

**Table Of Content**

**Journal Cover** ..... 2

**Author[s] Statement** ..... 3

**Editorial Team** ..... 4

**Article information** ..... 5

    Check this article update (crossmark) ..... 5

    Check this article impact ..... 5

    Cite this article ..... 5

**Title page** ..... 6

    Article Title ..... 6

    Author information ..... 6

    Abstract ..... 6

**Article content** ..... 7

---

# Academia Open



*By Universitas Muhammadiyah Sidoarjo*

---

## Originality Statement

The author[s] declare that this article is their own work and to the best of their knowledge it contains no materials previously published or written by another person, or substantial proportions of material which have been accepted for the published of any other published materials, except where due acknowledgement is made in the article. Any contribution made to the research by others, with whom author[s] have work, is explicitly acknowledged in the article.

## Conflict of Interest Statement

The author[s] declare that this article was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Copyright Statement

Copyright © Author(s). This article is published under the Creative Commons Attribution (CC BY 4.0) licence. Anyone may reproduce, distribute, translate and create derivative works of this article (for both commercial and non-commercial purposes), subject to full attribution to the original publication and authors. The full terms of this licence may be seen at <http://creativecommons.org/licenses/by/4.0/legalcode>

## EDITORIAL TEAM

### Editor in Chief

Mochammad Tanzil Multazam, Universitas Muhammadiyah Sidoarjo, Indonesia

### Managing Editor

Bobur Sobirov, Samarkand Institute of Economics and Service, Uzbekistan

### Editors

Fika Megawati, Universitas Muhammadiyah Sidoarjo, Indonesia

Mahardika Darmawan Kusuma Wardana, Universitas Muhammadiyah Sidoarjo, Indonesia

Wiwit Wahyu Wijayanti, Universitas Muhammadiyah Sidoarjo, Indonesia

Farkhod Abdurakhmonov, Silk Road International Tourism University, Uzbekistan

Dr. Hindarto, Universitas Muhammadiyah Sidoarjo, Indonesia

Evi Rinata, Universitas Muhammadiyah Sidoarjo, Indonesia

M Faisal Amir, Universitas Muhammadiyah Sidoarjo, Indonesia

Dr. Hana Catur Wahyuni, Universitas Muhammadiyah Sidoarjo, Indonesia

Complete list of editorial team ([link](#))

Complete list of indexing services for this journal ([link](#))

How to submit to this journal ([link](#))

## Article information

**Check this article update (crossmark)**



**Check this article impact (\*)**



**Save this article to Mendeley**



(\*) Time for indexing process is various, depends on indexing database platform

## **Knowledge, Attitudes, and Practice of Nursing Students about Insulin Therapy: A Cross-Sectional Study**

*Pengetahuan, Sikap, dan Praktik Mahasiswa Keperawatan tentang Terapi Insulin: Sebuah Studi Cross-Sectional*

**Husham Hussain Abdul-Ra'aoof, ali.malik@uobasrah.edu.iq, (0)**

*Fundamentals of Nursing Department, University of Basrah, Basrah, Iraq*

**Ali Malik Tiryag, ali.malik@uobasrah.edu.iq, (1)**

*Community Health Nursing Department, University of Basrah, Basrah, Iraq*

**Maher Abdulameer Atiyah, ali.malik@uobasrah.edu.iq, (0)**

*Fundamentals of Nursing Department, University of Basrah, Basrah, Iraq*

<sup>(1)</sup> Corresponding author

### **Abstract**

This study aims to assess the knowledge, attitudes, and practices of nursing students regarding insulin therapy. Conducted at the College of Nursing - University of Basrah, the research utilized a questionnaire to gather data from 200 participants over a six-month period. Results indicate a good overall level of knowledge about insulin therapy, a fair attitude towards it, and a medium level of suggested practice. Interestingly, while there was a significant correlation between participants' knowledge and gender, no discernible relationships were found between knowledge and other demographic variables, nor between attitudes and any demographic factors. This suggests the need for targeted educational interventions to improve attitudes and practices towards insulin therapy among nursing students.

#### **Highlights:**

- Varied knowledge levels among nursing students.
- Positive attitudes towards insulin therapy.
- Need for tailored educational interventions.

**Keywords:** Knowledge, Attitudes, Practice, Nursing Students, Insulin Therapy

Published date: 2024-06-01 00:00:00

## Introduction

A disorder in the metabolism of proteins, fats, and carbohydrates that was caused by either inadequate insulin secretion, resistance to the hormone's effects, or both. According to a survey by the According to the International Diabetes Federation, 382 million people had diabetes in 2013 and 592 million people are predicted to have the disease by 2035. [1].

Type I diabetes mellitus is distinguished from type II diabetes mellitus and gestational diabetes mellitus by an insulin deficit that needs daily insulin therapy. Pregnancy-related hyperglycemia is known as gestational diabetes, but ineffective insulin use by the body is the cause of type II diabetes mellitus. In many instances, insulin therapy is a crucial component of the management of type II diabetes as well as a cornerstone of treatment for type I diabetes. Despite this, 20% of individuals purposefully miss their doses of insulin, and at least 33% of Individuals neglect to take their insulin. as directed. As several non-pharmacological interventions must be performed in addition to drugs to effectively control diabetes mellitus, patient involvement is vital [2]. Because of this, controlling hyperglycemia requires proper insulin and oral medicine delivery; using the wrong method might have negative health effects [3], [4].

The pancreatic islets of Langerhans contain beta cells that release insulin, which travels straight into the circulation and affects the target cells of the liver, muscle, thyroid, and other tissues [5]. Insulin controls the production of carbohydrates from sugar and starch in these tissues. People with diabetes either do not produce any insulin at all or have a severe deficiency of it, therefore they must daily take calibrated quantities of insulin [6]. Since stomach acids impair the under-the-skin location of insulin injection, oral administration is not recommended [7]. Without the proper insulin action, the body cannot store glucose in the liver or muscles or build any fat. Endocrinologist Irl Hirsh, MD, asserts that fat is broken down and produces keto acids.. An imbalance in these acids' levels may result in diabetic ketoacidosis, a potentially lethal illness if the levels become too high. A normal person's pancreas releases insulin when they eat because their blood glucose levels increase, allowing the sugar to be stored as energy for later use. Without such pancreatic function, type 1 or advanced type 2 diabetics risk having blood sugar levels that are either dangerously high or dangerously low [8].

The sides of The four places are the thighs, the abdomen, the backs of the upper arms, and the upper outer buttocks. that may safely receive insulin injections. Rotating insulin injection sites should be done, and a methodical approach should be used, to prevent lumps and scar tissue on the skin. Therefore, the belly, outer thigh, back of the arm, and flank/buttock areas are all possible locations for injections. The rotation locations are shown visually. Compared to insulin injected into the thigh, insulin administered into the belly works more quickly. The pace at which insulin given into the arm absorbs varies depending on whether it is injected into the belly or the thigh [9], [10].

Although insulin injections often don't hurt too much, repeatedly injecting in the same location might result in inflammation, an increase in fat tissue (Lipohypertrophy), or scarring. Poor insulin absorption caused by Lipohypertrophy or scarring may influence insulin release, resulting in early postprandial hyperglycemia and/or delayed hypoglycemia [11].

rotating injectables sites to avoid lipohypertrophy and scarring and increase the predictability of insulin absorption and activity is crucial. methods for rotating injection locations are suggested. Rather than moving to different locations for every injection, rotation should happen inside the same location for at least a month. Each injection should be spaced a fingerbreadth (2.5 cm) from the one before. Utilizing the same location reduces insulin absorption variations daily. Avoid going near an area that has blisters or open sores. When changing locations, blood glucose monitoring should be done. Change in the injection site is usually linked to hypoglycemia.

When using a syringe to deliver medicine, the needle should be entered swiftly yet gently and withdrawn from the skin at the same angle. When using a 4-mm needle, it must be entered at a 90-degree angle. The 4-mm needle should only be used by extremely thin people and very young toddlers (6 years old). the needle being inserted perpendicularly into a flap of skin. To reduce the danger of IM injections, injections should always be delivered into a raised skinfold when using any syringe needle on children (6 years old), teenagers, or slender to normal-weight adults (BMI of 19–25). Lifting a skinfold is not necessary when injecting at a 45° angle with a 6-mm syringe needle because of the greater net penetration A 6-mm needle measures around 4 mm.<sup>7</sup> Others may use the 4-mm needle to inject without having to raise a skinfold.<sup>6</sup> To assist in preventing leaking and ensure injecting the entire amount of medicine, when giving the medication with a pen, press the thumb button before waiting for a slow count of 10.1, <sup>7</sup> Patients should be instructed to wait until the dosage dial in the dosing window has returned to "0" before withdrawing the needle [12].

## Method

This research was conducted at the University of Basrah's nursing college between November 20, 2022, and May 21, 2023. It is a descriptive cross-sectional study. Students from the College of Nursing at the University of Basrah



were enrolled in the study at any level (first-year, second-year, third-year, and fourth-year students) and for both morning and evening classes. A convenient sample consisting of (200) students of both genders was included in the study. A questionnaire consisting of close-ended questions was used for data collection. The questionnaire included four parts: The first part consisted of (7 items) related to the socio-demographic and clinical characteristics of the participants including age, gender, academic year, type of study, mother education, and residency. The second part of the questionnaire consisted of (11 questions) regarding participants' knowledge about insulin therapy. The third part of the questionnaire consisted of (10 questions) regarding participants' attitudes about insulin therapy. The fourth part of the questionnaire consisted of (17 questions) regarding participants' suggested practice about insulin therapy.

Frequency and percentage were used for analyzing the socio-demographic and clinical characteristics of the participants. Likert's three-point scale was used to assess the level of participants' knowledge and attitude, calculation mean score, and level of significance. Scoring of the answers regarding knowledge and attitudes as shown; 3 for Yes, 2 for I don't know, 1 for No. Assessment of the participants' knowledge and attitude level as shown according to a mean of score; Good = 2.24 - 3, Fair = 1.67 - 2.23, and Poor = 1-1.66. Significance of the participants' knowledge and attitudes level as shown; MOS > 2 Significant and MOS < 2 Non - significant. The grand mean score is used to assess the overall level of participants' knowledge and attitudes.

Frequency and percentage were used to assess the level of suggested practice, the traditional method of calculating grades uses (100 %) as a measure for scoring, as shown; Excellent from 90% and to 100%, Very good from 80 to less than 90%, Good from 70 to less than 80%, Intermediate from 60 to less than 70%, Accepted from 50 to less than 60%, Poor Less than 50%. Correlation between the participants' knowledge and attitude and their socio-demographic and clinical characteristics using Pearson's correlation coefficient and P-value at 0.05 level.

## Results and Discussion

### A. Results

This study shows that; a whole of 200 The research includes participants, two-third 133 (66.5 %) among the individuals involved were female, and the majority of the participants 180 (90%) were in the age group (15 - 25 years), the highest number of participants 76 (38%) were in the fourth year, they were distributed according to the type of the study; 117 (58.5%) were in the morning study while 83 (41.5) were in the evening study, a minority of the participants 18 (9%) were working before joining the college and distributed as (9 in the hospitals, 3 primary health care centers and 6 in other non-healthcare institutes).

This study shows that the participants have a good level of knowledge in nine items they have been asked about regarding insulin therapy including artificial synthesis of the insulin, types of insulin, the main effect of insulin on blood sugar, the timing of insulin therapy concerning the meals, sites of insulin injection in the body, the best place to store insulin, local massage and its effect on insulin absorption, complications of insulin, availability of insulin, while they have a fair level of knowledge regarding two items only: the main source of human insulin synthesis in the human body and the rotatory method for using insulin to avoid its local complications. They show significant knowledge concerning all items about insulin therapy they have been asked about.

This study shows that the participants have a good level of attitude in four items they have been asked about regarding insulin therapy including complications of insulin therapy, shaking of insulin vial before usage, hand washing before insulin injection, attendance of educational lectures about insulin therapy, while they have a fair level of attitude regarding five items including the real effect of insulin on blood sugar, the effect of healthy diet and exercise on insulin requirement, addiction on insulin, insulin is the last choice of treatment, the effect of insulin on body weight, they show poor attitudes level regarding one item: insulin therapy is considered as a stigma to the patient. They show significant attitudes for all items about insulin therapy they have been asked about, except when they asked about insulin therapy if considered as a stigma to the patient, they show poor attitude level.

This study shows an excellent level of suggested practice in two items: making sure about the type of insulin and expiry date before use, an excellent level in one item: being sure of emptying the syringe from any air bubble before injection, good level in three items: shaking of insulin vial and hand washing before injection of insulin, medium level of practice in eight items: pain associated with insulin injection, induration occurs with insulin injection, use of the proper anatomical and technical method for injection, use a rotatory method on insulin injection, poor practice in two items: reuse the syringes of insulin and if notice any infection at site of insulin injection.

The overall level of the participant's knowledge regarding insulin therapy is good (Grand mean score = 2.443). The overall level of the participant's attitude regarding insulin therapy is fair (Grand mean score = 2.266). The overall level of the participant's suggested practice regarding insulin therapy is medium (frequency = 2341, percentage = 68%).



This study shows a significant correlation between the participant knowledge and their gender at P value = 0.05 where the P value here was higher (P = 0.007), while the knowledge as correlated with other factors and the attitude correlated with all demographic and historical variables were nonsignificant as the P value was greater than (P=0.05 level).

Variable		Frequency	Percentage	
A	Gender	Male	67	33.5%
		Female	133	66.5%
		Total	200	100%
B	Age	15-25	180	90%
		26-35	17	8.5%
		36-45	3	1.5%
		Total	200	100%
C	Academic year	First	2	1%
		Second	54	27%
		Third	69	34.5%
		Fourth	76	38%
		Total	200	100%
D	Type of Study	Morning	117	58.5%
		Evening	83	41.5%
		Total	200	100%
E1	Any job before joining the study	Yes	18	9%
		No	182	91%
		Total	200	100%
E2	Place of work	Hospital	9	50%
		Primary HCC	3	%1.7
		Non-health institutes	6	%3.3
		Total	18	100%

**Table 1. Demographic Characteristics of The Study Participants**

No.	Variable	N.	Answer	Frequency	Percentage
A.1.	Personal history of Diabetes Mellitus	200	Yes	15	%7.5
			No	185	%92.5
			Total	200	100%
A.2.	Do they use insulin?	15	Yes	5	3.3%
			No	10	6.7%
			Total	15	100%
B.1.	Family history of DM	200	Yes	73	36.5%
			No	127	63.5%
			Total	200	100%
B.2.	Do they use insulin?	73	Yes	33	45.2%
			No	39	54.8%
			Total	73	100%

**Table 2. Distribution of The Participant According to The History of Diabetes Mellitus and Insulin Therapy**

Item	N	Response			MS	Level of knowledge	Significance
		YES	I don't know	NO			
Q1	200	125	44	31	2.47	Good	S
Q2	200	96	43	61	2.17	Fair	S
Q3	200	126	37	37	2.44	Good	S
Q4	200	158	19	23	2.67	Good	S
Q5	200	108	51	41	2.33	Good	S
Q6	200	147	31	22	2.62	Good	S
Q7	200	136	35	29	2.53	Good	S
Q8	200	120	40	40	2.4 0	Good	S

# Academia Open

Vol 9 No 1 (2024): June

DOI: 10.21070/acopen.9.2024.8795 . Article type: (Medicine)

Q9	200	73	63	64	2.04	Fair	S
Q10	200	139	33	28	2.55	Good	S
Q11	200	145	32	23	2.61	Good	S

MS= mean score, S= significant N=200

**Table 3. Level of The Participant's Knowledge about Insulin Therapy**

Item	N	Answers			MS	Level of attitude	Significance
		Yes	I don't know	No			
Q1	200	124	44	32	2.46	GOOD	S
Q2	200	95	43	62	2.16	FAIR	S
Q3	200	125	37	38	2.43	GOOD	S
Q4	200	25	77	98	1.63	POOR	NS
Q5	200	140	32	28	2.56	GOOD	S
Q6	200	77	54	69	2.04	FAIR	S
Q7	200	154	29	17	2.68	GOOD	S
Q8	200	105	54	41	2.32	FAIR	S
Q9	200	103	49	48	2.27	FAIR	S
Q10	200	70	76	54	2.08	FAIR	S

MS= mean of score, S= significant , NS= non-significant

**Table 4. Level of The Participant's Attitudes about Insulin Therapy**

Item	N	YES		NO		Level
		Frequency	Percentage	Frequency	Percentage	
Q1	200	189	94.5%	11	5.5%	Excellent
Q2	200	190	95%	10	5%	Excellent
Q3	200	147	73.5%	53	26.5%	Good
Q4	200	173	86.5%	27	13.5%	Very good
Q5	200	154	77%	46	23%	Good
Q6	200	135	67.5%	65	32.5%	Medium
Q7	200	131	65.5%	69	34.5%	Medium
Q8	200	129	64.5%	71	35.5%	Medium
Q9	200	128	64%	72	36%	Medium
Q10	200	153	76.5%	47	23.5%	Good
Q11	200	128	64%	72	36%	Medium
Q12	200	103	51.5%	97	48.5%	Accepted
Q13	200	68	34%	132	66%	Poor
Q14	200	92	46%	108	54%	Poor
Q15	200	155	77.5%	45	22.5%	Good
Q16	200	131	65.5%	69	34.5%	Medium
Q17	200	135	67.5%	65	32.5%	Medium
Total	3400	2341	68.9%	1059	31.1%	Medium

**Table 5. Level of The Participant's Suggested Practice about Insulin Therapy**

No.	Demographic and historical characteristics	Assessment level			
		Knowledge		Attitude	
1	Gender	P = 0.007	(S)	P = 0.498	(NS)
2	Age	P = 0.581	(NS)	P = 0.782	(NS)
3	Academic year	P = 0.658	(NS)	P = 0.183	(NS)
4	Type of Study	P = 0.190	(NS)	P = 0.413	(NS)
6	A. Personal history of DM	P = 0.278	(NS)	P = 0.772	(NS)
	B. Use of Insulin	P = 0.108	(NS)	P = 0.463	(NS)
7	A. Family history of DM	P = 0.711	(NS)	P = 0.727	(NS)
	B. Use of Insulin	P = 0.892	(NS)	P = 0.727	(NS)

P = p-value (0.001), S=significant, NS= nonsignificant

**Table 6.** *Correlation of Knowledge, Attitudes, and Suggested Practice with Demographic and Historical Characteristics of The Participants.*

## B. Discussion

The demographic information shows that the majority of the students who answered the questionnaire, 66.5%, most of them were women. of the students, 90%, were from the age group 15-25, the majority were in the fourth academic year, 38%, the morning study 58.5%, and according to the schedule, most of the students, 90%, were unemployed before joining the study 92.5% of the students did not have a personal history of diabetes 63.5% of the students did not have a high history of diabetes through the students' knowledge of insulin treatment, the result was good.

Through the attitudes about insulin treatment, the result was fair. Through practice, the result is medium, schedule 5-4 through a study in the American Journal of Pharmaceutical Education [13].

The present study agreed with other studies in Jordan [14] and the United States [15] and also revealed that nurses had inadequate knowledge of insulin administration. Similar incidences of practicing nurses not knowing enough about insulin administration were seen in Northern Ireland [16], Pakistan [17], Greece [18], and the United States [19].

It evaluated the effect of a standard patient scenario on the retention of first-stage students with the How to inject insulin. In comparison to standard teaching approaches, the intervention group exhibited considerably greater levels of knowledge and counselling abilities. Additionally, the primary endpoint and another trial indicated a little rapid increase in learning for the intervention group.

Based on the findings, it was noted that the research participants' knowledge levels were as follows: Of these, 44% have slightly sufficient understanding, 52% have insufficient knowledge, and only 4% have sufficient knowledge. Regarding insulin therapy, 27% of study participants with diabetes had a good attitude, 69% had a somewhat positive view, and 4% had an unfavourable opinion.

Eighty-two percent of participants in a London, England research regarding insulin treatment had a similar sentiment. However, a sizable portion of the study's patient population (7.3%) thought that consistent insulin use may result in addiction. A research carried out in Vietnam reported on a related concept.

In this research, about half of the subjects improperly retained insulin. This is a highly concerning circumstance since improper storage of the medication will compromise patients' ability to receive the right care.

## Conclusion

1. The study sample consisted of (200) nursing students; most of them female, and the majority of the participants were in the age group (15-25 years). Regarding the academic year; most of the participants were in the fourth year, according to the type of study; most of the students were in the morning study.
2. The overall level of the participant's knowledge regarding insulin therapy was good.
3. The overall level of the participant's attitude regarding insulin therapy was fair.
4. The overall level of the participant's suggested practice regarding insulin therapy was medium.
5. There is a significant correlation between the participants' knowledge and their gender only while showing a non-significant correlation between their knowledge and other demographic and historical variables.
6. Additionally, there was no discernible relationship between their attitude level and all demographic and historical variables.

## References

1. B. Zhou et al., "Worldwide trends in diabetes since 1980: a pooled analysis of 751 population-based studies with 4.4 million participants," *The Lancet*, vol. 387, no. 10027, pp. 1513-1530, 2016. [Online]. Available: [https://doi.org/10.1016/S0140-6736\(16\)00618-8](https://doi.org/10.1016/S0140-6736(16)00618-8)
2. L. Guariguata et al., "Global estimates of diabetes prevalence for 2013 and projections for 2035," *Diabetes Research and Clinical Practice*, vol. 103, no. 2, pp. 137-149, 2014. [Online]. Available: <https://doi.org/10.1016/j.diabres.2013.11.002>

3. E. S. Moghissi et al., "American Association of Clinical Endocrinologists and American Diabetes Association consensus statement on inpatient glycemic control," *Diabetes Care*, vol. 32, no. 6, pp. 1119-1131, 2009. [Online]. Available: <https://doi.org/10.2337/dc09-9029>
4. L. M. Prieto-Sanchez, "Hyperglycemia in-hospital management," SAGE Publications Sage UK: London, England, 2011, pp. 3-7. [Online]. Available: <https://doi.org/10.1177/2042018810397083>
5. G. Grassi et al., "Optimizing insulin injection technique and its effect on blood glucose control," *Journal of Clinical & Translational Endocrinology*, vol. 1, no. 4, pp. 145-150, 2014. [Online]. Available: <https://doi.org/10.1016/j.jcte.2014.07.006>
6. I. V. Misnikova et al., "A randomized controlled trial to assess the impact of proper insulin injection technique training on glycemic control," *Diabetes Therapy*, vol. 8, pp. 1309-1318, 2017. [Online]. Available: <https://doi.org/10.1007/s13300-017-0315-y>
7. A. H. Frid, "Treating psychological insulin resistance in type 2 diabetes," 2016. [Online]. Available: <https://doi.org/10.1016/j.jcte.2016.11.005>
8. L. Yuen et al., "Projections of the prevalence of hyperglycemia in pregnancy in 2019 and beyond Results from the International Diabetes Federation Diabetes Atlas," *Diabetes Research and Clinical Practice*, vol. 157, p. 107841, 2019. [Online]. Available: <https://doi.org/10.1016/j.diabres.2019.107841>
9. A. H. Frid et al., "New insulin delivery recommendations," *Mayo Clinic Proceedings*, 2016. [Online]. Available: <https://doi.org/10.1016/j.mayocp.2016.06.010>
10. C.-E. Chiang et al., "2018 Consensus of the Taiwan Society of Cardiology and the Diabetes Association of Republic of China (Taiwan) on the pharmacological management of patients with type 2 diabetes and cardiovascular diseases," *Journal of the Chinese Medical Association*, vol. 81, no. 3, pp. 189-222, 2018. [Online]. Available: <https://doi.org/10.1016/j.jcma.2018.01.001>
11. X. Wu et al., "Insulin injection knowledge, attitudes, and practices of nurses in China: a cross-sectional nationwide study," *Diabetes Therapy*, vol. 12, pp. 2451-2469, 2021. [Online]. Available: <https://doi.org/10.1007/s13300-021-01122-x>
12. A. H. Frid et al., "Worldwide injection technique questionnaire study: population parameters and injection practices," *Mayo Clinic Proceedings*, 2016. [Online]. Available: <https://doi.org/10.1016/j.mayocp.2016.06.011>
13. A. E. Gurmu and F. S. Teni, "Knowledge, attitude and practice among diabetic patients on insulin therapy towards the disease and their medication at a university hospital in Northwestern Ethiopia: a cross-sectional study," *International Journal of Pharmaceutical Sciences Research*, vol. 5, no. 10, pp. 685-692, 2014.
14. M. Yacoub et al., "An assessment of diabetes-related knowledge among registered nurses working in hospitals in Jordan," *International Nursing Review*, vol. 61, no. 2, pp. 255-262, 2014. [Online]. Available: <https://doi.org/10.1111/inr.12090>
15. R. L. Derr et al., "Insulin-related knowledge among health care professionals in internal medicine," *Diabetes Spectrum*, vol. 20, no. 3, pp. 177-185, 2007. [Online]. Available: <https://doi.org/10.2337/diaspect.20.3.177>
16. A. Robb, B. Reid, and E. A. Laird, "Insulin knowledge and practice: a survey of district nurses in Northern Ireland," *British Journal of Community Nursing*, vol. 22, no. 3, pp. 138-145, 2017. [Online]. Available: <https://doi.org/10.12968/bjcn.2017.22.3.138>
17. M. A. Mushtaq, "Study of insulin injection technique amongst the nursing staff," *Pakistan Journal of Medical Sciences*, vol. 22, no. 3, p. 310, 2006.
18. D. Theofanidis, "In-hospital administration of insulin by nurses in northern Greece: an observational study," *Diabetes Spectrum*, vol. 30, no. 3, pp. 175-181, 2017. [Online]. Available: <https://doi.org/10.2337/ds16-0001>
19. A. O. Shogbon-Nwaesei et al., "Time-motion analysis of nurses utilizing insulin pen devices compared to vial and syringe in an inpatient setting," *Journal of Pharmacy Practice*, vol. 32, no. 2, pp. 126-131, 2019. [Online]. Available: <https://doi.org/10.1177/0897190017743132>