

# A mixed-method study examining family physicians' perceptions regarding insulin pump therapy

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## Abstract

**Background:** Primary health care (PHC) physicians lack sufficient knowledge about insulin pump therapy.

**Objectives:** to assess the level of knowledge and attitude of PHC physicians toward Insulin Pumps.

**Methods:** A cross-sectional study was done on PHC physicians working in primary healthcare settings at the main University Hospital and at the medical services centers at King Abdulaziz University, Jeddah, Saudi Arabia. Data about participants' demographics, experience, specialty, workplace, and current position were collected. Their knowledge and attitude toward insulin pump therapy were assessed through online Google Forms. A qualitative part of the study was done by interviewing six physicians to report their opinion about insulin pumps therapy.

**Results:** There was a lack of understanding of the function of an insulin pump and the elimination of the usage of finger sticks, however most of them were aware of the different types of insulin dosages and the appropriate age group for insulin pump therapy. The majority of the participants had a favorable attitude toward insulin pump therapy, as evidenced by the qualitative and quantitative findings of the

study. Physicians who were 30 to 49 years old, consultants, and those with 10 to 19 years of experience all scored much better on knowledge. Knowledge deficits, a hazy system, financial concerns, the lack of pumps, and the lack of a skilled physician were all barriers to initiating patients on insulin pump therapy.

**Conclusions:** There is a need for training programmes to increase PHC understanding and attitudes about insulin pump therapy.

**Keywords:** knowledge, attitude, insulin, pumps, PHC, Jeddah

## Introduction

Diabetes mellitus (DM) is defined as a metabolic disorder that results from disturbances in insulin secretion, action, or both, and leads to chronic hyperglycemia with defects in carbohydrate, lipid, and protein metabolism, as defined by the World Health Organization (WHO) (1). The worldwide DM prevalence in 2014 was 9% in males and 7.9% in females, and this prevalence has nearly doubled since the 1980s when it was 4.3% in males and 5% in females (2). The prevalence of DM in Saudi Arabia has recently been ranked the second-highest in the Middle East region, and seventh highest worldwide, with approximately 7 million (21.8%) having DM and almost 3 million (9.3%) having pre-diabetes (3).

There have been recent advances in the management of DM, especially for patients on insulin therapy. Significant strides have also been made in glucose monitoring technology and insulin delivery methods (4). Continuous subcutaneous insulin infusion (CSSI) system also known as insulin pump is one of the favored insulin delivery methods which was first used in the late 1970s and this technology has progressed over the years to now mimic physiological insulin secretion, behaving as an artificial pancreas (5, 6).

Despite all these advances with proven benefits, the average glycosylated hemoglobin (HbA1C) among type 1 diabetic patients has worsened from 2012 to 2018 (7). This worsening might be the result of the underutilization of available methods and technology (8).

Limited data is available on the knowledge and attitude of physicians towards the use of CSSI. Locally there was a cross-sectional study that included physicians from different Saudi regions who worked in hospitals with a total number of 307 participants. The study found that there WAS a significant lack of knowledge among physicians regarding insulin pump therapy. However, the perceived attitude of physicians toward this therapy was deemed positive (4).

With the increasing use of insulin pump therapy, family and primary health care physicians will need to deal more often with diabetic patients who use insulin pumps in outpatient and urgent care clinic settings where this lack of knowledge regarding CSII is bound to affect patients' safety and clinical outcome. To the best of our knowledge, the evaluation of knowledge and attitude toward Insulin Pumps among Primary Health Care Physicians has not been conducted before.

This study aimed to assess the level of knowledge and attitude of primary health care physicians toward Insulin Pumps.

## Subjects and methods

This study was a cross-sectional study that was conducted between March 1, 2021, and February 1, 2022, at King Abdulaziz University (KAU), Jeddah, Saudi Arabia. Jeddah is the largest city in the western region of Saudi Arabia with a population of around 3.4 million (9).

Participants included Saudi and non-Saudi physicians working in primary healthcare settings at the main University Hospital and at the medical services centers at King Abdulaziz University. The targeted population of this study included practicing Physicians in the PHC setting at various levels, such as consultants, specialists/registrars, residents, and general practitioners. The total sampling technique was used in this study. The total number of participating physicians was 90.

For the survey in this study, we repurposed a questionnaire with permission from another study that was published in the International Journal of Environmental Research and Public Health based on the American Diabetes Association and the National Institute for Health and Care Excellence (4). The survey was tested using a pilot study before it was distributed to participants. We designed a Google form containing the survey and distributed it through the WhatsApp® application.

### Abbreviations:

PHC	Primary Health Care
DM	Diabetes mellitus
WHO	World Health Organization
CSSI	Continuous subcutaneous insulin infusion
HbA1C	Glycosylated Hemoglobin
KAU	King Abdulaziz University
SD	Standard Deviation
AID	Automated insulin administration
HCPs	Health Care Physicians
DIY	Alternative do-it-yourself
KAUH	King Abdulaziz university Hospital
UMCS	University Medical Center services

The questionnaire consisted of 28 questions divided into three sections. The first section included 7 questions on demographic data, age, gender, nationality, professional period, specialty, workplace, and current position. The second section consisted of 7 questions related to the attitude of physicians toward insulin pump therapy technology, such as frequency of dealing with insulin pumps, their opinion about the importance of gaining necessary information, need for an educational program to ensure the safety of dealing with insulin pumps, the impact of insulin pump therapy on patients, criteria for patient selection, and barriers to use of insulin pump therapy. The third section consisted of 14 questions related to the physicians' knowledge on insulin pump therapy. The questions covered the basic information, including pump function, technique, type of insulin commonly used, therapy regimen, patients' eligibility, change of the infusion set, as well as risks in case of insulin pump interruption. The physicians' knowledge of insulin pump therapy was evaluated as follows. For each of the 28 questions, a score of 1 was assigned for correct answers and a score of 0 for incorrect answers. The total knowledge score was calculated as the sum of all individual scores, ranging from 0 to 28 points, with higher scores indicating greater knowledge regarding insulin pump therapy. Using cutoff points at 50% and 75% of the total score, participants were classified as having poor (0 to 12), average (13 to 20), or good knowledge (21–28). For the evaluation of attitude regarding insulin pump therapy, scores of 1 to 5 were assigned for the answers to the 7 questions based on a five-point Likert scale ranging from "strongly disagree" (score 1) to "strongly agree" (score 5). The total attitude score was calculated as the sum of all individual scores, ranging from 7 to 35 points, with higher scores indicating a more positive attitude regarding insulin pump therapy. Using cutoff points at 50% and 75% of the total score, participants were classified as having a negative (7 to 17), neutral (18 to 26), or positive attitude (27 to 35).

The data was collected through Google Forms and transferred to an Excel sheet, which was then analyzed by IBM SPSS statistic version 25. AP  $-value < 0.05$  was considered to be significant.

A qualitative part of this study was done by interviewing six physicians to report their opinion about the need for the basic knowledge about insulin pumps, and where should patients go for their insulin pump therapy, criteria for referral and whom to refer to, barriers for starting patients on insulin pump therapy, sources of patient education about insulin pump therapy, frequency of seeing patients in primary care setting for managing insulin pumps and their attitude towards insulin pump therapy.

A pilot study was conducted to test the questionnaire validity on 10% of the population. It was carried out with the application of the full methodology and analysis of results. The method, feasibility, and duration were assessed. Necessary changes were made and described. If this is not possible, at least pretesting of the study tool should be conducted.

Ethical approval was obtained from the Committee of Bioethics at King Abdulaziz University. All participants gave their written informed consent before filling out the survey.

## Results

### 1- Quantitative result

The questionnaire was sent to all primary care physicians at KAU (90) and 83 of them responded (response rate was 90%). The majority of participants were younger than 40 (83.1%) and more females responded (60.2%). Most of them were enrolled in family medicine training programs (91.6%). Residents constituted around two thirds of the physician. (63.9%). The rest of the demographics are shown in Table 1.

The results of the assessment of physicians' knowledge regarding insulin pump therapy are presented in Table 2. Most of the participants failed to choose the correct answers regarding the function of insulin pump and the elimination of finger stick use (q1 and q14), while questions regarding main types of insulin doses and the right age group for insulin pump therapy (q3 and q5) were the most correctly answered questions.

Regarding physicians' attitude toward insulin pump therapy, the vast majority of the physicians stood in the agreement end towards all statements (Tables 3 and 4). However, a noteworthy number of participants were neutral with the statements regarding insulin pump candidates selection and barriers to insulin pump therapy (statements 4 and 5).

When comparing the knowledge and attitude scores based on the socio-demographic characteristics of the participating physicians (Table 5), a one-way ANOVA showed statistically significant difference between age groups and total score of knowledge,  $F(82)=3.26$ ,  $p<0.05$ . However, LSD post hoc test showed that physicians aged 30-49 years have statistically significantly higher scores than the rest of the sample (post hoc result). Additionally, one-way ANOVA with LSD post hoc showed that Consultants had statistically significant higher knowledge scores than specialists and residents,  $F(82)=8.16$ ,  $p<0.05$  and (post hoc result). Moreover, one-way ANOVA with LSD post hoc showed that physicians with 10-19 years of experience had statistically significant higher knowledge scores than the rest of the sample  $F(82)=8.16$ ,  $p<0.05$  and (post hoc result).

### 2- Qualitative results

(Table 6) illustrates the result of the qualitative part of the research that included a personal interview with six physicians. There was agreement from 3 of the studied physicians on the need for the basic knowledge about the criteria of candidate patients, whom to refer, types of pumps and types of insulin used in pumps, interpretations, complications and technology. Of the 6 interviewed physicians, only 2 thought that patients who are on insulin pump should follow up for their insulin pump therapy in primary care clinics. And 2 agreed that primary care

physicians should be involved in sharing care with more specialized physicians. All interviewed physicians didn't have clear criteria for referral and whom to refer, and all reported that knowledge deficit, vague system, financial issues, pumps unavailability, and unavailability of trained physician were significant barriers for starting patients on insulin pump therapy. All physicians stated that currently, the only sources for patient education about insulin pump therapy are endocrinology physicians, diabetologists,

pediatricians, and social media. During their clinical practice, only 2 participants reported seeing a single patient in primary care setting for purpose other than managing insulin pumps. All the interviewed participants agreed that only the minority of patients receive pumps in private hospital because it isn't for public patients. And the response of all of them on this statement "are you a fan of insulin pump therapy?" was that they all saw its helpfulness, indicating a good attitude.

**Table 1. Sociodemographic characteristics of physicians (n = 83)**

Study Variables	N (%)
<b>Age group</b>	
• 20-29	40 (48.2 %)
• 30-39	29 (34.9 %)
• 40-49	7 (8.4 %)
• ≥ 50	7 (8.4 %)
<b>Gender</b>	
• Male	33 (39.8%)
• Female	50 (60.2%)
<b>Specialty</b>	
• Family Medicine	76 (91.6%)
• General practitioner	7 (8.4%)
<b>Position</b>	
• Consultant	17 (20.5%)
• Specialist	13 (15.7%)
• Resident	53 (63.9%)
<b>Workplace</b>	
• KAUH	66 (79.5%)
• UMCS	17 (20.5%)
<b>Nationality</b>	
• Saudi	75 (90.4%)
• Non-Saudi	8 (9.6%)
<b>Years of Experience</b>	
• 0-9	62 (74.7%)
• 10-19	14 (16.9%)
• 20-30	7 (8.4%)

Table 2. Assessment of the knowledge regarding insulin pump therapy (n = 83).

Statement	Correct Answers Aqeel 2020	Correct Answers Alghamdi 2022
1. Function of insulin pump therapy	(9.8%)	(3.6%)
2. Type of insulin used in the pump	(47.6%)	(42.2%)
3. The main type(s) of insulin doses in the pump	(57.3%)*	(75.9%)*
4. Insulin pump therapy is recommended for which type of diabetic patient	(14.0%)	(20.5%)
5. Insulin pump therapy can be used for which age group	(87.0%)**	(94%)**
6. Mechanism of loading insulin pump by the patient	(46.6%)	(37.3%)
7. The frequency of changing infusion set of insulin pump, who is responsible for this action.	(39.4%)	(31.3%)
8. The best candidate for insulin pump therapy	(53.7%)	(54.2%)
9. Insulin pumps come in different types	(65.5%)*	(41%)*
10. The patient needs to do very well with the new technology to be on insulin pump	(28.7%)	(36.1%)
11. The pump needs to be implanted, and therefore minor surgery is needed	(48.5%)	(34.9%)
12. The pump can be disconnected even for a short time (<1 h).	(47.9%)	(44.6%)
13. Severe hyperglycemia or possibly diabetes ketoacidosis can result from pump discontinuation even for several hours	(53.4%)	(39.8%)
14. The pump (especially if attached to continuous glucose monitoring) eliminates the need for self(finger-stick) glucose monitoring	(28.7%)*	(9.8%)*

\*More than 15%

\*\*Highly correct answer

Table 3. Assessment of the attitude toward insulin pump therapy (n = 83).

Statement	SD N (%)	D N (%)	N N (%)	A N (%)	SA N (%)
Physicians should know the basic information and understand primary principles of insulin pump therapy	1 (1.2%)	0	7 (8.4%)	29 (34.9%)	46 (55.4%)
Each hospital should have a structured diabetes program (start from assessment & education to determination & initiation, then to outcome evaluation) for patients who are on insulin pump	0	0	8 (9.6%)	33 (39.8%)	42 (50.6%)
Insulin pump therapy promotes the patient emotionally & psychologically to improve the management of their high blood sugar	0	0	9 (10.8%)	39 (47%)	35 (42.2%)
The selection of eligible candidates for insulin pump therapy depends more on the patient motivation and readiness than desires by physicians or family	0	3 (3.6%)	15 (18.1%)	41 (49.4%)	24 (28.9%)
The major barrier to insulin pump therapy is the high cost more than the associated safety issues or adverse effects	0	2 (2.4%)	20 (24.1%)	37 (44.6%)	24 (28.9%)
Educational programs for diabetic patients about the benefits & risk of insulin pump	0	0	7 (8.4%)	37 (44.6%)	39 (47%)

SD—Strongly Disagree; D—Disagree; N—Neutral; A—Agree; SA—Strongly Agree.

**Table 4. Mean and standard deviation of physicians' responses to questionnaire items**

Statement	M (SD)	t-test (p)
Physicians should know the basic information and understand primary principles of insulin pump therapy	4.43 (0.75)	17.36 (0.00)
Each hospital should have a structured diabetes program (start from assessment & education to determination & initiation, then to outcome evaluation) for patients who are on insulin pump	4.41 (0.66)	19.36 (0.00)
Insulin pump therapy promotes the patient emotionally & psychologically to improve the management of their high blood sugar	4.31 (0.66)	18.10 (0.00)
The selection of eligible candidates for insulin pump therapy depends more on the patient motivation and readiness than desires of physicians or family	4.03 (0.78)	11.98 (0.00)
The major barrier to insulin pump therapy is the high cost more than the associated safety issues or adverse effects	4.00 (0.79)	1.44 (0.00)
Educational programs for diabetic patients about the benefits & risk of insulin pump	4.38 (0.64)	19.70 (0.00)

Table 5. Comparison of the mean knowledge and attitude scores according to the physicians' sociodemographic characteristics (n = 83).

Factor	Knowledge		Attitude	
	Score (14) Mean $\pm$ SD	p-Value	Score (30) Mean $\pm$ SD	p-Value
<b>Age group</b>				
20-29	4.98 $\pm$ 1.93	$p < 0.026^{**}$	25.58 $\pm$ 2.33	$P > 0.81$
30-39	6.21 $\pm$ 2.47		25.38 $\pm$ 2.80	
40-49	7.43 $\pm$ 2.94		26.43 $\pm$ 2.15	
$\geq 50$	5.43 $\pm$ 2.37		25.57 $\pm$ 2.99	
<b>Gender</b>				
Male	5.54 $\pm$ 2.26	$P > 0.742$	25.24 $\pm$ 2.62	$P > 0.33$
Female	5.72 $\pm$ 2.41		25.80 $\pm$ 2.44	
<b>Specialty</b>				
Family Medicine	5.74 $\pm$ 2.40	$P > 0.27$	25.54 $\pm$ 2.53	$P > 0.646$
General practitioner	4.71 $\pm$ 1.38		26.00 $\pm$ 2.52	
<b>Position</b>				
Consultant	7.47 $\pm$ 2.76	$p < 0.001^{**}$	25.65 $\pm$ 2.98	$P > 0.78$
Specialist	5.77 $\pm$ 1.88		26.00 $\pm$ 2.31	
Resident	5.04 $\pm$ 2.01		25.45 $\pm$ 2.44	
<b>Workplace</b>				
KAUH	5.74 $\pm$ 2.52	$P > 0.35$	25.50 $\pm$ 2.54	$P > 0.35$
UMCS	5.29 $\pm$ 1.49		25.88 $\pm$ 2.45	
<b>Nationality</b>				
Saudi	5.72 $\pm$ 2.42	$P > 0.41$	25.48 $\pm$ 2.56	$P > 0.58$
Non-Saudi	5.00 $\pm$ 1.31		26.50 $\pm$ 1.85	
<b>Years of Experience</b>				
0-9	5.23 $\pm$ 1.95	$p < 0.000^{**}$	25.48 $\pm$ 2.47	$P > 0.46$
10-19	8.07 $\pm$ 2.87		25.43 $\pm$ 2.79	
20-30	4.57 $\pm$ 1.27		26.71 $\pm$ 2.43	

Table 6. Qualitative results of physicians' interview (No.:6)

<b>Question 1</b>	<b>How much do you think primary care physicians should know about insulin pump therapy?</b>	
<b>Themes</b>	Some Agreed to know basic knowledge in form of: 1. Criteria of candidate patients 2. Whom to refer	Some Agreed to know basic knowledge in form of: 1. Criteria of candidate patients 2. Whom to refer 3. Types of pumps 4. Types of insulin used in pumps 5. Interpretations 6. Complications 7. Technology
<b>Participants</b>	P1, P3 and P5	P2, P4 and P6
<b>Question 2</b>	<b>Do you think patient who are on insulin pump should follow up for their insulin pump therapy in primary care clinics?</b>	
<b>Themes</b>	Some Agreed that patients should be followed at primary care clinics	Some Disagreed that patients should be followed at primary care clinics
<b>Participants</b>	P2 and P6	P1, P3, P4 and P5
<b>Question 3</b>	<b>Should you as a primary care physician be involved in managing patients on insulin pumps</b>	
<b>Themes</b>	Some Agreed that primary care physicians be involved in sharing care with more specialized physicians	Some Disagreed that primary care physicians be involved
<b>Participants</b>	P2 and P6	P1, P3, P4 and P5
<b>Question 4</b>	<b>What factors should you depend on in patient selection for insulin therapy? Do you have a clear criterion for referral and to whom?</b>	
<b>Themes</b>	All the participants don't have a clear criteria for referral and whom to refer	
<b>Participants</b>	P1, P2, P3, P4, P5 and P6	
<b>Question 5</b>	<b>What do you think are the barriers for starting patients on insulin pump therapy?</b>	
<b>Themes</b>	All the participants agreed on the following barriers: 1- Knowledge deficit 2- A vague system 3- Financial issues 4- Pumps availability 5- Availability of trained physicians	
<b>Participants</b>	P1, P2, P3, P4, P5 and P6	
<b>Question 6</b>	<b>Currently, how are patients educated about insulin pump therapy?</b>	
<b>Themes</b>	All the participants agreed that the only sources for patient educations are: 1- Endocrinology physicians 2- Diabetologist 3- Pediatricians 4- Social media	
<b>Participants</b>	P1, P2, P3, P4, P5 and P6	
<b>Question 7</b>	<b>How often do you see patients on insulin pumps therapy?</b>	
<b>Themes</b>	Two participants reported seeing a single patient in primary care setting for purpose other than managing insulin pumps	All other participants have never seen patient on insulin pumps
<b>Participants</b>	P2 and P4	P1, P3, P5 and P6

**Table 6. Qualitative results of physicians' interview (No.:6) (continued)**

<b>Question 8</b>	<b>In our survey the result showed that you rarely see patients on insulin pump. Why do you think that is?</b>	
Thames	They all agreed that only the minority of patients receive pumps in private hospital because it isn't for public patients.	
Participants	P1, P2, P3, P4, P5 and P6	
<b>Question 9</b>	<b>Are you a fan of insulin pump therapy?</b>	
Thames	All agreed on its helpfulness	
Participants	P1, P2, P3, P4, P5 and P6	
<b>Question 10</b>	<b>Do you think your patients are ready for pump?</b>	
Thames	One participant said no	All other participant reported don't know
Participants	P1	P2, P3, P4, P5 and P6

## Discussion

In our study, we evaluated the knowledge and attitude of primary health care physicians at King Abdulaziz University toward insulin pump therapy.

Our findings showed that physicians have a significant deficit of knowledge about insulin pump therapy as most of them gave the wrong answer regarding the function of insulin pump and the elimination of finger stick use. On the other hand, the studied physicians had a positive attitude toward this therapy.

Despite the fact that clinical trials, research, and patient experience have all proved the value of AID, it is still out of reach for many patients. Alternative do-it-yourself (DIY) solutions to off-the-shelf AID devices have emerged as a result of patient-driven innovation (10).

According to a recent study, the largest obstacle to answering patient concerns about what is accessible is HCPs' lack of awareness about how Automated insulin administration (AID) works (74.4 percent). In addition, 64.5 percent of HCPs said they were "likely" or "very likely" to use the fact sheet when responding to patient inquiries about AID alternatives (10). Increased awareness and use of AID technology, according to this study, offer optimism for further reducing the burden of diabetes, but there is a need to close the knowledge gap about DIY AID (10).

Insulin pump mismanagement among diabetic patients could be caused by a lack of basic awareness among primary healthcare providers about insulin pumps (11). According to Grunberger et al. (11) effective implementation of IP is largely based on the skills, knowledge, and resources needed to use this type of insulin therapy in a way that is both effective and does not put participants in danger. This necessitates meticulous selection of both professionals and patients.

Many studies have been undertaken to examine physicians' knowledge and attitudes concerning insulin pumps, but none of them have focused on primary care physicians, so we only included primary care physicians from one of the country's largest and most specialized medical centers. Only two Saudi studies have been conducted on the

subject. One of these investigations was conducted in 2020 by Alaqeel et al and involved primary health care physicians. The study looked at physicians' attitudes and expertise about insulin pump therapy in Saudi Arabia. This study comprised 307 physicians, including 82 family physicians. According to the survey, 56.7 percent had insufficient knowledge and 53.4 percent had a good attitude, which is similar to our findings (4).

The other Saudi study looked at the degree of knowledge and attitudes towards insulin pump therapy among healthcare providers in Riyadh. The majority of respondents (80%) were unaware of the basic components of an insulin pump, and a further 79 percent were unaware that an insulin pump can be loaded with insulin by the patients themselves based on their needs. However, the physicians polled had a positive outlook on insulin pumps, with nearly 73 percent believing that knowing the basics and understanding the basic principles of insulin pump therapy is critical, and 50.7 percent believing that insulin pump therapy benefits patients emotionally and psychologically and can help with uncontrolled blood glucose management (4).

Participants with a higher age had significantly higher knowledge ratings, according to the current study. Furthermore, consultants and physicians with 10 to 19 years of experience scored statistically significantly higher on knowledge. Knowledge was influenced by older age and years of practice in the Alaqeel study, which is similar to our findings (4). This can be explained by the fact that these doctors have more expertise, have had greater exposure to more patients, and thus have had more opportunities to learn about insulin pumps and how they affect patients. Furthermore, they are more up to speed on the latest research and medical literature on diabetes therapy (4).

There were few negative sentiments concerning the usage of DIY AID. The majority of HCPs believe that their lack of understanding of how AIDs work is the most significant impediment to answering patient questions regarding what is available (74.4 percent). In addition, 64.5 percent of HCPs said they were "likely" or "very likely" to use the fact sheet when responding to patient inquiries about AID alternatives (10).

Less training and exposure to insulin pumps could explain the poor level of knowledge observed in this investigation. Endocrinologists had the highest degree of knowledge in the Alaqeel study, which is likely due to the fact that they keep up to date on such devices by attending conferences and are the target audience for insulin pump manufacturers' advertising and sales campaigns. Furthermore, endocrinologists have a better level of diabetes knowledge. Because managing an insulin pump by a physician with insufficient knowledge can lead to serious complications such as diabetic ketoacidosis or severe hypoglycemia, it is a requirement that physicians responsible for these patients' care have experience with insulin pumps in order to ensure the patients' safety and well-being (12). Moreover, unqualified physicians may refuse to prescribe an insulin pump to patients who may benefit from it (12).

As in the qualitative part of our study nearly all the participants agreed on 'we should know basic knowledge in form of clear referral criteria and whom to refer to', so when we see our survey in the quantitative part as per questions 1,4,5,7 and 8 on (table 2) they poorly answered these questions which means that we need to increase the physicians' knowledge toward insulin pump therapy.

The use of insulin pump (IP) in Saudi Arabia is currently somewhat low, and there is limited indication regarding their effect on glycaemic control and diabetes treatment satisfaction (13). Overall, most of our participants showed a positive attitude toward insulin pumps. Due to the scarcity of studies on this topic, we speculated that this finding is also important as it showed the agreement between knowledge and attitude, which could be the basis for future investigations.

All the interviewed physicians in the qualitative part of the research admitted that knowledge deficit, vague system, financial issues, pumps unavailability, and unavailability of trained physicians were significant barriers for starting patients on insulin pump therapy. In a prior study, half of the physicians reported to having insufficient consultation periods and appointment frequency to allow for insulin therapy escalation. HbA1c values were unavailable to 40% of PCPs in order to inform their management recommendations (14). One of the greatest challenges, according to another study, is a lack of resources within the healthcare team to promote device use (15).

The number of IP users among Saudi youth is still low, according to Bin Abbas et al. (16). He claims that a lack of patient/family motivation, health-care team enthusiasm, and adequate technical support are among the contributing factors. This was explained by the usability of current technology, where attention spans are short and bad encounters are common, affecting more than 40% of users each year, with a minority, notably in youngsters, requiring hospitalization.

## Limitations

There are several limitations in our study. It was a cross-sectional study that could reveal the associations between variables without concluding the casual relationships. In addition, the use of a peer-designed questionnaire for data collection could have a recall bias.

## Conclusion

This study found a deficient knowledge among studied physicians about the function of insulin pumps and the elimination of finger stick use, while most of them knew types of insulin doses and the right age group for insulin pump therapy. The majority had a positive attitude towards insulin pump therapy that was obvious through results of the qualitative and quantitative parts of the research. Physicians with older age (30-49 years), consultants and those with 10-19 years of experience had statistically significant higher knowledge scores.

The main barriers for starting patients on insulin pump therapy were knowledge deficit, vague system, financial issues, pumps unavailability and the unavailability of trained physicians. It is suggested that the King Abdulaziz University Hospital take suitable efforts to enhance the number of skilled physicians who can treat patients on insulin pump therapy, especially given the rising number of diabetes cases in Saudi Arabia each year. We recommend implementing training programmes focusing on dealing with patients who use insulin pumps in order to improve understanding. Furthermore, because there are few studies on the management of these patients in Saudi Arabia, we urge that future research focus on the challenges that healthcare providers experience when dealing with patients who use insulin pumps.

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## References

1. Alberti KGMM, Zimmet PZJ. Definition, diagnosis and classification of diabetes mellitus and its complications. Part 1: diagnosis and classification of diabetes mellitus. Provisional report of a WHO consultation. 1998;15(7):539-553.
2. Zhou B, Lu Y, Hajifathalian K, Bentham J, Di Cesare M, Danaei G, et al. Worldwide trends in diabetes since 1980: a pooled analysis of 751 population-based studies with 4.4 million participants. *The Lancet*. 2016;387(10027):1513-1530.
3. Batais MA, Alamri AK, Alghammas MA, Alzamil OA, Almutairi BA, Al-Maflehi N, et al. Diabetes and driving recommendations among healthcare providers in Saudi Arabia. A significant gap that requires action. *Saudi Med J*. 2018;39(4):386-394.
4. Alaqeel A, Almushaigh A, Almijmaj M, Almesned R, Alsuhaibani M. Are Physicians in Saudi Arabia Ready for Patients with an Insulin Pump? An Examination of Physician Knowledge and Attitude. *Int J Environ Res Public Health*. 2020 15;17(24):9394.

5. American Diabetes A. 2. Classification and Diagnosis of Diabetes: Standards of Medical Care in Diabetes-2020. *Diabetes Care*. 2020;43(Suppl 1):S14-S31.
6. Sherr JL, Tauschmann M, Battelino T, de Bock M, Forlenza G, Roman R, et al. ISPAD Clinical Practice Consensus Guidelines 2018: Diabetes technologies. *Pediatr Diabetes*. 2018;19 Suppl 27:302-325.
7. Foster NC, Beck RW, Miller KM, Clements MA, Rickels MR, DiMeglio LA, et al. State of Type 1 Diabetes Management and Outcomes from the T1D Exchange in 2016-2018. *Diabetes Technol Ther*. 2019;21(2):66-72.
8. Marks BE, Waldman G, Reardon K, Terrio S, Kumar A, Stafford DEJ, et al. Improving pediatric endocrinology trainees' knowledge about insulin pumps and continuous glucose monitors with online spaced education: Technology Knowledge Optimization in T1D (TeKnO T1D). *Pediatr Diabetes*. 2020;21(5):814-823.
9. <census31-prim-05.pdf>
10. Murray J, F. Clayton M, L. Litchman M. Health Care Provider Knowledge and Perceptions of FDA-Approved and Do-It-Yourself Automated Insulin Delivery. *Journal of Diabetes Science and Technology* 2020; 14(6):1017-1021.
11. Grunberger G, Abelson JM, Bailey TS, Bode BW, Handelsman Y, Hellman R, et al. Consensus statement by the American association of clinical endocrinologists/ American college of endocrinology insulin pump management task force', *Endocr Pract* 2014; 20(5), pp. 463-489.
12. Ross PL, Milburn J, Reith DM, Wiltshire E, Wheeler BJ. Clinical review: Insulin pump-associated adverse events in adults and children. *Acta Diabetol* 2015;52, 1017-1024.
13. Al Hayek AA, Robert AA, Al Dawish MA, Braham RB, Goudeh HS, Al Sabaan F S. Efficacy of Insulin Pump Therapy on Diabetes Treatment Satisfaction and Glycemic Control Among Patients with Type 1 Diabetes Mellitus in Saudi Arabia: A Prospective Study', *Diabetes Therapy* 2015; 6(2), pp. 227-236.
14. Motilal S. Physician related barriers towards insulin therapy at primary care centres in Trinidad: a cross-sectional study. *BMC Fam Pract* 21, 197 (2020); 21:197-205.
15. Pauley ME, Berget C, Messer LH, Forlenza GP. Barriers to Uptake of Insulin Technologies and Novel Solutions. *Med Devices (Auckl)* 2021 12;14:339-354.
- 16-Bin-Abbas BS, Sakati NA, Raef H, Al-Ashwal AA. Continuous subcutaneous insulin infusion in type 1 diabetic Saudi children. A comparison with conventional insulin therapy', *Saudi Med J* 2005; 26(6):918-922.