarm on the insulin pump to prevent emergency conditions; and taking action in case of trouble shouting the insulin pump to prevent emergency conditions (18 items).
  Part II: Assess nurse details about the pump including basal rate, bolus dose, insulin to carbohydrate ratio, insulin sensitivity factor, insulin action time, reservoir, cannula, tubing or delivery line, infusion set, items for continuous glucose monitoring, handling of special circumstances, and pump malfunctions (21 items).For scoring, each item observed to be "done" was scored one and the "not-done" scored zero. The average of the three trials observed was calculated and rounded-up to zero or one score. Within (60) minutes. For each area the scores of the item were summed-up and the total divided by the number of the items, giving a mean score for the part. These scores were converted into percent scores. The practice was considered competence if the percent score was ≥85% and incompetence if ≤85%.
- **Third tool: Likert Attitude scale:** This scale was adopted from **(Alghadeer et al., 2019[7].)** and includes 10 items in order to assess the attitude of the nurse toward effect of using insulin pump guidelines on nurses' performance in caring for children with type 1 diabetes. For scoring, nurse's responses classified as "strongly agree", "agree", "natural", "disagree" "strongly disagree" and respectively scored 5, 4, 3, 2, and 1. The scores of the items summed up and converted into percentage scores. Then all data classified into two categories: Positive attitude if score ≥60% or Negative attitude if score > 60%.

***Tools' validity and reliability*:** Three panelists from the Ain Shams University nursing faculty who specialize in pediatric nursing examined the content validity of the data collection tools. They were chosen to assess the contents for readability, comprehension, applicability, and relevance. The opinion was elicited regarding the format, layout, and relevancy of the tools, and all of their remarks were taken into consideration, and the tools

were regarded as valid from the expert's point of view.

Pilot study: A pilot study was conducted to test the clarity and applicability of the study tools and to estimate the time needed for each tool. It was done on 10% of the total studied nurses (10 nurses) under the pilot study, who were excluded from the present study to avoid sample bias and contamination. A few modifications were made, and the final form was developed. This phase took two weeks, the 3rd and 4th weeks of December 2022.

Fieldwork: the study was carried out through four phases, namely assessment, planning, implementation, and post-evaluation.

Assessment phase: before data collection, an official approval to conduct the study was obtained through a letter addressed from the Dean of the Faculty of Nursing, Ain Shams University to the Director of the Pediatric Hospital. Then, the researcher met with the Director of Pediatric Hospital to explain the study maneuvers, and to get an agreement on the proposed teaching methods to be applied in the nursing course.

Planning phase: the researcher started the preparation of the action plan for applying practical guidelines educational program was constructed, revised and modified from the related literatures to improve the nurses' knowledge, practices and attitude regarding caring for children with type 1diabetes on insulin pump. Different methods of teaching were used as lecture, group discussion, and demonstration & re-demonstration. Suitable teaching media was included as power-point presentation, booklet and videos to help proper understanding of the content. The action plan was validated by a jury consisting of two experts specialized in pediatric diabetes and endocrinology.

Implementation phase: Practical guidelines for nurses were implemented in the form of sessions, each session differ in content than another. Each session based on principles and skills of communication. Total number of sessions is 5 theoretical, 2 practical and one evaluative sessions that were provided for the studied nurses with the total hours were 10 hours and 20 minutes for each group including breaks that were divided into the two days; distributed on two days (Monday & Wednesday) a week for each group for all sessions during the first 3 months except for session No. 10 (evaluation session). Each session had its own title, objectives and content guided by the nurses' hand out.

Post-program evaluation phase: the researcher evaluated the effect of practical guidelines on nurses performance regarding insulin pump for children with type 1 Diabetes after six months using the same tools used in pre-test evaluation (post phase).

Administrative design and Ethical considerations: Official approval was obtained through an issued letter from Dean of faculty of nursing Ain Shams University to hospital directors of the previously mentioned setting and the researcher will explained aims of the study and its expected outcomes. An approval of the research protocol was obtained from the scientific Research Ethics Committee of the Faculty of Nursing, Ain Shams University. The aim, purpose, benefits of the study, and the impact of this study on the nurses were explained to the Director of the Institute and to nurses to get their agreement. In addition, the researcher got an oral consent from each nurses participate. They were reassured about maintaining their anonymity and the confidentiality of any collected data. They were also informed that they were allowed to choose to participate or not in the study and that they had the right to withdraw from the study at any time.

Statistical analysis: Data collected from the studied sample was revised, coded, and entered using a personal computer (PC) using the SPSS version. Computerized data entry and statistical analysis were fulfilled using the Statistical Package for Social Sciences (SPSS) version 22. Data were presented using descriptive statistics in the form of frequencies, percentages, and mean SD. The Chi-square statistic is commonly used for testing relationships between categorical variables. A correlation coefficient, or "Pearson correlation," is a numerical measure of some type of correlation, meaning a statistical relationship between two variables.

Significance of the results:

- Highly significant at p-value < 0.01.
- Statistical significance was considered at a p-value < 0.05.
- **Non-significant at p-value ≥ 0.01.**

Results

The study sample consisted of 100 nurses with slight female prealomnance (56.0%) with mean age of 40.75 ±

8.014. Regarding their education, (52.0%) of nurses had university education, and 64.0% of them had >10% years of experience (Table 1).

Before implementing the educational program, only 37% of the studied cohort aware of the definition of insulin pump. Only 44% knew the different parts of the insulin pump, and only 29% were aware that the insulin pump contains a dose calculator (Table 2).

(Table 2) Highlight the impact of educational intervention on the overall nurse's knowledge, showing a significant improvement in their knowledge after completing the educational program and this improvement included their overall understanding and experience with insulin pump ($p \leq 0.001$**).

(Figure 1a) Reveals that there was a statistically significant improvement in the total level of nurses' knowledge about using the insulin pump for children with type 1 diabetes mellitus after completing the educational program ($p<0.05$*).

(Figure 1b) Reveals that there was a significant improvement in the total level of nurses' practices about the insulin infusion after completing the educational program ($p<0.05$*).

Before implementing the educational program, only 36% of the assessed nurses showed positive attitude for using the insulin pump. However after the educational program, 64.0% of the assessed nurses showed a positive attitude (Figure 2).

As anticipated, when increasing the nurses' knowledge with insulin pump, both their total practices (r 0.8, $p<0.001$**), total attitude increase(r 0.9, $p<0.001$**) (Table 3).

Table 1: Personal characteristics of nursing students in the study sample (n=100).

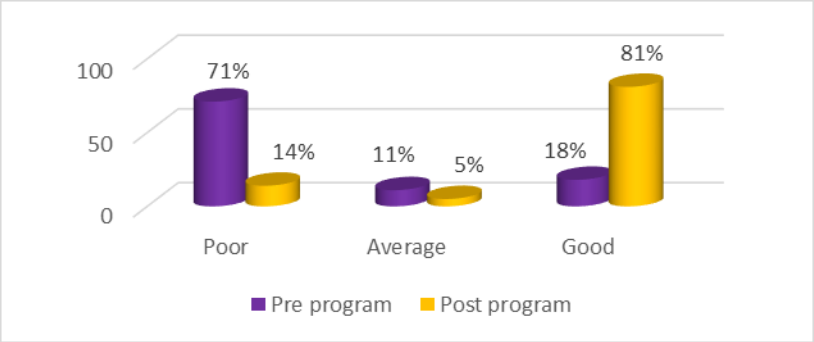
Socio-demographic data	Frequency	Percent
Age/ years		
14 ≤ 29	12	12.0
30 ≤ 39	28	28.0
40 ≤ 49	44	44.0
≥50	16	16.0
Mean ±SD **40.75 ± 8.014**		
Gender		
Male	32	32.0
Female	68	68.0
Marital Status		
Single	8	8.0
Married	56	56.0
Divorced	28	28.0
Widow	8	8.0
Educational level		
Diploma	20	20.0
Nursing institute	24	24.0
university	52	52.0
Others	4	4.0
Years of experience		
>5	8	8.0
5-10	28	28.0
>10	64	64.0

Table 2: Distribution of the studied nurses' knowledge about insulin pump pre & post educational program (n=100).

Items	Pre Correct		Pre Incorrect		Post Correct		Post Incorrect		Chi-square X^2	p-Value
	No.	%	No.	%	No.	%	No.	%		
Definition of insulin pump	37	37.0	63	63.0	88	88.0	12	12.0	8.009	0.003*
Most common type of DM that use insulin pump.	36	36.0	**64**	**64.0**	**85**	**85.0**	15	15.0	9.926	0.001**
Parts of the insulin pump connected to the body	44	44.0	56	56.0	85	85.0	15	15.0	13.866	0.000**
Time of changing infusion parts connected to the body	37	37.0	63	63.0	84	84.0	16	16.0	11.187	0.000**
Parts of an extracorporeal insulin pump	44	44.0	56	56.0	87	87.0	13	13.0	11.741	0.000**
Insulin pump contains an electronic dosage control processor.	29	29.0	71	71.0	86	86.0	14	14.0	6.649	0.005*
Insulin pump contains a reservoir to store insulin.	36	36.0	64	64.0	87	87.0	13	13.0	8.405	0.002*
Definition of Infusion device (impregnation) with the pump.	35	35.0	65	65.0	85	85.0	15	15.0	6.227	0.009*

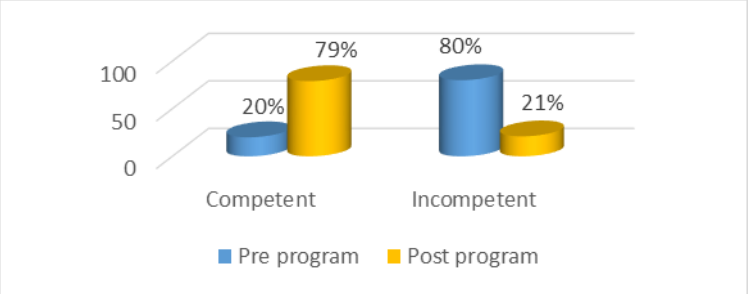
Chi-square test, * * highly statistically significance p≤ 0.001, * statistically significance p≤ 0.05

Figure (1): Percentage distribution of the studied nurses' total level of knowledge about using the insulin infusion pump for children with type 1 Diabetes mellitus pre & post educational program (n=100)

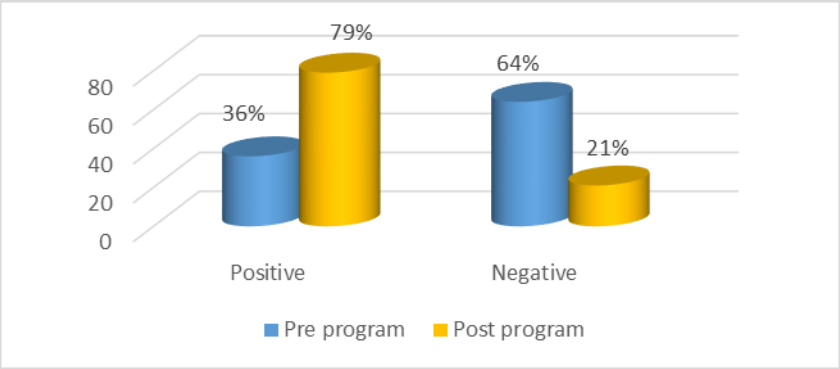


X^2 (1) = Relation between pre& post program (11.544), (p=0.021*)

Figure (2): Percentage distribution of the studied nurses' total practice about using the insulin pump for children with type 1 Diabetes mellitus pre & post educational program (n=100).



*= **Relation between pre& post program (6.646),** (p=0.005*)*
Figure (3): Percentage distribution of the studied nurses' total attitude regarding using the insulin pump for children with type 1 Diabetes mellitus pre & post educational program (n=100).



= Relation between pre& post program (5.440), (p=*0.016)

Table 3 Correlation between total knowledge, practices and attitude regarding insulin infusion pump pre & post educational program (n=100).

Variable	Total practices				Total knowledge			
	Pre- program		Post-program		Pre- program		Post-program	
	r	p- value	r	p- value	r	p- value	r	p- value
Total knowledge	0.532	0.000**	0.904	0.000**	-	-	-	-
Total attitude	0.354	0.000**	0.699	0.000**	0.242	0.015*	0.800	0.000**

R-Pearson Correlation Coefficient,
*** * highly statistically significance p≤ 0.001, * statistically significance p≤ 0.05**

Discussion

It hypothesized that the application of educational programs will lead to significant improvement in nurses' knowledge and their performance. The current study proved this hypothesis and demonstrated significant improvements in the overall knowledge, practice and attitude of nurses after implementation of the educational intervention. The improvements were maintained throughout the 6-month.

The current study revealed that the impact the educational intervention on the overall nurse's knowledge, showed a significant improvement in their knowledge after completing the educational program and this improvement included their overall understanding and experience with insulin pump

As regard the studied nurses' total level of knowledge about using the insulin infusion pump for children with type 1 diabetes mellitus pre- and post-educational programs, the current study displayed that there was a statistically significant improvement in the total level of nurses' knowledge about using the insulin infusion pump for children with type 1 diabetes mellitus post-educational programs compared with the pre-educational program.

Similar to our data **Kamkar. (2020)** [8], when assessing the role of diabetes educators in promoting diabetes-based knowledge on insulin pump, showed a significant improvement in knowledge about insulin pump therapy after the educational program proving its effective and superior role. Also, **Marks et al., (2020)** [9], reported a significant improvement in the participants knowledge about the use of insulin pumps after an online spaced educational program targeting pediatric endocrinology trainees.

Alishaq., (2018) [10], evaluated the impact of diabetes educational interventions on nurses' knowledge among a cohort of nurses from both Abu Dhabi and Dubai. In accordance with the current data, the total practice of recruited nurses significantly improved after the training sessions.

The present study indicated that there was a highly statistically significant improvement in total nursing attitude after the educational programs compared with pre-educational programs. As evidenced, only more than one-third of them had a positive attitude pre-intervention, which improved to nearly two-thirds of them having a positive attitude post-intervention. On the same scene, a study conducted by **Moran et al., (2021)** [12]. Reported that, after attending diabetes camp, nurses had a positive change in their attitudes regarding diabetes management. This suggests that the educational intervention had a positive impact on the nurses' attitudes and their willingness to use the insulin pump for children with type 1 diabetes mellitus.

The current study revealed that there was a highly statistically significant correlation between total nurses' knowledge and total practices regarding insulin infusion pump hypothesizing having that nurses a good level of knowledge are more competent in practice.

Consistently, **Zhou et al., (2020),** [13] reported the efficacy of long-training in diabetes-related knowledge, practice and attitudes among a cohort of liaison diabetes nurses. Likewise, **Alruwaili et al., (2023),** [14] stated that the inadequate nurses' management practices of children with diabetes mellitus were exacerbated by nurses' moderate level of knowledge.

Regarding the correlation between total nurses' knowledge and attitude, the current study showed a highly significant positive correlation between total nurses' knowledge and total attitude. This can be escplained as nurses who have a good level of knowledge seem to have a positive attitude.

Similarly, this result was agreed upon by **Liao et al., (2023),**[15] who found significant positive correlation between knowledge and attitude scores among the studied nurses. In the same vein, **Karahan et al., (2019),** [16] stated that there was a positive correlation between nurses' knowledge and attitude after using a web-based diabetes training program.

Results from the current study was compatible with **Wu et al., (2021),** [17]who noticed that there was a statistically significant positive correlation between the studied nurses, knowledge, practice, and attitude scores among a cohort of Chinese nurses . Also, **Mo et al., (2023),** [18] proved similar findings among a cohort study of non-endocrinology nurses.

Conclusion

Intervention of program targeting nurse's performance and practice on using insulin pump had a positive effect on overall nurses' performance, knowledge and practice. Regular training programs targeting both health care professionals and allied care professional should be part of the clinical practice to improve outcomes and adherence to treatment.

Statements & Declarations

Funding: "The authors declare that no funds, grants, or other support were received during the preparation of this manuscript."

Competing Interests: "The authors have no relevant financial or non-financial interests to disclose."
Author Contributions**:** "All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Y E, F M and N A. The first draft of the manuscript was written by H S and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript."

Acknowledgement: not applicable

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