



Nurses' Perception regarding Artificial Pancreas among Type I Diabetes Mellitus at the National Diabetic Institute

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Abstract

Background: Artificial Pancreas is newly advanced technology in management of type I Diabetes Mellitus Patients. Nurses play a crucial role in helping diabetic patients through guidelines that increase knowledge, improve attitude and practice regarding use of artificial pancreas. **The study aimed to** assess nurses' perception regarding artificial pancreas among type I diabetes mellitus at the national diabetic institute. **Design:** A Descriptive research design was used. **Setting:** The study conducted at the National institute of diabetes and Endocrinology. **Sample:** A Convenience sample include 218 nurses was used. **Tools:** one tool, Structured interview questionnaire was used and consist of four parts, demographic characteristics of studied nurses', nurses' knowledge regarding artificial pancreas, nurses' attitude toward artificial pancreas and nurses' reported practices regarding artificial pancreas. **Results:** 54.1% of the studied nurses had good level of knowledge regarding artificial pancreas, while 66.6% and 54.2% of the studied nurses had positive attitude and incompetence level of reported practices regarding artificial pancreas respectively. **Conclusion:** There was a high statistically significant positive correlation between total knowledge, attitude and reported practices of studied nurses regarding artificial pancreas. **Recommendations:** Apply and implement an educational program for nurses to increase awareness of nurses regarding artificial pancreas.

Key words: Artificial Pancreas, Nurses' perception, Type 1 Diabetes Mellitus

I. Introduction

An artificial pancreas is a man-made device that is designed to release insulin in response to changing blood glucose levels in a similar way to a human pancreas, regulation of blood glucose levels in diabetic patients, through the integration of the following modules: insulin infusion pump, algorithm for the estimation of insulin delivery rates/bolus, Continuous Glucose Measurement System (CGMS). The CGM provides real-time measurements of blood glucose levels, which are then used by a control algorithm to determine the appropriate insulin delivery through the pump. These algorithms are designed to respond to fluctuations in glucose levels, aiming to maintain normal blood glucose and minimize the risk of hypoglycemia (Wang et al., 2023).

Artificial pancreas therapy is an emerging treatment option that combines an insulin pump and a continuous glucose monitor with a control algorithm to deliver insulin in a glucose-responsive manner (i.e., a single-hormone artificial pancreas system). Glucagon can also be delivered in a similar glucose-responsive manner, as in dual-hormone systems. Therefore, the use of an artificial pancreas can reduce the burden on the patient by automatically adjusting the amount of insulin entering the body based on sensor glucose levels (Elsadig et al., 2024)

The patient with type 1 diabetes mellitus is an important part of artificial pancreas delivery system. The concentration of glucose circulating in the patient's blood is constantly changing. It is affected by the patient's diet, activity level, and how his or her body metabolizes insulin, health condition, stress, side effects from other medications and psychological condition of patients of type 1 diabetes mellitus all these considerations nurses should take part in patient plan of care in dealing with artificial pancreas (Abo Algany et al., 2024).

Nurses' should have had knowledge to educate patients about artificial pancreas, purpose, reasons, mechanism of action, different types of artificial pancreas, benefits, barriers, complications of artificial pancreas, important follow up of artificial pancreas and the ways of dealing with artificial pancreas at different situations for maintain health and welfare for patient with type 1 diabetes mellitus (Abouزيد et al., 2022).



Nurses' had good opportunity to persuade patients that using of artificial pancreas radically changing type 1 diabetes management. Showing patients that artificial pancreas makes frequently analyzing glucose reading and accuracy insulin delivery make continually blood glucose control and improve quality of life (**Zeng et al., 2019**). Also, nurses' had adequate practices about artificial pancreas to educate and orient patients about how to use and deal with AP as new technology for treatment of type 1 diabetes mellitus and using of artificial pancreas reduces the patients stress compared to that using the sliding-scale method. In addition, adopting the use of an artificial pancreas for the management of blood glucose improved sense of security and sense of wellbeing (**Marshall et al., 2020**).

Community health nurses (CHN) play a major role by using their experience as specialist nurses in diabetes management and care in improving the knowledge, improve attitude and practices of patients regarding artificial pancreas by providing education, counselling and ongoing support. Community health nurses empowering patients to make informed decisions about their health and guidance to promote patient well-being (**Jiang et al., 2020**).

II. Significance of the study

The prevalence of Diabetes Mellitus (DM) among Egyptian adult is 18.4% and ranks ninth in the prevalence of DM worldwide and number of diabetic adults was 10.8450 in early 2022, and percentage of artificial pancreas increased 3.5 % every year, the artificial Pancreas device system will offers various options for diabetic patients and lower prevalence of diabetes and make significant reduction in incidence of hyperglycemic patients by not only monitor glucose level in the body but also automatically adjust the delivery of insulin to reduce the high blood glucose levels (hyperglycemia) and minimize the incidence of low blood glucose (hypoglycemia) with little or no input from the patient (**International Diabetes Federation (IDF), 2021**).

In Egypt, Study performed in Ain-shams University on 600 patients with type I diabetes mellitus were recruited from diabetology clinic age 14 and above and their mean HbA1C was 8.66% with 200 (33%) having HbA1C ($>7\%$), 200 with good glycemic control having HbA1C ($\leq 7\%$) and 200 with poor glycemic control having HbA1C ($>7\%$), The study mentioned that 36 persons (9%) were treated by artificial pancreas and insulin pump therapy (**Safinaz et al., 2022**)

Worldwide, about 422 million people are affected by diabetes, with the majority of them living in low- and middle-income countries such as Egypt. Every year, 1.5 million deaths are directly attributed to diabetes. Despite remarkable advances in the treatment of type 1 diabetes, the achievement of optimal glycemic control without the occurrence of hypoglycemia remain a challenge for patients of all ages as well as healthcare providers. The current approach to insulin therapy for type 1 diabetes involves either injecting insulin multiple times a day or infusing insulin continuously under the skin using an artificial pancreatic insulin pump (**Yahiya et al., 2024**).

The first artificial pancreas approved by Food and Drug Administration (FDA) in 2016 under the name of hybrid closed loop system that continuously measures glucose levels and delivers the appropriate dose of basal insulin for age of 14 or older, Many countries using artificial pancreas for diabetic type 1, development of artificial pancreas continue to progress rapidly and the artificial pancreas promises to become part of clinical care, improve the lives of type I diabetes mellitus, in Egypt application of artificial pancreas will result in improved care reflected in lower of Hb1c and quality of life improve, artificial pancreas systems market is anticipated to grow significantly in the future (**Šoupal et al., 2019**).

The artificial pancreas system secrete insulin into body according to information received from blood sugar measurements making millions of people suffering from diabetes to be assurance about their life in the future (**Breton et al., 2022**) Therefore, this study was conducted to assess nurses' perception regarding artificial pancreas among type 1 diabetes mellitus at the National diabetic institute.

III. Aim of the study:

The aim of this study was to assess Nurses' Perception Regarding Artificial Pancreas among Type I Diabetes Mellitus at the National Diabetic Institute through the following:

- 1- Assessing nurses' knowledge regarding artificial pancreas.
- 2- Recognizing nurses' attitude toward artificial pancreas.



3-Determining nurses' reported practices regarding artificial pancreas.

Research questions:

- 1- What are nurses' knowledge regarding artificial pancreas.?
- 2-What are nurses' attitude toward artificial pancreas?
- 3-What are nurses' reported practices regarding artificial pancreas?
- 4-Is there relationship between nurses' knowledge, attitude, reported practices and their demographic characteristics?

IV. Subject and Methods

The subject and methods for this study was portray under the four main items as following:

- I- Technical item.
- II- Operational item.
- III- Administrative item.
- IV- Statistical item.

I. Technical Item

The technical item includes research design, setting, subject and tools for data collection.

Research design: -

A Descriptive research design was applied to achieve the aim of this study.

Setting:

This study was conducted at National institute of diabetes and endocrinology which consist of 9 floors, the first floor, clinics, emergency department and blood bank. The Second floor, the Human Resources Department and storage area. The third floor, the hospital director and the nursing supervisor office, The fourth floor operations, sterilization department and intensive care unit. The fifth floor, the economic treatment pharmacy and the free treatment and children's pharmacy. Sixth floor, children department. The seventh floor, intensive care for insurance patients and women and economic patients. The eighth floor, men's department. The ninth floor is the doctors' residence.

Sampling:

A Convenience sample of nurses worked at National institute of diabetes and Endocrinology.

Sample size:

Total nurses worked at National Diabetes Institute and Endocrinology were 500

The sample size was calculated by following equation:

$$n=N [1+N (e^2)]$$

n=sample size

N=population size is 500

e=,05 is the level of perception

$$n=500[1+500 (.0025)] =218$$

The actual size of sample was 218 nurse through year 2023-2024.

Tools for data collection

One tool of data collection was used to carried out the current study namely, A structural interviewing questionnaire

This tool was developed by investigator after reviewing the national and international related literature. It will consist of four parts.

Part I: Demographic characteristics of nurses: Includes seven questions about age, sex, marital status, educational level, place of residence, years of experience and monthly income

Part II: Nurses' knowledge regarding artificial pancreas:

Knowledge about artificial pancreas, include function of pancreas, meaning of artificial pancreas, indications, mechanism of function, different types of artificial pancreas, persons more needed for artificial pancreas, benefits of artificial pancreas, barrier of using artificial pancreas, different types of insulin uses in artificial pancreas, complications of artificial pancreas, mechanism of insertion, method of insulin pump, follow



up of insulin pump, ways of dealing with artificial pancreas during travel, dealing with artificial pancreas during exercise, dealing with artificial pancreas during shower. It composed of 16 closed /ended questions.

Scoring system: -

Scoring system for knowledge items, a complete correct answer was scored 2 grads, incomplete correct answer was scored 1 grade and incorrect answer or don't know was scored zero. Total score were 32 points for 16 items range from 0-32. The score of knowledge was categorized into:

- **Good knowledge** $\geq 75\%$ (24-32 grads)
- **Fair knowledge** 50 - > 75% (16-> 24 grads)
- **Poor knowledge** > 50% (>16 grads)

Part III: Nurses' attitude toward artificial pancreas :- The scale used to measure nurses attitude was artificial pancreas questionnaire and include items about thinking that using of artificial pancreas whenever available would be safe and effective, the best way to avoid the complications of diabetes type1 by using the artificial pancreas, advise others with type 1 diabetes to use artificial pancreas, the artificial pancreas will decrease the frequent finger prick, the diabetic patient will cope with artificial pancreas easily, the artificial pancreas will improve the quality of life of type 1 diabetes mellitus patients, the artificial pancreas will decrease the doctor visit, the artificial pancreas will improve glucose control, the artificial pancreas will decrease the traditional ways for measuring blood sugar, using of artificial pancreas will duplicate in future, using of artificial pancreas will improve the psychiatric condition of diabetic patients, using of artificial pancreas will be the best solution of diabetes. It composed of 12 items.

Scoring system: for assessment nurses' attitude about artificial pancreas, agree was equal 3 grades, neutral was equal 2 and disagree was equal 1 grade. Total scores were 36 for 12 items range from 12-36. The score of each item stumped up and then converted into percent grade.

Positive attitude $\geq 60\%$ (≥ 22 grads)

Negative attitude > 60% (> 22 grads)

Part IV : Nurses' reported practices regarding artificial pancreas : Includes items about performing hand washing by water and soap and dry it before dealing with patients, using alcohol swap for cleaning site of sensor and infusion pump, using sterile gloves during insertion, insert sensor and insulin pump in suitable place for patient privacy, fixing sensor and insulin pump properly, make calibration of insulin pump before using, insert sensor code to insulin pump before the using, make program of insulin on available system, filling insulin pump by sufficient amount of insulin before insertion, making follow up insulin pump insertion for any signs of inflammations, taking doctor consult in any change happen at site of site of sensor and insulin pump, take doctor consultation in case of disturbances of blood sugar level, reassess response of patient after procedure, perform hand washing after finishing insertion of artificial pancreas. It composed of 15 items.

Scoring system: -

Each item had two responses of reported practices, done was scored 1 and not done was scored zero. Total score was 15 for 15 items range from 0-15. The Total score are calculated and converted into percent scores as

- **Competent reported practices** $\geq 60\%$ (≥ 9 grades)
- **Incompetent reported practices** > 60% (> 9 grades)

Validity: -

The validity of the tool was tested through a panel of three experts in Community Health Nursing to review relevance of the tools for comprehensiveness, understanding and applicability.

Reliability:

Reliability of tool was tested to determine, the extent to which the questionnaire items related to each other. Cronbach's Alpha in this study found to be 0.89 for knowledge ,0.86 for attitude and 0.88 for reported practices.

V. Ethical considerations:

An official permission to conduct the proposed study was obtained from the Scientific Research Ethics Committee at Faculty of Nursing, Helwan University. Participation in the study was voluntary and subjects were given complete full information about the study and their role before signing the informed consent. The



ethical considerations were include explaining the purpose and nature of the study, stating the possibility to withdraw at any time, confidentiality of the information where it was not being accessed by any other party without taking permission of the participants. Ethics, values, culture and beliefs was being respected.

II- Operational Item:

Preparatory phase:

A review of the past, current, national and international related literature covering all aspects helpful in designing and processing of data collection tools were available books, articles, internet, periodicals and magazines.

VI. Pilot study:

The pilot study has been conducted to test clarity, applicability and understanding of the tool. It has been conducted on 10 % (22 nurses) of the sample. They have been selected from setting chosen for the study. The results of the pilot study helped in refining the interview questionnaire and to schedule the time frame. No modificatis were done in tool so, the participants of the pilot were included in the main study sample.

VII. Field work:

Data collection of these study was started at the beginning of September 2023 until end of November 2023. Theinvestigator introduced himself to nurses, explained the aim of the study and its implications and how to fill questionnaire and ensure cooperation. Informed consent was obtained from participants. The questionnaire sheet takes about 15-20 minutes to complete. Data was collected at 2 days (Sunday and Thursday from 8am to 2pm) every week within 3 months. The investigator taken about 10 nurses each day, 20 nurses each week about 80 nurses per month. The interviewing questionnaire sheet was completed by the investigator from each nurse.

III- Administrative Item:

An official letter requesting permission to conduct study was obtained from the Dean of Faculty of Nursing, Helwan University to the director of the institute to obtain approval to carry out the study. The letter included a permission to collect the necessary data and explain the purpose and nature of the study.

IV-Statistical Item:

Data collected from the studied sample was revised, coded, and entered using personal computer(pc). Computerized Data entry and analysis were performed using SPSS statistical package version 26. Data were presented using descriptive statistics in the form of frequencies, percentages. Chi-square test (χ^2) was for comparison between variables. Spearman correlation measures the strength and direction of association between two ranked variables. Also, used Mean \pm SD.

Significance of the results: -

- Highly statistically significant at P-value ≤ 0.01
- Statistically significant at p-value > 0.05
- Non- significant at p-value > 0.05 .

IX. Results

Table (1): Shows that, 34.9 % of the studied nurses were in age 30- < 40 years with the mean age 34.9 \pm 10.1%, 61 % of them were female and 52.3% of them were married as well 40.8% of them had baccalaureate degree qualification, 67.9 of them residence in urban area, Also, 44% of the studied nurses had years of experience 5 -<10 years.

Figure (1): Clarifies that, 33% of the studied nurse had fair level of knowledge regarding artificial pancreas, 54.1% of the studied nurses had good level of knowledge regarding artificial pancreas while, 12.8% of them had poor level of knowledge regarding artificial pancreas.

Figure (2): Reveals that, 66.6% of the studied nurses had positive attitude level regarding artificial pancreas. While 33.4% of the studied nurses had negative attitude level regarding artificial pancreas

Figure (3): Indicates that, 54.2% of the studied nurses had incompetence level of reported practices regarding artificial pancreas. While 45.8% of the studied nurses had competence level of reported practices regarding artificial pancreas.

Table (2): Reveals that, there were statistically significant relation between total level of knowledge of studied nurses and their age, marital status, place of residence and years of experience at P value at (< 0.05).

Table (3): Demonstrates that, there were statistically significant relation between total attitude level of the studied nurses and their sex, marital status, educational level and years of experience at P value at (< 0.05).

Table (4): Shows that, there was statistically significant relation between total reported practices level and their place of residence.

Table (5): Demonstrates that, there were statistically significance positive correlation between total knowledge, attitude and reported practices of the studied nurses (P value < 0.05).

Table (1): Frequency distribution of the studied nurses according to their Demographic characteristics (n = 218).

Demographic characteristics		No	%
Age in years	20 - 30	70	32.1
	30 - 40	76	34.9
	40 - 50	43	19.7
	≥ 50	29	13.3
Mean ± SD 35.9 ± 10.1			
Sex	Female	133	61.0
	Male	85	39.0
Marital status	Single	58	26.6
	Married	114	52.3
	Divorced	35	16.1
	Widow	11	5.0
Educational level	Technical diploma	34	15.6
	Technical institute	81	37.2
	Bachelor of Nursing	89	40.8
	Master's degree	14	6.4
Place of residence	Rural	70	32.1
	Urban	148	67.9
Years of experience	< 5	57	26.2
	5 - 10	96	44.0
	≥10	65	29.8

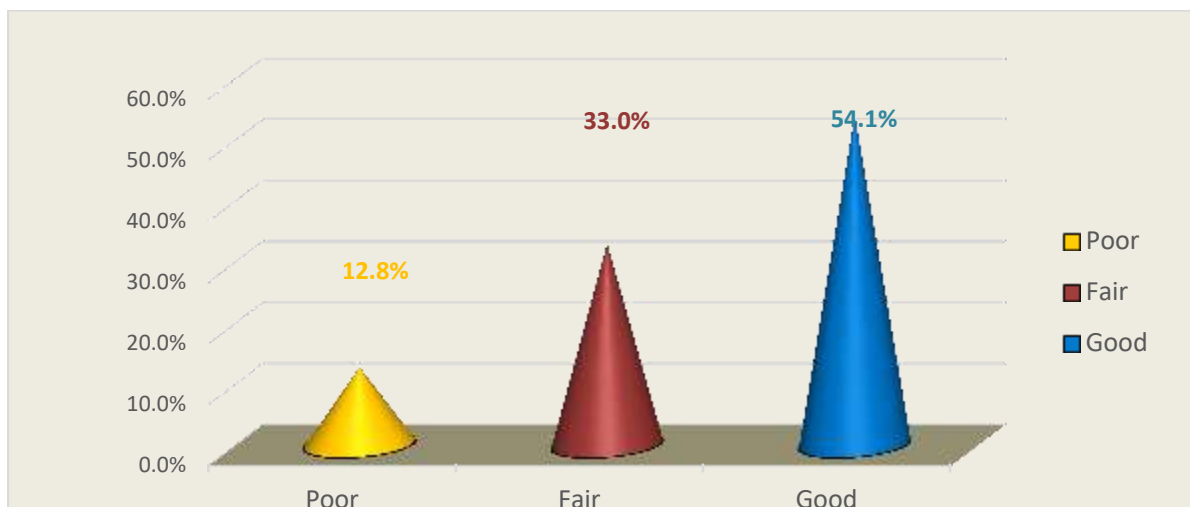


Figure (1): Total knowledge level of studied nurses regarding artificial pancreas (n218).

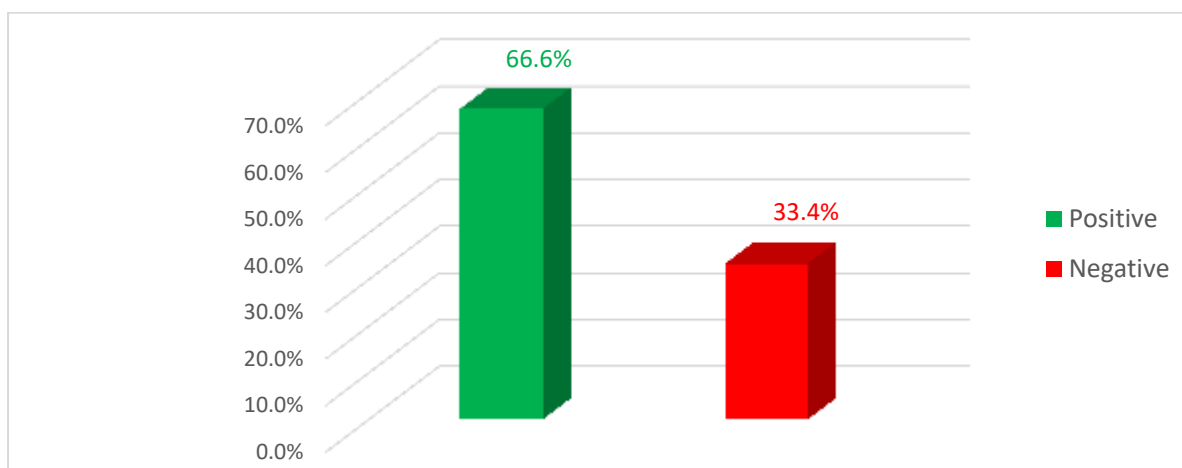


Figure (2): Total attitude level of the studied nurses regarding to artificial pancreas (n = 218).

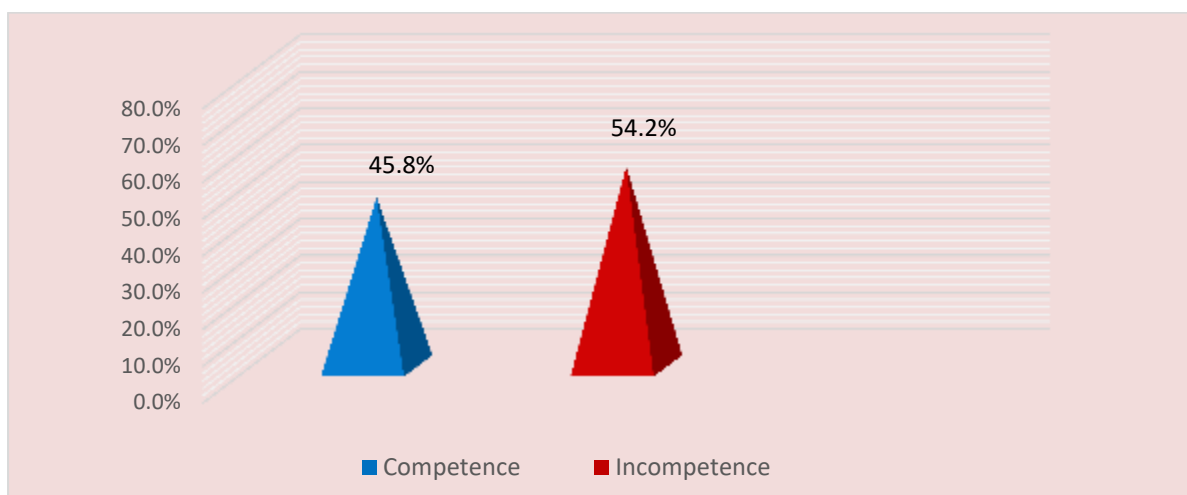


Figure (3): Total reported practices of the studied nurses regarding to artificial pancreas (n = 218).

Table (2): Relations between total knowledge level of the studied nurses and their demographic characteristics (n=218).

Demographic characteristics		Total Knowledge						X ²	P value
		Poor n=28		Fair n=72		Good n=118			
		No.	%	No.	%	No.	%		
Age (In years)	20 – 30	15	21.4	27	38.6	28	40	13.8	0.03*
	30 – 40	6	7.9	19	25.0	51	67.1		
	40 – 50	4	9.3	17	39.5	22	51.2		
	≥ 50	3	10.3	9	31.0	17	58.7		
Sex	Female	19	14.3	37	27.8	77	57.9	4.2	0.12
	Male	9	10.6	35	41.2	41	48.2		
Marital Status	Single	13	22.4	26	44.8	5	32.8	19.9	0.003*
	Married	8	7.0	32	28.1	5	64.9		
	Divorced	4	11.4	11	31.4	5	57.2		
	Widow	3	27.3	3	27.3	5	45.4		
Educational level	Diploma	3	8.8	15	44.1	16	47.1	8.8	0.18
	Technical institute	8	9.9	21	25.9	52	64.2		
	Bachelor of Nursing	15	16.9	33	37.1	41	46		
	Master's degree	2	14.3	3	21.4	9	64.3		
Place of residence	Rural	9	12.9	33	47.1	28	40	10.1	0.007*
	Urban	19	12.8	39	26.4	90	60.8		
Years of experience	< 5	14	24.6	22	38.6	20	36.8	15.2	0.004*
	5 – 10	9	9.4	22	22.9	60	67.7		
	≥10	5	7.7	22	33.8	38	58.5		
Monthly income	Enough & save	0	0.0	2	28.6	5	71.4	7.7	0.09
	Enough	9	8.4	33	30.8	65	60.8		
	Not enough	19	18.3	37	35.6	48	46.1		

** Significant at P Value ≤ 0.05

Table (3): Relations between total attitude level of the studied nurses and their demographic characteristics (n=218).

Demographic characteristics		Total attitude				X ²	P value
		Positive n=145		Negative n=73			
		No.	%	No.	%		
Age (in years)	20 – 30	49	70	21	30	2.8	0.09
	30 - 40	42	55.2	34	44.7		
	40 - 50	29	44.1	14	41.1		
	≥ 50	25	86.2	4	13.8		
Sex	Female	76	57.1	57	42.9	14.5	0.002*
	Male	69	81.1	16	17.6		
Marital status	Single	45	77.6	13	22.4	6.5	0.03*
	Married	66	57.8	48	42.1		
	Divorced	26	74.2	9	25.7		
	Widow	8	72.7	3	27.2		
Educational level	Diploma	30	88.2	4	11.8	9.8	0.001*
	Technical institute	47	58	34	41.9		
	Bachelor of Nursing	56	62.9	32	36		
	Master's degree	12	85.7	3	14.2		
Place of residence	Rural	49	70	22	30	0.47	0.49
	Urban	96	64.9	51	34.5		
Years of experience	< 5	45	79	12	18	6.1	0.004*
	5 – 10	57	59.3	39	40.6		
	≥10	43	66.1	22	32.3		
Monthly income	Enough & save	5	71.4	3	28.5	0.19	0.66
	Enough	54	70	31	29		
	Not enough	67	62.5	39	37.5		

** Highly statistically significant at P Value ≤ 0.05

Table (4): Relations between total reported practices level of the studied nurses and their demographic characteristics (n=218).

Demographic characteristics		Total reported practices				X ²	P value
		Incompetence n=118		Competence N=100			
		No.	%	No.	%		
Age (in years)	20 – 30	41	58.5	29	41.4	1.63	0.2
	30 – 40	40	52.6	36	47.3		
	40 – 50	21	48.8	22	51.1		

	≥ 50	16	55.1	13	44.8		
Sex	Female	66	49.6	67	50.3	2.7	0.09
	Male	52	61.1	33	38.8		
Marital status	Single	31	53.4	27	46.5	1.8	0.2
	Married	67	58.7	47	41.2		
	Divorced	14	40	21	60		
	Widow	6	54.5	5	45.5		
Educational level	Diploma	16	47	18	35	0.12	0.72
	Technical institute	41	50.6	40	49.4		
	Bachelor of Nursing	53	59.5	36	40.5		
	Master's degree	8	57.1	6	42.9		
Place of residence	Rural	21	30	49	70	39.3	0.00*
	Urban	97	56.5	31	34.5		
Years of experience	< 5	30	44.7	37	55.3	3.3	0.06
	5 – 10	57	59.3	39	40.7		
	≥10	31	47.7	34	52.3		
Monthly income	Enough & save	5	71.4	2	28.6	1.6	0.2
	Enough	50	46.7	57	53.3		
	Not enough	63	61.1	41	39.9		

** Highly statistically significant at $P \leq 0.001$.

Table (5): Correlation between total level of knowledge, attitude and reported practice among the studied nurses (n=218)

Variables	Total Knowledge		Total Attitude		Total Practices	
	R	P	r	P	R	P
Total Knowledge			0.628	0.000	0.739	.002
Total Attitude	0.281	0.000**	-	-	0.439	.001
Total reported Practices	0.275	0.000**	0.327	0.000**	-	-

** Highly statistically significant at $P \leq 0.001$.



X. Discussion

An artificial pancreas is a system made of three parts that work together to mimic how a healthy pancreas controls blood glucose. An artificial pancreas system uses a continuous glucose monitor, an insulin pump and program stored on the pump or a smart phone, the insulin pump can be worn on a belt, stored in a pocket or attached directly to the skin. Importance of using artificial pancreas in patient with type 1 diabetes is better blood glucose management, reducing risk of dangerous hypoglycemia, increasing life style flexibility, improved wellbeing and preventing hazards of miss doses of insulin (**Sortland & Kasen, 2022**).

Nurses' perception plays an important role in increase awareness about artificial pancreas systems transformative technologies in treatment of type 1 diabetes mellitus patients and help reduce the day-to-day burden of trying to optimize type 1 diabetes control and diabetes management make the process easier and can enhance patient's quality of life. Currently, the artificial pancreas system is the most advanced technology to help reduce the risk of exercise induced hypoglycemia, Community health nurses play a major role using their experience as specialist nurses in diabetes management and care in improving the knowledge and practices of patients regarding artificial pancreas (**Breton et al., 2020**).

Regarding demographic characteristics of the studied nurses, the finding of the current study revealed that, more than one third of the studied nurses' were in age group from 30 - < 40 years, with mean age was 36.4 ± 10.17 years. This result was inconsistent with the results of study performed by **Mekky et al., (2023)** in Benha University Hospital, Egypt (n=70), in their recent study titled "Effect of an Educational Program on the Nurses' Performance and Patients' Health Outcomes regarding Diabetic Ketoacidosis." and found that 57 % of studied nurses' their age less than 25 years old. From investigator point of view, dealing with patient with artificial pancreas need experienced nurses not newly graduated.

Regarding sex and marital status, the finding of the current study illustrated that, more than half of the studied nurses' were female and married. This finding were agree with **Abdelrahman et al., (2020)**. whose conducted study in Assuit University Hospital, Egypt (n=150) entitled "Assessment of Nurses' Knowledge and Practices Regarding Care of Patients with Diabetic Coma" and clarified that, 58 % of studied nurses' were female and married.

Concerning educational level, the results of the present study revealed that, more than two fifths of the studied nurses' had bachelorette degree. This results were in the same line with **Farzaei et al., (2023)** whose conducted study in India (n=200) in their recent study titled "Nurses' knowledge, attitudes, and practice with regards to nutritional management of diabetes mellitus" and clarified that 43.0% of the studied nurses had bachelorette degree. From the investigator point of view, these results are due to the culture and state's interest in education, which led to the presence of a large number of nurses had bachelor's degrees in nursing.

Regarding place of residence, the current study revealed that more than two third of studied nurses' from urban areas. This finding was agree with **Kasen et al., (2020)** whose conduct study in India (n=70) in their study titled "Finding the Balance": A Qualitative Study of the Experience of Nurses and Patients with Diabetes on an Insulin Pump in the Hospital " and revealed that 69 % of nurses' residence in urban areas.

Regarding years of experience, the current study revealed that more than two fifths of the studied nurses' had 5 - < 10 years of experience. This study was consistent with **Landu & Crowley, (2023)**. whose conducted study in Africa (n=100) in their recent study titled "Primary health care nurses' knowledge, self-efficacy and performance of diabetes self-management support" And found that 47.2 % nurses' had 5- < 10 years of experience.

Regarding monthly income, the current study revealed that half of the studied nurses' monthly income was not enough. This study was consistent with to **Ali, (2023)**. whose conducted study in Benha University, Egypt (n=100) in their recent study titled "Evaluation of awareness and attitude of pediatric nursing students, nurses, and adolescents regarding type one diabetes advanced devices and virtual nursing." and illustrated that 51.2 % of the studied nurse had a good level of economic status. From investigator point of view, this may be due to that monthly income in the developing country was slightly low.

Regarding total knowledge level of studied nurses regarding artificial pancreas. The finding of this study clarified that, one third of the studied nurse had fair level of knowledge regarding artificial pancreas and more than half of the studied nurses had good level of knowledge regarding artificial pancreas. This result in same line with



Kasen et al., (2020) and revealed 52.8 % of studied nurses had good knowledge regarding artificial pancreas and 35 % of them had fair knowledge about artificial pancreas. From investigator point of view, nurses need more education to care safely for a patient about artificial pancreas systems

Regarding studied nurses' total attitude about artificial pancreas. The finding of present study revealed that, more than two thirds of studied nurses had positive attitude level regarding artificial pancreas while more than one third had negative attitude. This result in same line with **Albers et al., (2020)** in Netherlands (n=188) in their study entitled "The effect of the social influence of a diabetes nurse's working environment on the intention to recommend the artificial pancreas as a treatment method for Diabetes Type 1" and clarified that 64.3% of participants had positive attitude level regarding artificial pancreas while 35.7% had negative attitude level toward artificial pancreas.

Regarding total reported practices of the studied nurses regarding artificial pancreas. The current study revealed that, more than half of the studied nurses' had incompetence level of reported practices regarding artificial pancreas. This results in same line with **Lukas et al., (2022)** in Netherlands (n=176) in their recent study about "The influence of nurses' individual characteristics on their intention to advise an artificial pancreas" and illustrated that 53.4% of participant had incompetent level of reported practices regarding artificial pancreas. From investigator point of view, Nurses' needs more training to use artificial pancreas with diabetic type 1 patients and identify weaken areas to enhance knowledge and skills.

Regarding relations between total knowledge level of the studied nurses and demographic characteristics. The finding of current study revealed that, there was statistically significant relation between total level of knowledge of the studied nurses and their age. This result consistent with the result of study performed by **Lukas et al., (2022)** and revealed that there was statistically significant relation between total knowledge of nurses and their age.

The finding of current study revealed that, there was statistically significant relation between total level of knowledge of the studied nurses and the marital status of studied nurses. This result consistent with the result of study performed by **Saldanha et al., (2022)** in India (n=200) in their recent study titled "Development of Artificial Pancreas to manage Diabetes" and revealed that there was statistically significant relation between total knowledge of nurses and their marital status.

The finding of current study revealed that there was statistically significant relation between total attitude level of the studied nurses and their sex. This result was inconsistent with the result of study performed by **Schoenbeck et al., (2020)** In Germany (n=150) in their study entitled "Innovations in medical technology the influence of personal and product characteristics on physicians' acceptance of the Artificial Pancreas" and they observed there were no significant differences in the attitude scores according to other variables, such as gender, nationality, residence, region except for age they found older age was significant with greater attitude.

The finding of current study revealed that, there was statistically significant relation between total attitude level of the studied nurses and their marital status. This result was consistent with the result of study performed by **Ahmad et al., (2023)** In Canada (n=102) in their study entitled "The artificial pancreas: current status and future prospects in the management of diabetes" and found that significance relation between total attitude level of studied nurses and their educational level. From investigator point of view, this may be due to the educational level will have positive attitude level toward new technology in field of nursing.

The finding of current study revealed that there was statistically significant relation between total attitude level of the studied nurses and educational level, this result was consistent with the result of study performed by **skylet et al., (2020)** In USA (n=110) in their study entitled "Comparison Between Closed-Loop Insulin Delivery System (the Artificial Pancreas) and Sensor-Augmented Pump Therapy: A Randomized-Controlled Crossover Trial" and revealed that there was significant relation between total attitude level of studied nurses and their educational level.

The finding of current study revealed that there was statistically significant relation between total attitude level of the studied nurses and their years of experience, this result was consistent with the result of study performed by **David et al., (2020)** In Colombia (n=72) in their study entitled "Artificial pancreas systems:



experiences from concept to commercialization” and found that significance relation between total attitude level of studied nurses and their years of experience.

The finding of current study revealed that there was statistically significant relation between total reported practices level of the studied nurses and their place of residence. This result in the same line with **Peter et al., (2019)** in USA (n=328) in their study titled “Do-It-Yourself Artificial Pancreas Systems: A Review of the Emerging Evidence and Insights for Healthcare Professionals ” and found that significance relation between total level of practices and place of residence of participant.

Also, this result agreement with **Messer et al., (2021)** in Austria (n=100) in study titled "Why expectations will determine the future of artificial pancreas." And found significant relation between total reported practices level of the studied nurses and their place of residence.

The finding of current study revealed that, there was statistically positive correlation between total nurses' knowledge and attitude and reported practices regarding artificial pancreas. This result match with **Husham et al., (2024)** in alraq (n=200) in their recent study titled “Knowledge, Attitudes, and Practice of Nurses about Insulin Therapy and artificial pancreas: A Cross-Sectional Study.” and demonstrated that, there were a highly statistically significance positive correlation between total knowledge and attitude and reported practices of the studied nurses.

XI. Conclusion

In the light of current study result and answered research questions, it could be concluded that:

More than half of the studied nurses' had good level of total knowledge, two thirds of them had positive attitude, while more than half of them had incompetence reported practices about artificial pancreas. Furthermore, there was a high statistically significant positive correlation between total knowledge, attitude and reported practices of studied nurses regarding artificial pancreas. There was a highly statistically significant relation between studied nurses' total knowledge and demographic characteristics as (age, marital status, place of residence, years of experience). There was statistically significant relation between total attitude level of the studied nurses and demographic characteristics as (sex, marital status, educational level and years of experience). There was statistically significant relation between total reported practices level of studied nurses and their place of residence.

XII. Recommendations

From the present findings, the following recommendations were suggested:

- Apply and implement an educational program for nurses about artificial pancreas to increase awareness regarding artificial pancreas.
- Booklets and posters should be available for nurses about artificial pancreas.
- Future research on large sample of nurses and other setting is needed.

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