Original Article

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Community Section

Medication Adherence and its Association with Treatment Satisfaction and Diabetes Related Psychological Distress among Type 2 Diabetes Mellitus Patients: A Cross-sectional Study from Rural Thiruvallur District, India

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ABSTRACT

Introduction: Effective management of Type 2 Diabetes Mellitus (T2DM) requires sustained medication adherence. However non adherence coupled with low treatment satisfaction and psychological distress, can adversely impact glycaemic control.

Aim: To assess the level of medication adherence among patients with T2DM, and also to determine its relationship between treatment satisfaction, diabetes-related psychological stress.

Materials and Methods: A community based cross-sectional study was conducted at ACS Medical College and Hospital, Thiruvallur, Tamil Nadu, India, from January to April 2024 among 350 adult T2DM patients selected through systematic random sampling. Data collection involved a semi-structured questionnaire, Morisky Medication Adherence Scale-4 (MMAS-4), Diabetes Treatment Satisfaction Questionnaire (DTSQ), and Diabetes Distress Scale-17 (DDS-17). Statistical analysis was performed using Chi-square tests and multiple logistic regression in Statistical Package for Social Sciences (SPSS) version 25 with significance value at $p<0.05$.

Results: The mean age of participants was 46.3±10.4 years. Majority of the participants were female 186 (53.1%). Most of the participants were married 340 (97.1%) and 220 (62.9%) were employed, and over 189 (54%) belonged to the upper-middle class as per the Modified BG Prasad Scale. Among the participants, 135 (38.6%) exhibited high adherence, 137 (39.1%) moderate adherence, and 78 (22.3%) low adherence. Moderate treatment satisfaction was observed in 278 (79.4%), and 126 (36%) reported clinically significant psychological distress. Bivariate analysis reported that medication adherence showed significant associations with age, educational status, occupation, Socioeconomic Status (SES), mode of drug intake, number of doses per day, family support, glycaemic control drug regimen (p-value <0.05). Medication adherence also showed significant associations with treatment satisfaction scale (p-value=0.0001) and DDS (p-value=0.022). Multiple logistic regression analysis showed significance for age (p-value=0.002), educational status (p-value=0.010) and mode of drug intake (p-value=0.008).

Conclusion: Medication adherence among rural T2DM patients was moderate and influenced by treatment satisfaction and psychological distress. Strengthening education, enhancing psychological support and implementing community based interventions are critical in improving adherence and clinical outcomes.

Keywords: Adherence barriers, Diabetes education, Emotional distress, Glycaemic control, Non communicable diseases

INTRODUCTION

In recent years, Non Communicable Diseases (NCDs) have become the primary cause of death in developing nations, where their burden outweighs that of infectious diseases. T2DM is the most common form of NCD, with particularly high rates seen in India [1]. Currently, India has the highest number of adults affected by diabetes, with an estimated 212 million cases. Among them, about 12.1 million individuals are over the age of 65, and by 2045, the number of people living worldwide with Type 2 diabetes is expected to reach 700.2 million [2].

Over half of the affected individuals remain unaware of their condition, potentially leading to severe health complications if timely diagnosis and treatment are not provided. Inadequate management of diabetes significantly increases the risk of developing complications, thereby adversely impacting an individual's overall well-being [3]. The management of diabetes mellitus generally necessitates a comprehensive, multifactorial strategy yet the effectiveness of these strategies is often compromised due to suboptimal adherence to prescribed medication regimens [4].

According to World Health Organisation (WHO), adherence is defined as "the extent to which a person's behaviour-taking medication, following a diet, and/or executing lifestyle changes-corresponds with agreed recommendations from a health care provider" [5]. Medication non adherence remains a critical global concern and notably, adherence rates are significantly higher in patients with acute conditions compared to those managing chronic diseases such as diabetes mellitus [6]. On the other hand, better medication adherence is associated with reduced healthcare costs and improved self-management of diabetes mellitus [7].

Maintaining patient satisfaction of treatment is increasingly recognised as a key determinant in evaluating the effectiveness and overall standard of healthcare delivery [8]. Treatment satisfaction, which refers to the patient's assessment of whether a treatment meets or surpasses their personal expectations, plays a crucial role

in promoting good medication adherence [9]. Diabetes-Related Distress (DRD) relates to the emotional and psychological challenges resulting from diabetes and also refers to the negative emotional or affective experiences resulting from the challenge of living with the demands of diabetes, regardless of the type of diabetes [10,11]. The DRD arising from various factors such as the burden of managing a chronic disease, dietary restrictions, limited family support, are often associated with poor glycaemic control and diminished Quality of Life (QoL) [12].

Although these issues are increasingly recognised, there were a lack of research exploring the relationship between medication adherence, treatment satisfaction, and DRD among type 2 diabetes patients in rural areas of India [13-15]. Understanding how these factors interact is essential for creating targeted interventions that can improve treatment outcomes and enhance the QoL for individuals with diabetes in these communities [16]. Hence, this study was conducted with the aim to assess the level of medication adherence among patients with T2DM, identify the key factors contributing to low adherence, and also to determine relationship between treatment satisfaction, diabetes-related psychological stress, and medication adherence among the study participants.

MATERIALS AND METHODS

A community-based cross-sectional study was conducted among T2DM patients residing in the rural field practice area of ACS Medical College and Hospital, Thiruvallur District, Tamil Nadu, India from January 2024 to June 2024 after obtaining the Institutional Ethical Committee (IEC) approval number 542/2022/IEC/ACSMCH. Informed consent was obtained from the study participants before the start of the study.

Inclusion and Exclusion criteria: Adult patients diagnosed with T2DM and who had been living with T2DM for at least one year and those who were taking treatment for diabetes were included in this study. The patients who were not oriented with time, place and person and not willing to participate in this study were excluded.

Sample size calculation: Systematic random sampling method was adopted to select the study participants. The required sample size was calculated based on the previous study done by Abhilash P et al., in Mangalore, India (33.8% of high medication adherence). The estimated sample size was 350, using an alpha error of 0.05 and power of 80%, the formula $n=(1.96)^2PQ/L^*L$, where P- 33.8%, L- 5 [17].

Study Procedure

Data was collected using pretested, semi-structured questionnaires for the background information of the study participants and MMAS-4 to measure medication adherence. Treatment satisfaction was evaluated using the DTSQ, and DRD was assessed using the DDS 17. Glycaemic control was assessed with HbA1C levels. Value of HbA1c less than 6.5 was considered adequate and value more than 6.5 was considered inadequate glycaemic control [18].

Morisky Medication Adherence Scale- 4 (MMAS-4): MMAS-4 is a simple, validated tool to assess a patient's adherence to prescribed medication regimens. It consists of four yes/no questions that address common barriers to medication adherence, such as forgetting to take medicine, carelessness in taking medicine, stopping medication when feeling better, and stopping medication when feeling worse. Each "yes" response was scored as 1, and each "no" response was scored as 0, resulting in a total score ranging from 0 to 4. Overall score of 0 indicates high adherence, a score of 1-2 indicates medium adherence, and a score of 3-4 suggests low adherence [19].

Diabetes Treatment Satisfaction Questionnaire (DTSQ): DTSQ is a validated tool used to assess a patient's satisfaction with their diabetes treatment, covering aspects like blood sugar control, convenience, and flexibility of therapy. It consists of 8 items rated on a 7-point Likert scale, where higher scores generally indicate greater satisfaction. The total score ranges from 0 to 36, with scores of 0-12 indicating low satisfaction, 13-24 reflecting moderate satisfaction, and 25-36 showing high satisfaction with treatment [20].

Diabetes Distress Scale-17 (DDS-17): DDS-17 is a validated questionnaire designed to assess emotional distress specifically related to people living with diabetes. It consists of 17 items, each rated on a 6-point Likert scale ranging from 1 (no problem) to 6 (a very serious problem). The total score was calculated by averaging the responses, with higher scores indicating greater distress. Scores are interpreted as follows: less than 2.0 suggested little or no distress, 2.0 to 2.9 indicated moderate distress, and 3.0 or above reflected high distress that may require clinical attention [21].

Study variables: This study assessed a range of variables which included sociodemographic variables comprising age, gender, religion, education, occupation, marital status, type of housing, socioeconomic status (according to Modified BG Prasad Scale version 2024) [22], family size. Additional variables about diabetic profile of the study participants such as duration of diabetes, family history, and mode of drug intake, number of daily doses, family support, and glycaemic control (based on HbA1c levels) were also examined.

STATISTICAL ANALYSIS

Data entry was done in MS Excel. Descriptive statistics were done. Inferential statistics were done using Chi-square test, and multivariate regression tests using IBM SPSS version 25 software.

RESULTS

The mean age of the study participants was 46.31+10.43 years. The female participants accounted for a slightly higher proportion (53.1%) compared to males (44.9%). Most of the participants were Hindus (62.9%), and only 15.7% were Muslims. In this study, 23.5% had completed high school, while 17.4% were illiterate. Almost all the participants were married (97.1%), and most of them (62.9%) were employed. Most (77.7%) of the study participants were living in semi-pucca houses. The results showed that over half of the study participants (54%) belonged to the upper-middle class, while 32.6% were categorised as middle class according to Modified BG Prasad Scale. [Table/Fig-1] depicted the socio-demographic profile of 350 study participants.

S. No.	Variables	Frequency (%)
1.	**Age (in years)**	
	18-45	60 (17.1)
	46-59	261 (74.6)
	≥60	29 (8.3)
2.	**Gender**	
	Male	157 (44.9)
	Female	186 (53.1)
	Others	7 (2)
3.	**Religion**	
	Hindu	220 (62.9)
	Muslim	55 (15.7)
	Christian	66 (18.9)
	Others	9 (2.6)
4.	**Educational Status**	
	Illiterate	61 (17.4)
	Primary school	57 (16.3)
	Middle school	61 (17.4)
	High school	82 (23.5)
	Higher secondary school	40 (11.4)
	Undergraduate/postgraduate	49 (14)

5.	**Marital status**	
	Married	340 (97.1)
	Unmarried	10 (2.9)
6.	**Occupation**	
	Employed	220 (62.9)
	Unemployed	130 (37.1)
7.	**Type of house**	
	Pucca house	24 (6.9)
	Semi - pucca house	272 (77.7)
	Kutcha house	54 (15.4)
8.	**Socio economic status (According to Modified BG Prasad Scale version 2024)**	
	Upper class	15 (4.3)
	Upper middle class	189 (54)
	Middle class	114 (32.6)
	Lowe middle class	30 (8.6)
	Lower class	2 (0.5)

[Table/Fig-1]: Sociodemographic characteristics of the study participants (N=350).

[Table/Fig-2] depicts the diabetic profile of the study participants. Family history of diabetes was reported by 54.6% of the study individuals. In this study, 45.1% of the study participants had been diagnosed with T2DM for more than 10 years, while 22% had lived with diabetes for 2-10 years. The majority (67.8%) were managing their condition with Oral Hypoglycaemic Agents (OHA), while 20.1% were on insulin therapy. Glycaemic control was found to be adequate in 62.6% of participants, whereas 37.4% had inadequate control.

S. No.	Variables	Frequency (%)
1.	**Family history of diabetes**	
	Yes	191 (54.6)
	No	159 (45.4)
2.	**Duration of diabetes (in years)**	
	<1 year	54 (15.4)
	1-5 years	61 (17.4)
	6-10 years	77 (22.0)
	>10 years	158 (45.1)
3.	**Mode of drug intake**	
	OHA	238 (67.8)
	Insulin	70 (20.1)
	OHA+insulin	42 (12.1)
4.	**Glycaemic control**	
	Adequate control	217 (62.6)
	Inadequate control	133 (37.4)
5.	**Family support**	
	Yes	166 (47.4)
	No	184 (52.6)
6.	**Number of doses of drug per day**	
	Once daily	179 (51.1)
	Twice daily	133 (38))
	Thrice daily	38 (10.9)

[Table/Fig-2]: Diabetic profile of the study participants (N=350).

[Table/Fig-3] showed the medication adherence levels among the study participants as assessed by the MMAS-4 scale. Of the 350 individuals, 135 (38.6%) demonstrated high adherence, 137 (39.1%) had medium adherence, and 78 (22.3%) exhibited low adherence to the medications. The overall mean adherence score was 1.71±1.52.

[Table/Fig-4] illustrates treatment satisfaction levels among the study population based on the DTSQ scale. Of the 350 participants, 278 (79.4%) reported moderate satisfaction with their treatment,

S. No.	Variables	Frequency (%)	Mean±SD
1.	High adherence to medication	135 (38.6)	1.71±1.52
2.	Medium adherence to medication	137 (39.1)	
3.	Low adherence to medication	78 (22.3)	

[Table/Fig-3]: Medication adherence using MMAS- 4 scale (N=350).

S. No.	Diabetes Treatment Satisfaction Questionnaire (DTSQ) Scale	Frequency (%)	Mean±SD
1.	High satisfaction with treatment	15 (4.3)	16.64±4.32
2.	Moderate satisfaction with treatment	278 (79.4)	
3.	Low satisfaction with treatment	57 (16.3)	

[Table/Fig-4]: Treatment satisfaction using DTSQ scale (N=350).

57 (16.3%) had low satisfaction, and only 15 (4.3%) reported high satisfaction. The mean DTSQ score was 16.64±4.32.

[Table/Fig-5] presents the distribution of DRD among the participants, assessed using DDS 17. The overall mean diabetes distress score was 2.36±0.94. Out of 350 individuals, 197 (56.3%) had little or no distress, 27 (7.7%) reported mild to moderate distress, while 126 (36%) exhibited clinically significant high distress.

S. No.	Diabetes Distress Classification	Frequency (%)	Mean±SD
1.	Little or no diabetes distress	197 (56.3)	2.36±0.941
2.	Mild to moderate distress	27 (7.7)	
3.	Clinically significant high distress	126 (36)	

[Table/Fig-5]: Diabetes related distress using DDS 17 Scale (N=350).

[Table/Fig-6] presents the bivariate analysis of background variables with medication adherence among 350 T2DM patients. Statistically significant associations were found between medication adherence and variables such as age (p=0.002), educational status (p=0.0001), occupation (p=0.001), Socioeconomic Status (SES) (p=0.031), mode of drug intake (p=0.021), family support (p=0.033), number of daily drug doses (p=0.0001), and glycaemic control (p=0.0001). Notably, higher adherence was more common among older individuals, those with higher education levels, employed participants, those receiving OHAs, and individuals reporting family support.

[Table/Fig-7] demonstrated a statistically significant association between medication adherence and both diabetes treatment satisfaction and

S. No.	Variables	Medication adherence n (%)			p-value
		High	Medium	Low	
1.	**Age (in years)**				
	18-45	31 (51.7)	19 (31.7)	10 (16.7)	0.002*
	46-59	99 (37.9)	112 (42.9)	50 (19.2)	
	≥60	5 (17.2)	6 (20.7)	18 (62.1)	
2.	**Gender**				
	Male	62 (39.5)	57 (36.3)	38 (24.2)	0.317
	Female	68 (36.6)	79 (42.5)	39 (21)	
	Prefer not to say	5 (71.4)	1 (14.3)	1 (14.3)	
3.	**Educational status**				
	Illiterate	5 (8.2)	34 (55.7)	22 (36.1)	0.0001*
	Primary school	26 (45.6)	13 (22.8)	18 (31.6)	
	Middle school	23 (37.7)	25 (41)	13 (21.3)	
	High school	36 (43.9)	33 (40.2)	13 (15.9)	
	Higher secondary school	20 (50)	13 (32.5)	7 (17.5)	
	Undergraduate/ postgraduate	25 (51)	19 (38.8)	5 (10.2)	
4.	**Occupation**				
	Employed	101 (45.9)	78 (35.5)	41 (18.6)	0.0001*
	Unemployed	34 (26.2)	59 (45.5)	37 (28.5)	

5.	**Marital status**				
	Married	129 (37.9)	136 (40)	75 (22.1)	0.412
	Unmarried	6 (60)	1 (10)	3 (70)	
6.	**Type of house**				
	Pucca	7 (29.2)	8 (33.3)	9 (37.5)	0.271
	Semi - pucca	98 (36)	114 (41.9)	60 (22.1)	
	Kutcha	30 (55.6)	15 (27.8)	9 (16.7)	
7.	**Socio economic status**				
	Upper class	0	15 (100)	0	0.031*
	Upper middle class	74 (39.2)	77 (40.7)	38 (20.1)	
	Middle class	53 (46.5)	31 (27.2)	30 (26.3)	
	Lower middle class	7 (23.3)	14 (46.7)	9 (30)	
	Lower class	1 (50)	0	1 (50)	
8.	**Duration of diabetes (in years)**				
	< 1	29 (53.7)	18 (33.3)	7 (13)	0.110
	1-5	23 (37.7)	25 (41)	13 (21.3)	
	6-10	29 (37.7)	25 (32.5)	23 (29.9)	
	>10	54 (34.2)	69 (43.7)	35 (22.2)	
9.	**Family history of diabetes**				
	Yes	83 (43.5)	69 (36.1)	39 (20.4)	0.121
	No	52 (32.7)	68 (42.8)	39 (24.5)	
10.	**Mode of drug intake**				
	OHA	99 (41.6)	93 (39.1)	46 (19.3)	0.021*
	Insulin	29 (41.4)	24 (34.3)	17 (24.3)	
	OHA+Insulin	7 (16.7)	20 (47.6)	15 (35.7	
11.	**Family support**				
	Yes	99 (59.6)	53 (31.9)	14 (8.4)	0.033*
	No	36 (19.6)	84 (45.7)	64 (34.8)	
12.	**Number of doses per day**				
	Once daily	84 (46.9)	67 (37.4)	28 (15.6)	0.0001*
	Twice daily	48 (36.1)	52 (39.1)	33 (24.8)	
	Thrice daily	3 (7.9)	18 (47.4)	17 (44.7)	
13.	**Glycaemic control**				
	Adequate	94 (43.3)	95 (43.8)	28 (12.9)	0.0001*
	Inadequate	41 (30.8)	42 (31.6)	50 (37.6)	

[Table/Fig-6]: Bivariate analysis of background variables with medication adherence (N=350).
*statistically significant

	Medication adherence (N=350)			p-value
	High adherence	Medium adherence	Low adherence	
Diabetes treatment satisfaction scores				
Low satisfaction	22 (38.6)	26 (45.6)	9 (15.8)	0.0001*
Moderate satisfaction	98 (35.3)	111 (39.9)	69 (24.8)	
High satisfaction	15 (100)	0 (0)	0 (0)	
Diabetes Distress Scale (DDS)				
Little or no distress	82 (41.6)	76 (38.6)	39 (19.8)	0.022*
Mild to moderate distress	16 (59.3)	8 (29.6)	3 (11.1)	
Clinically significant high distress	37 (29.4)	53 (42.1)	36 (28.6)	

[Table/Fig-7]: Association of medication adherence with treatment satisfaction and diabetes related distress (N=350).
*statistically significant

DRD among 350 participants. All individuals with high treatment satisfaction exhibited high adherence 15 (100%), while low satisfaction was more frequent in the medium adherence group (p=0.0001). Similarly, clinically significant diabetes distress was predominantly observed among participants with medium 53 (42.1%), whereas those with high adherence showed lower distress levels 82 (41.65).

A multiple logistic regression analysis was conducted to examine the association between medication adherence and selected independent variables among T2DM patients. The overall regression model was statistically significant (F7, 342)=8.753, p<0.001), suggesting that the predictors explained a meaningful proportion of variance in medication adherence. Among the predictors, age category, educational status, mode of drug intake were found to be statistically significant with medication adherence. Negative coefficient was observed for educational status indicating an inverse relation between educational status and the outcomes such as medication adherence and treatment satisfaction. Other variables, including religion, occupation, SES classification, and glycaemic control, were not found to be significantly associated with medication adherence in the present study [Table/Fig-8].

S. No.	Variables	Coefficient (B)	95% Confidence interval		p-value
			Lower bound	Upper bound	
1.	Age (years)	0.515	0.185	0.846	0.002*
2.	Educational status	-0.148	-0.260	-0.036	0.010*
3.	Mode of drug intake	0.324	0.084	0.0564	0.008*
4.	Religion	0.34	0.165	0.233	0.735
5.	Occupation	0.319	0.050	0.688	0.090
6.	Socioeconomic status	0.068	0.147	0.283	0.536
7.	Glycaemic control	0.126	0.186	0.437	0.427

[Table/Fig-8]: Multiple logistic regression analysis of the variables.

DISCUSSION

Medication adherence is crucial for effective diabetes management, with poor adherence leading to increased morbidity, mortality, and healthcare costs and improved medication adherence also contributes to improvement in diabetes-related QoL [23]. Complex treatment regimens, including multiple daily medications, diet, and exercise, can make adherence challenging for patients which can cause psychological distress and make a diabetic patient non adherent to their medication [24]. Medication adherence is as important as it was evidenced from the previous studies, that it is associated with better glycaemic control, fewer hospitalisations, and reduced medical expenses [25].

Diabetic patients are at a high risk of declining psychological health [26] and found to frequently experience significant stress as a result of the many rigorous self-care obligations for improving glycaemic control (lifestyle changes, medication adherence, and blood glucose self-monitoring), concerns about hypoglycaemia and diabetes complications, and non conducive living and social support environments [27] leading to diabetes related distress and non medication adherence [28].

Also, patient satisfaction is an important measure of healthcare quality and is a crucial determinant of patients' perspective on behavioural intention especially in diabetes and studies have shown that higher levels of patient satisfaction are associated with improved medication adherence [29-31]. This study thus aimed to prove the hypothesis that there is a significant association between treatment satisfactions, diabetes related psychological distress, and medication adherence among type 2 diabetic patients.

The result of the current study showed 137 (39%) of study subjects were in medium adherence, 78 (22.3%) were in low adherence, and only 135 (38.6%) were in high adherence to medication according to MMAS 4 Scale. Comparing this results with the previous studies showed that medication adherence among diabetic patients in India varies across studies, with moderate adherence rates ranging from 33.5% to 34.5% [32,33], poor adherence is prevalent, with one study reporting 74% of patients having poor adherence [34].

The present study showed that 278 (79.4%) of the study subjects were moderately satisfied, 57 (16.2%) were less satisfied, and only 15 (4.2%) were highly satisfied according to DDS 17 Scale. This was in line with the previous studies which said that treatment satisfaction among diabetic patients in India shows moderate to high levels, with studies reporting satisfaction rates of 75.9% to 87.8% [35,36].

Assessment of diabetes related distress showed 56.3% of the study subjects were with little or no distress, 36% were with clinically significant high distress, and 7.7% were in mild to moderate distress according to DDS 17 scale. Comparison with previous literature showed that a systematic review and meta-analysis estimated the pooled prevalence of DD at 33% [37] (Sinha et al., 2024), while individual studies reported rates ranging from 18 to 62.5% [38-40].

The current study showed a statistically significant association between age, qualification, occupation, SES, glycaemic control, mode of drug intake and medication adherence. This was in line with the previous study by Bakar ZA et al., which said that demographic factors such as age, gender, and education level may influence both satisfaction and adherence [41]. Factors associated with better adherence included higher age, longer disease duration, good diabetes knowledge, and regular blood sugar monitoring as reported in a study conducted by Sharma D et al., [42]. Conversely, factors linked to poor adherence include low education, unemployment, complex drug regimens, and lack of family support [34]. The present study also found that the treatment satisfaction varies based on medication type, with patients receiving OHAs alone reporting higher satisfaction compared to those on insulin. This was also in line with other studies done by Sharma D et al., Desai C et al. and Balamurugan V et al., [42,43,44]. Another study by Gahlan D et al., found that patients on insulin therapy were found to experience greater distress compared to those on oral hypoglycaemic agents [38]. From the results of this current study, improving treatment satisfaction may enhance patients' self-efficacy and adherence, leading to better long-term glycaemic control and reduced risk of complications, which forms a comprehensive diabetes care and should be integrated into standard care packages.

Limitation(s)

As a cross-sectional study, it cannot infer causal relationships between medication adherence, treatment satisfaction, and psychological distress. The use of self-reported tools such as the MMAS-4, DTSQ, and DDS-17 may subject to recall bias and social desirability bias, potentially affecting the reliability of responses. The study was limited to a rural population in Thiruvallur district, which may restrict the generalisability of findings to other regions or urban settings.

CONCLUSION(S)

In summary, the study reveals a moderate level of medication adherence among rural patients with T2DM, which is significantly associated with treatment satisfaction and diabetes-related psychological distress. Enhancing adherence through focused interventions has the potential to improve both glycaemic control and overall QoL. To achieve sustained improvements, future efforts should emphasise patient education, mental health support, and streamlined treatment plans. Community-driven strategies and ongoing follow-up are crucial for maintaining long-term adherence. Additionally, longitudinal studies are needed to assess the effectiveness of integrated care approaches in managing diabetes.

Permission for DTSQ usage obtained from HPR Ltd.

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