A Nurse-Led Demonstration Efficacy With Tailored Mobile Application For Skill Development In Self-Administration Of Insulin Therapy Among Type-II Diabetes Patients

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ABSTRACT

Background: Diabetes mellitus (DM) is one of the most prevalent public health concerns globally. It is a disorder of carbohydrate metabolism in which blood glucose level is chronically high due to insulin's impaired secretion or action. It has two types: type I, which occurs in childhood and is usually mediated by immune mechanisms, and type II, which occurs later in life, particularly with advancing age due to diseases of the pancreas. A significant portion, accounting for 60% of the patient population performing self-administration of insulin incorrectly

Objective: To assess nurse-led demonstration efficacy with tailored mobile application for skill development in self-administration of insulin therapy among Type-II diabetes mellitus patients.

Methodology: A single group pretest-posttest quasi-experimental study design was used in this investigation. The sample size consisted of 88 Type II Diabetic patients using a nonprobability purposive sampling technique. A validated technique was used to assess the effectiveness of the nurse-led demonstration efficacy with adapted mobile application for skill development program, as well as the self-administration of insulin therapy among Type-II diabetes mellitus patients before and after. The study participants' baseline self-administration of insulin therapy scores were initially obtained through pre-assessment. The selected participants were subsequently provided with two months of workshop-style interventional sessions, and post-intervention data were collected.

Results: The intervention had a considerable impact on the mean efficacy level, according to the study's findings. It was 10.53 with a standard deviation (SD) of 3.997 prior to the intervention, showing a comparatively low level of proficiency in insulin self-demonstration. A week after the intervention, the mean climbed dramatically to 25.84 with an SD of 2.425, indicating a considerable improvement in performance and more consistent results across participants. Shortly after the intervention, the mean increased significantly to 23.28 with a lower SD of 3.366. With a P-value of.000 and a t-value of -28.424 and -36.202, it was determined that the increase in insulin demonstration efficacy was statistically significant.

Conclusion: It is concluded that the nurse-led demonstration efficacy with tailored mobile application program has positive effect on self-administration of insulin therapy among Type-II diabetes mellitus patients

INTRODUCTION

Diabetes mellitus (DM) is one of the most prevalent public health concerns globally. It is a disorder of carbohydrate metabolism in which blood glucose level is chronically high due to insulin's impaired secretion or action. It has two types: type I, which occurs in childhood and is usually mediated by immune mechanisms, and type II, which occurs later in life, particularly with advancing age due to diseases of the pancreas (Chan et al., 2022).

Type II diabetes mellitus (T2DM) has become a leading public health problem globally, especially in developing countries (Yan et al., 2022). According to the latest International Diabetes Federation (IDF), the global prevalence of T2DM in adults was 536.6 million people (10.5%) in 2021, and that there would be 783.2 million people (12.2%) living with diabetes worldwide by 2045 Furthermore, data from the International Diabetes Federation (IDF) indicates that over 80% of individuals with diabetes are situated in low- and middle-income. This underscores the substantial impact of diabetes on diverse populations and emphasizes the disproportionate burden faced by less economically advantaged nations (Kieu & Iles, 2023).

Approximately 463 million adults worldwide have diabetes, and 90% of these people suffer from type II diabetes mellitus (Mota et al., 2022). Pakistan ranks 3rd in the world in diabetes prevalence after China and India (Azeem et al., 2022). The prevalence of diabetes in Pakistan in 2016, 2018, and 2019 was 11.77%, 16.98%, and 17.1% respectively. According to the International Diabetes Federation, in 2022, 26.7% of adults in Pakistan are affected by diabetes making the total number of cases approximately 33,000,000. This number is alarmingly high and is also increasing with each passing year (Azeem et al., 2022).

According to the World Health Organization (WHO), diabetes was the largest cause of mortality in 2019, claiming approximately 1.5 million lives. Since the prevalence is greater in low and middle-income countries, Pakistan is one of the more vulnerable countries to diabetes-related deaths (Cheng & Zhang, 2022).

Oral hypoglycemic agents and insulin are the major treatment modalities for the effective control of glycemic index. The patient with diabetic is expected to take the medicines regularly and know about proper insulin administration (Evans et al., 2023) .

Taking oral medication is easy compared to insulin administration which required skills (Park et al., 2023). In a research report over 30% of diabetic patients use insulin either as their primary treatment or in conjunction with oral anti-diabetic medications Despite receiving consistent expert multidisciplinary care, diabetic patients or their caregivers bear the responsibility for glucose monitoring and insulin injection administration (Shah et al., 2023). A significant portion, accounting for 60% of the patient population performing self-administration of insulin incorrectly (Sunny et al., 2021).

Learning to administer insulin includes drawing it into a syringe, mixing types if needed, and picking the right spot to inject. Doing it safely requires practice, even though many diabetic patients feel scared and might want to delay learning. Nurses are central in teaching insulin skills, helping patients overcome fears or challenges (Winkley et al., 2023).

Knowledge of insulin management itself is a great concern for our country to work on diabetes care. The insulin dependent patient needs information about diabetes and insulin administration therapy Health care providers have important role to educate the patients about diabetic care and health promotion (Tian et al., 2023).

Limited understanding of the disease significantly contributes to insufficient self-care practices and poor glycemic control. This deficiency in knowledge extends to both low- and middle-income countries as well as high-income countries, highlighting the importance of addressing gaps in disease awareness, including self-administration skills. (Bukhsh et al., 2019).

Demonstration and videos assisted teaching help in skill development in Diabetes patients regarding self-administration of insulin (Kaur et al., 2020). Mobile applications (apps) are reported to be helpful in supporting diabetes self-care but are reported to lack widespread use in both developed and underdeveloped countries (Adu et al., 2019).

With the high penetration of smartphone usage and Internet availability, mobile-health (m-health) may play a crucial role to overcome the barriers of self-management (Abd-alrazaq et al., 2021). The integration of mobile apps into insulin self-administration is reported to offer benefits for patients, providing convenient tools for monitoring, dosage adjustments, and personalized guidance. This patient-centered approach aims to enhance empowerment, improve adherence, and contribute to better glycemic control, ultimately leading to improved overall health outcomes for individuals managing diabetes (Cai et al., 2020).

Objective of the Study

To assess nurse-led demonstration efficacy with tailored mobile application for skill development in self-administration of insulin therapy among Type-II diabetes mellitus patients

MATERIAL AND METHODS

Study Design and Setting

A quasi experimental study was conducted. The study was conducted at Anwer Riaz Qadeer Diabetic Institute Lahore from May 2024 till September 2024.

Study participants and Sampling

The Study population consisted of diagnosed Type-II Diabetes Mellitus insulin dependent patient visiting Anwer Riaz Qadeer Diabetic Institute Lahore. A purposive sample of n=88 participants was recruited based on the inclusion criteria. Sample size of 88 cases was calculated with 95% confidence interval, 5% margin of error by using following formula.

This utility calculates the sample size required to estimate a proportion (or prevalence) with a specified level of confidence and precision.

Inputs are the assumed or estimated value for the proportion, the desired level of confidence, the desired precision of the estimate and the size of the population for limited population sizes. The desired precision of the estimate (also sometimes called the allowable or acceptable error in the estimate) is half the width of the desired confidence interval. For example if you would like the confidence interval width to be about 0.1 (10%) you would enter a precision of +/- 0.05 (5%).

The program outputs the sample sizes required to estimate the true value with the desired precision and confidence, for both an infinite population and for a population of the specified size. If population size is left blank or zero, only the sample size for an infinite population is calculated.

Note: Adjustment for finite population size may underestimate required sample size unless this is also taken into account when estimating variance and resulting confidence interval.

Sample size is calculated using the formula: $n = (Z2 \times P \times (1 - P))/e2$

Where:

- Z = value from standard normal distribution corresponding to desired confidence level (Z=1.96 for 95% CI)
- P is expected true proportion
- e is desired precision (half desired CI width).

For small populations n can be adjusted so that $n(adj) = (N \times n)/(N+n)$. Adjustment for finite population size is described by Thrusfield M, 2005. Veterinary Epidemiology, 2nd Edition, Blackwell Science, Oxford, UK (p 183).

Inclusion Criteria

- Confirmed diagnosis of diabetes Mellitus Type-II
- Prescribed insulin as part of their treatment plan
- 30 to 60 years old
- Willing to participate
- No other identified co-morbidities

Exclusion criteria

- Cognitive Impairment
- Language Barriers
- Uncontrolled Comorbidities
- Pregnant clients
- Visual impairment
- Neurological Impairments

Data Collection Procedure

Data for the insulin self-administration skills efficacy level among study participants was collected through Observational checklist adopted from (Kaur et al., 2020) (r = 0.714) to assess the skills of the diabetes mellitus patients by assessing the patients while doing procedure of self-administration of insulin injection which included 12 steps, which are further, divided into sub steps (30 steps) related to the self-administration of insulin injection technique. Participants were recruited based on their willingness with the help of a written informed consent. The filled questionnaires were collected and processed for the data analysis.

During pre-assessment phase, patients were selected in the study following the inclusion criteria. Written Informed Consents was taken from all the study participants. The aims and objectives of the study was shared with participants. App was installed and patients were assisted to get registered and MR number was given to the clients. During the pre-interventional phase, the researcher completed a checklist while patients demonstrate self-administration of insulin.

For the intervention, the participants were split into 8 groups of around 11 each. 40 to 50 minutes sessions per week was held, rotating between the groups. The sessions, powered by a mobile app. Step by step learning to use the mobile application was taught. Engagement with mobile application with each session was monitored. The educational intervention consisted of 4 sessions where each session consisted of 40-50 minutes. Each session had specific objectives. This was done through different learning and teaching methods like brain storming, demonstration and Use illustrated media e.g. video, pictures and lab top etc.

After intervention period skill development of patient was assessed through checklist right after intervention phase and one week after interventional phase. The data was entered in SPSS 21 version and analyzed.

Tool validity and Reliability

The questionnaires were validated from five experts. The content validity index (CVI) was 22.6/25=0.90. A Pilot study was carried on 20 % sample size, where the Cronbach's Alpha value was .742.

Ethical Considerations

The rules and regulations set by the research ethical committee (REC) of the University of Lahore were followed while conducting the research and the rights of the research participants were respected. Permission was taken from participants. Written informed consent was taken from all the participants. All information and data collection was kept confidential. Participants were kept anonymous throughout the study.

RESULTS

Tables 1: Demographic Characteristics of Participants (n=88).

Variable	frequency	Percentage%
Age in years		
31-40 years	42	47.8
41-50 years	38	43.2
51-60 years	8	9.0
Family History of Diabetes		
Positive Family History	61	69.3
Negative family History	27	30.7
Job Status		
Un employed	48	54.5
Self employed	40	45.5
Level of Education		
Un Educated	12	13.6
Low (Read & Write)	22	25
Moderate (Primary)	34	38.6
High (Secondary & University)	20	22.7
Duration of Insulin Given		
Less than one years	13	14.8
One year and above	75	85.2
Diagnosis duration		
Less than 1 year	15	17
1-3 years	38	43.2
More than 3 years	35	39.8
Frequency of Insulin Injection		
Once a day	52	59.1
Two times a day	26	29.5
Three times a day	7	8
Four times a day	3	3.4
Gender		
Male	39	44.3
Female	49	55.7

Finding presents a comprehensive overview for the different demographic characteristics of the study participants (table 1). The age distribution of the participants reveals that almost half (47.8%) are between the ages of 31 and 40, with a slightly smaller percentage (43.2%) in the age bracket of 41 to 50. The 51–60 age bracket comprises a small portion (9%) of the population. While 30.7% of individuals report having no family history of diabetes, the majority of participants (69.3%) had a favorable family history. 45.5% of the participants work for themselves, while 54.5% of them are unemployed. 38.6% of individuals are moderately educated (primary), followed by 25% who are poorly educated (read and write), 22.7% who are well educated (secondary and university), and 13.6% who are not educated at all.

Details about the clinical aspects of managing diabetes are also provided. Just 14.8% of people have been on insulin for less than a year, compared to the vast majority (85.2%) who have been on it for one year or longer. Based on the length of time from diagnosis, 43.2% of people with diabetes have had the condition for 1-3 years, 39.8% for over 3 years, and 17% for less than a year. The majority of participants (59.1%) inject insulin once day, whereas 29.5% inject twice daily. The frequency of injections varies. A lesser percentage injects once a day (8%) or twice a day (3.4%). Last but not least, there is a slight majority of female participants (55.7%) compared to male participants (44.3%), indicating a generally balanced gender distribution.

Table: 2 Efficacy levels of Insulin self-demonstration (Pre-Post intervention). (N=88)

Mothers' care	**Pre [n (%)]**	**Post 1 [n (%)]**	**Post 2 [n (%)]**
Very Poor Efficacy levels	37(42.0)	0 (0.00)	0 (0.00)
Poor Efficacy levels	43(48.9)	0 (0.00)	0 (0.00)
Fair Efficacy levels	08 (9.1)	23 (26.1)	6 (6.8)
Good Efficacy levels	0 (0.00)	54 (61.4)	53 (60.2)
Very good Efficacy levels	0 (0.00)	11 (12.5)	29 (33)

The differences between 88 diabetic patients' insulin self-demonstration efficacy levels before and after an intervention are shown in the table. 3. The majority of individuals had low efficacy prior to the intervention; 42.0% fell into the "Very Poor" efficacy category and 48.9% into the "Poor" category. Merely 9.1% of the subjects exhibited "Fair" efficacy, while none showed "Good" or "Very Good" efficacy. But following the intervention, a noticeable improvement was observed. There are now no diabetes patients in the "Very Poor" or "Poor" categories. Immediately after the intervention, 26.1% of research subjects achieved a "Fair" level, 61.4% achieved "Good" efficacy, and 12.5% displayed "Very Good" efficacy. During the second post assessment even more improved scores were observed where 6.8% of research subjects achieved a "Fair" level, 60.2% achieved "Good" efficacy, and 33% displayed "Very Good" efficacy. These outcomes demonstrate the intervention's strong beneficial influence on the participants' capacity for insulin self-demonstration.

Table: 3 Comparison of insulin demonstration efficacy levels. (N=88)

Variable	**Pre-intervention Mean ± SD**	**Post-intervention 1 Mean ± SD**	**Post-intervention 2 Mean ± SD**	**Mean difference**
Insulin Demonstration Efficacy Level	10.53±3.997	23.28±3.366	**25.84**±2.425	-12.75& -15.31

* p value was obtained by paired t test with 0.05 level of significance.

The insulin demonstration efficacy levels of 88 participants are compared before and after an intervention in Table 5. The standard deviation (SD) of 3.997 and the mean efficacy level of 10.53 before to the

intervention suggest a rather low degree of proficiency in insulin self-demonstration. With a smaller standard deviation of 3.366 and a significant improvement to 23.28 for the mean efficacy level immediately after the intervention and after one week in the second assessment the mean efficacy score increased to 25.84 with standard deviation of 2.425, it appears that participant performance was more consistent. With a mean difference of -12.75 and -15.31 between pre- and post-intervention1 and post two assessment efficacy levels, the intervention significantly improved the participants' capacity to demonstrate insulin delivery.

Table.4 Effect on participants' insulin demonstration efficacy levels (N=88)

Variables		**Pre-intervention Mean ± SD**	**Post-intervention Mean ± SD**	**t**	**P value**
Insulin Demonstration Efficacy Level	Observation 1	10.53±3.997	23.28±3.366	**-28.424**	.000
	Observation 2	10.53±3.997	**25.84**±2.425	**-36.202**	.000

The table presents the effect of an intervention on the insulin demonstration efficacy levels of 88 participants. Before the intervention, the mean efficacy level was 10.53 with a standard deviation (SD) of 3.997, indicating relatively low skill in insulin self-demonstration. Soon after the intervention, the mean increased significantly to 23.28 with a lower SD of 3.366, whereas one week after the intervention, the mean increased significantly to 25.84 with a SD of 2.425, showing substantial improvement in performance and more consistent outcomes among participants. A t-value of -28.424 and -36.202 was calculated, and the P-value was .000, indicating that the improvement in insulin demonstration efficacy was statistically significant. This suggests that the intervention had a highly positive and reliable effect on enhancing the participants' insulin administration skills.

DISUSSION

The age distribution in this study, with the majority of participants being between 31 and 50 years old, aligns with some prior research, such as the study by Netere et al. (2020), which reported a similar mean age where mean age (±SD) was 38.5 ± 13.8 years (Netere et al., 2020). However, this distribution contrasts with other studies where older age groups predominated where majority of samples were in age group older than the current study that is (53.30%) (Bhosale et al., 2018), age group were involved >46 years (51.3%) (Shafi et al., 2020) and mean age of 52.87+7.66 years. (Ahmed, Marzouk, & Mahmoud, 2018). These differences in age distribution could reflect variations in study populations or settings, indicating that insulin administration challenges might span across a broader age range than previously thought. This variation also suggests that educational interventions should be tailored to different age groups to address specific needs effectively.

The current study reveals that a significant proportion of participants had a positive family history of diabetes, which is consistent with previous research indicating similar trends (e.g., 76% in (Shafi et al., 2020) and 70% in (Bhosale et al., 2018). This suggests a strong genetic or familial link in diabetes prevalence. However, the educational background of participants in this study diverges from previous findings. While a smaller percentage of participants in the current study were well-educated (22.7%), other studies reported higher education levels among participants, such as 33.3% with secondary education (Bhosale et al., 2018) and 40% with high school education (Ahmed, Marzouk, & Mahmoud, 2018). These discrepancies highlight the varying educational profiles of individuals with a family history of diabetes, suggesting that educational interventions in diabetes care should consider these demographic differences to improve outcomes across different populations.

The current study indicates that a large majority of participants have been on insulin for more than a year, and nearly 40% have had a diabetes diagnosis for over three years. This suggests that many participants have a relatively long experience with both the condition and its management. Comparatively, past studies

reported varying durations of diabetes and insulin use. For example, (Bhosale et al., 2018) found that majority of participants had been diagnosed with diabetes for more than five years, but a notable proportion had only recently started self-administering insulin (within 1 month to 1 year). Similarly, (Ahmed, Marzouk, & Mahmoud, 2018) observed that 30% of participants had diabetes for 5-10 years. These variations highlight that while the duration of diabetes might be long, the duration of insulin use can vary significantly, indicating different stages of disease progression and treatment adoption among patients. This variability underscores the need for tailored diabetes management strategies that consider the length of time patients have been managing their condition and using insulin.

The gender distribution in this study, with a slight majority of female participants, suggests a relatively balanced representation between genders, although it leans slightly towards females. This finding aligns with other studies where a higher proportion of female diabetic patients was reported, such as 62.7% in (Shafi et al., 2020) and 56.3% in (Alarfaj & Alayed, 2023). However, this contrasts with other research where males predominated, such as in (Ahmed, Marzouk, & Mahmoud, 2018), where 66.67% of participants were male, and in (Netere et al., 2020), where 54.8% were male. These differences in gender distribution across studies may reflect variations in the study populations, cultural factors, or gender-related differences in health-seeking behavior and diabetes prevalence. Understanding these gender dynamics is essential for tailoring diabetes education and management strategies to ensure they are equally effective for both men and women.

The findings of the current study highlight a concerning trend in the self-administration of insulin among participants, with nearly half categorized as having "Poor" practices and a significant portion classified as "Very Poor." This indicates that the vast majority of participants are struggling to correctly administer insulin, with only a small fraction demonstrating a "Fair" level of proficiency. These results underscore a critical need for targeted interventions to improve self-administration skills among patients.

This trend is consistent with previous research, such as the study by (Liang, 2022), which reported that 85.5% of participants had poor practices in insulin self-administration. Similarly, (Shafi et al., 2020) found that only 40% of patients performed insulin self-administration correctly, while 60% did not. (Gandhar, 2018) also observed that a majority of participants (46.6%) demonstrated only average practices, with a minority (21.8%) achieving excellent performance.

The consistency across these studies suggests that inadequate self-administration of insulin is a widespread issue that needs to be addressed through more effective educational and support programs. Improving patients' skills in this area is crucial for better diabetes management and reducing the risk of complications associated with improper insulin use. The low levels of proficiency highlighted in these studies reflect the need for continuous patient education, training, and monitoring to ensure that patients are equipped with the necessary skills to manage their condition effectively.

The results of this study show that after the intervention, insulin self-administration efficacy significantly improved. When it came to efficacy, most people were first classified as having low efficacy (42.0% as "Very Poor" efficacy and 48.9% as "Poor" efficacy). By contrast, none of the subjects showed "Good" or "Very Good" efficacy, and only 9.1% had "Fair" efficacy. There was a striking change in efficacy levels after the intervention, with no participants staying in the "Very Poor" or "Poor" categories. Immediately after the intervention, 61.4% of the participants demonstrated "Good" efficacy, 12.5% shown "Very Good" efficacy, and 26.1% of the subjects achieved a "Fair" level. During the second post assessment even more improved scores were observed where 6.8% of research subjects achieved a "Fair" level, 60.2% achieved "Good" efficacy, and 33% displayed "Very Good" efficacy. This substantial improvement shows that the participants' capacity to self-administer insulin was greatly enhanced by the intervention, changing their capacity for self-management and lowering the likelihood of mistakes.

A related study that used video-assisted instruction to teach diabetic teenagers significantly improved their ability to administer insulin on their own, supporting the findings. Before the video intervention in that study, only 22.5% of participants had appropriate practice abilities; however, 85.5% of participants attained adequate practice levels following the intervention. This validates the results of the present investigation, highlighting the efficacy of focused educational treatments, like mobile applications

or video-based training, in improving the practical abilities associated with insulin self-administration (Ahmed, Marzouk, & Mahmoud, 2018). The enhanced results could be explained by the visual and participatory learning experience that video-assisted education offers. Patients can see and perform the right techniques repeatedly, which helps to reinforce information and boost confidence. This approach is in line with earlier research's suggestions, which emphasize the value of doable, patient-centered interventions in enhancing diabetic self-management.

In a previous study, SPSS 17th edition was used to evaluate the data through both descriptive and inferential statistics. Compared to the pre-implementation observation (7.0%), the performance score after the first observation (11.8%) was statistically significant ($p \leq 0.05$). 30.0% of patients had statistically significant ($p \leq 0.00$) differences between pre and post-1 observations after the second observation. The self-administration of insulin injection protocol was found to be efficient in enhancing the skills of individuals with diabetes mellitus (Huang et al., 2021).

The participants' baseline insulin knowledge score was 6.81 (SD = 2.28), which suggests that their prior understanding of insulin management was somewhat low. The mean score dramatically improved to 16.85 (SD = 1.84) after the educational intervention, with a p-value of less than 0.001, indicating that the improvement was statistically significant. This significant improvement demonstrates how well the instruction improved participants' comprehension of insulin regulation. The low p-value highlights the intervention's beneficial effects on patients' comprehension and management of insulin therapy by indicating that the observed change in knowledge was unlikely to be the result of random chance (Liang et al., 2021).

Another study results reveal a statistically significant improvement in both self-management ($t=29.639$; $p<0.001$) and self-efficacy ($t=28.293$; $p<0.001$) among patients with Type 2 DM in the experimental group. These findings suggest that the intervention had a substantial and positive effect on both aspects of diabetes care and management (Subramanian, Porkodi, & Akila, 2020).

This indicates that intervention in the current study effectively improved insulin self-administration efficacy, a finding that mirrors the results of past studies using video-assisted education. Both approaches highlight the importance of structured, interactive learning tools in empowering diabetic patients to manage their condition more effectively. Future interventions could further explore combining video resources with mobile health applications for a more comprehensive approach to diabetes management.

CONCLUSION

In conclusion, the nurse-led demonstration combined with a tailored mobile application has shown promising efficacy in enhancing skill development for self-administration of insulin therapy among patients with type II diabetes. This innovative approach leverages personalized education and technology to empower patients in managing their condition effectively, promoting adherence to treatment, and improving self-care competencies. By addressing barriers such as limited health literacy and lack of confidence, this intervention underscores the critical role of nurses in fostering patient autonomy and optimizing diabetes management outcomes. Future research should focus on scaling this model, exploring long-term impacts, and evaluating its cost-effectiveness across diverse populations.

Recommendations

Based on the comprehensive findings of this study, several recommendations can be proposed:

Long-term Follow-up Studies: Future investigations ought to concentrate on assessing how mobile applications used in nurse-led interventions affect insulin self-administration abilities over the long run. This would assist in determining if the skill and confidence gains are maintained over time and how they affect the long-term health outcomes of patients with Type II diabetes.

Wider Application to Other Chronic disorders: Patients managing other chronic disorders like asthma or hypertension that call for self-care and medication adherence could test and modify the customized

mobile application employed in this study. This may increase the management of chronic diseases through the use of mobile health technologies.

Integration with Healthcare Systems: Future research should look into how to combine these mobile health apps with electronic health records (EHR) and healthcare systems in order to optimize the benefits of such interventions. This will facilitate more effective follow-up care and data tracking on insulin delivery by facilitating more smooth communication between patients and healthcare professionals.

Cost-Effectiveness Analysis: To evaluate the financial viability of deploying nurse-led, mobile application-based interventions on a larger scale, future study should also include a cost-effectiveness analysis. This would assist legislators and healthcare professionals in evaluating the benefits of funding such diabetes care initiatives.

Enhanced User Engagement Features: The mobile application may be able to maintain patient involvement and enhance skill retention by using gamification, reminders, or other user engagement elements. Future research ought to look into how these characteristics affect patient outcomes and engagement.

Increasing Training for Caregivers: Future interventions could include teaching caregivers how to assist patients with insulin delivery, improving overall care, and creating support networks for people with Type-II diabetes, given the significant role that family and caregivers play in the management of diabetes.

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