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Nationwide Survey of Physicians Awareness and Adherence to Diabetes Guidelines in China

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Nationwide Survey of Physicians Awareness and Adherence to Diabetes Guidelines in China

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ABSTRACT

Objective: To explore physicians' familiarity with four diabetes guidelines and their practice of specific recommendations from diabetes guidelines.

Design: Cross-sectional survey study.

Setting: A questionnaire survey was conducted online among physicians in the Specialist Committee for Primary Diabetes Care of China Association of Chinese Medicine, and snowball sampling method was used to reach more physicians.

Participants: 1150 physicians (461 tertiary care physicians (TCPs), 307 secondary care physicians (SCPs), and 382 primary care practitioners (PCPs)) from 192 cities in 30 provinces in China with complete data.

Results: The TCPs had the highest familiarity with the type 2 diabetes mellitus guideline (91.33%), followed by the national primary care diabetes guideline (76.79%), the American Diabetes Association standards guideline (72.24%) and the traditional Chinese medicine (TCM) diabetes guideline (63.77%). The overall result of physicians' self-reported reference to western diabetes guidelines (73.22%) was twice of that for TCM diabetes guidelines (33.83%). The PCPs' familiarity with the four guidelines is about 50% or less. Less than 40% of physicians chose the option of "hand over to a special nutritionist or professional nutrition team" involving dietary or physical exercise management for diabetics. About 90% of physicians from different groups had instructed diabetics with self-monitoring blood glucose. As for health education management, 75.70% of the TCPs reported they had the diabetes health management team, followed by SCPs (57.00%) and PCPs (27.49%). Moreover, about 40% of physicians didn't grasp the guideline recommendations about hypoglycemia well enough.

Conclusions: The level of familiarity and adherence to the screening guidelines varied among physicians in different level hospitals. Of note, there have significant discrepancies between physicians' awareness and adherence to western medicine guidelines and TCM guidelines. In addition, there is a gap between clinical practice and guidelines in terms of physicians' awareness and practice of diabetes guidelines.

KEY WORDS: Diabetes Mellitus; Guidelines; Physician Awareness

1. INTRODUCTION

Diabetes is a metabolic disorder caused by genetic and environmental factors, which had become a critical health concern worldwide owing to its high prevalence and related disability and mortality^[1,2]. From 1980 to 2014, the increasing prevalence had nearly quadrupled the number of adult diabetes patients worldwide^[3]. A nationally-representative epidemiological survey has demonstrated that the overall prevalence of diabetes in mainland China was 12.8%^[4]. However, according to the monitoring report on chronic diseases and their risk factors in China, the national diabetes awareness rate, treatment rate, and control rate were 38.0%, 34.1% and 33.1%, respectively^[5]. Moreover, another large sample survey found that only 12.42% patients achieved glycemic control^[6]. Therefore, it is necessary to address this important public health issue so that the improved national diabetes awareness rate, treatment rate and control rate are expected.

Clinical practice guidelines are statements that assist health professionals and patients in achieving optimal management of diseases. At the same time, the physicians' standardized mastery and active application of the practice guidelines are important for ensuring the health professionals to achieve optimal management of patients^[7]. Previous studies have pointed out that successful adoption of clinical practice guidelines was related to physician awareness^[8-10]. Additionally, a systematic review identified physicians' lack of awareness of a guideline's existence and lack of familiarity with the guideline as the leading causes of deviation from recommended therapy^[11]. Significantly, a cross-sectional study found that physicians' lack of knowledge and patients' lack of awareness to type 2 diabetes guidelines could account for about 70% of non-adherence^[12]. Therefore, it is critical and necessary to emphasize physician awareness and adherence to clinical guidelines.

For the prevention and standardized management of diabetes mellitus, a series of clinical guidance documents have been released successively, such as the type 2 diabetes mellitus (T2DM) guideline issued by Chinese Diabetes Society (CDS)^[13], the national primary care diabetes guideline issued by CDS^[14], the traditional Chinese medicine (TCM) diabetes guideline issued by China Association of Chinese Medicine (CACM)^[15], and the standards of medical care in diabetes issued by the American Diabetes Association

(ADA)^[16]. However, it remains unclear whether physicians follow these guidelines, and particularly whether different physicians have different awareness and adherence to the guidelines. To provide nationally representative evidence of physicians' awareness and adherence to diabetes guidelines in China, we conducted a national survey to compare physicians' awareness, adherence and practice of different diabetes guidelines, as well as the comparison among different physician groups from tertiary to primary. Furthermore, to ensure the implementation of diabetes guidelines into current practice, the facilitators and barriers to diabetes guidelines implementation by different physician groups were identified as well.

2. RESEARCH DESIGN AND METHODS

2.1 Survey design

This is an investigator-initiated, non-commercial survey of physicians in different level hospitals in China. This work was carried out by the Specialist Committee for Primary Diabetes Care of China Association of Chinese Medicine, which is a national academic institution, majority of physicians as members of the Specialist Committee have participated in the survey questionnaire. The questionnaire was distributed electronically to the participants, electronically written informed consent was showed to respondents before proceeding with the survey. These participants were also asked to help forward the questionnaire to additional general practitioners, physicians, and experts using the snowball sampling method. In the overall design of this survey, we try to ensure that the respondents are physicians from different grades of hospitals in China, including physicians from tertiary to primary medical institutions. Besides, considering the purpose of this study, the endocrinology diabetes specialists, general practitioners, and TCM physicians were mainly enrolled.

2.2 Questionnaire and pretest

A questionnaire with 42 items was established, which was consisted of four sections. Section I assessed participants' clinical background and basic demographic data. Section II assessed participants' familiarity and self-reported reference to different diabetes guidelines. These questions were set as single-choice questions in the form of Likert scales. Section III assessed participants' practice and application of specific measures in

1 diabetes guidelines, the list of guideline-based recommendations was shown in Appendix 1. We reworded the
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3 guideline action statements into options so that respondents could choose the most appropriate answers to these
4
5 questions. These questions were set as single-choice questions or multiple-choice questions respectively.
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8 Section IV investigated the facilitating factors and barriers in the process of guideline implementation.
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10 The questionnaire was pilot tested in 24 physicians from Fujian and Gansu provinces in China from Aug
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12 20, 2021 to Aug 27, 2021 to determine whether the questions were clear, understandable and logical.
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15 Additionally, experts who are familiar with the diabetes guidelines were invited to criticize the contents of the
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17 questionnaire. Finally, we optimized the questionnaire items based on the results of the pilot survey and expert
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19 consultation meeting.
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23 **2.3 Sample and administration**

24 The sample size was calculated according to the cross-sectional survey sample size estimation formula $N =$
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26 $(Z_{\alpha}^2 * pq) / (d^2)^{[17]}$. In this study, we calculated the sample size by taking $\alpha = 0.05$, $Z_{\alpha} = 1.96$, $q = 1 - p$, and d as the
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28 allowable error (usually set at $d = 0.1 * p$). In this estimation formula, p represents the proportion of Chinese
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30 physicians very familiar with diabetes guidelines according to literature search, which is about 26.2%. By
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32 plugging in the values, the final sample size was determined to be 1082 cases. The formal investigation was
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34 performed from Sep 22, 2021 to Oct 29, 2021, a total of 1 162 participants completed the survey. After the
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36 logical verification of these collected samples, if there are any discrepancies in the questionnaires, it was
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38 confirmed through telephone.
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47 **2.4 Statistical analysis**

48 Statistics analysis was performed using SAS Version 9.4. Analysis was primarily descriptive, but
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50 appropriate inferential statistics were performed where comparisons between groups were indicated. Pearson
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52 Chi-square test was used to compare categorical variables as appropriate. Wilcoxon rank-sum tests were used
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54 when the numerical variables didn't meet the normal distribution. In addition, Cochran-Mantel-Haenszel
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56 (CMH) tests were used when the variables were ordinal categorical variables. The differences among different
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1 physician groups regarding guidelines awareness and adherence were analyzed, including tertiary care
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3 physicians (TCPs), secondary care physicians (SCPs), and primary care practitioners (PCPs). Then a
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5 comparison among endocrinologists, general practitioners, and other physicians was also performed. In this
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7 study, the differences across each group were reported as percentage differences. A *P*-value less than 0.05 is
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9 statistically significant.
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13 3. RESULTS

16 3.1 Sample characteristics

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18 1 162 questionnaires were finally collected, we included 1 150 (98.97%) questionnaires from physicians
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20 after excluding 12 questionnaires (7 from nurses, 2 from pharmacists and 3 from medical teachers). 461
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22 questionnaires (40.09%) were from TCPs, 307 questionnaires (26.70%) from SCPs, and 382 questionnaires
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24 (33.22%) from PCPs. There were no significant differences among the three groups of physicians in age, but
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26 there are differences in gender, education level, professional category, years in practice, technical title, diabetes
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28 practice setting, and treatment number of diabetics per week. Full characteristics of the physicians are shown in
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30 supplemental appendix 1.
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36 3.2 Physicians' familiarity with diabetes guidelines

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39 Physicians' familiarity with diabetes guidelines is illustrated in Figure 1. The results suggested that the
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41 TCPs had the highest familiarity (including very familiar and relatively familiar) with the CDS T2DM
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43 guideline (91.33%), followed by the CDS national primary care guideline (76.79%), the ADA diabetes
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45 guideline (72.24%) and the CACM TCM diabetes guideline (63.77%). The result from the SCPs' familiarity
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47 with four guidelines generated similar results. The PCPs' familiarity with four guidelines followed by the CDS
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49 national primary care guideline (51.05%), the CDS T2DM guideline (51.04%), the CACM TCM diabetes
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51 guideline (35.34%), and the ADA diabetes guideline (22.25%).
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58 Additional analysis was performed by using different professional physicians, which demonstrated that the
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60 endocrinologists had the highest familiarity with the CDS T2DM guideline (95.48%), followed by the CDS

1 national primary care guideline (80.15%), the ADA diabetes guideline (74.86%) and the CACM TCM diabetes
2 guideline (62.47%). In addition, the general practitioners had the best familiarity with the CDS national primary
3 care guideline (55.23%), followed by the CDS T2DM guideline (53.97%), the CACM TCM diabetes guideline
4 (32.64%) and the ADA diabetes guideline (26.78%). The result from the other physicians' familiarity of all
5 guidelines generated similar results.
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16 Insert "Figure1. Physicians' familiarity with four diabetes guidelines (the CDS T2DM guideline, the CDS
17 national primary care diabetes guideline, the CACM TCM diabetes guideline, the ADA diabetes guideline). (A)
18 Analysis based on the groups of physicians in different level hospitals. (B) Analysis based on the groups of
19 physicians with different majors. *Note.* ADA, the American Diabetes Association; CDS, the Chinese Diabetes
20 Society; TCM, traditional Chinese medicine; CACM, the China Association of Chinese Medicine."
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31 **3.3 Physicians' self-reported reference to diabetes guidelines**

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34 Physicians' self-reported reference to diabetes guidelines illustrated in Table1. As for modern medicine
35 guidelines, the results suggested that the "frequent reference" rates of TCPs, SCPs and PCPs were 80.91%,
36 77.20% and 60.73% respectively. While, the "frequent reference" rates of TCPs, SCPs and PCPs for TCM
37 guidelines were 36.23%, 36.48% and 28.80% respectively. Similarly, the "frequent reference" rates of
38 endocrinologists, general practitioners and other physicians for modern medicine guidelines were 86.84%,
39 62.76% and 62.19%. The "frequent reference" rates of endocrinologists, general practitioners and other
40 physicians for TCM guidelines were 36.74%, 25.52% and 35.07%.
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Table 1. Physicians self-reported reference to Diabetes Guidelines [n(%)]

		Physicians in different level hospitals				Physicians in different departments				
Categories		Overall	Tertiary care	Secondary care	Primary care	<i>P</i> -value	Endocrinologists	General	Other	<i>P</i> -value
		(n = 1150)	physicians (n = 461)	physicians (n = 307)	practitioners (n = 382)		(n = 509)	practitioners (n = 239)	physicians (n = 402)	
Modern medicine guidelines ^a	Frequent reference	842 (73.22)	373 (80.91)	237 (77.20)	232 (60.73)		442 (86.84)	150 (62.76)	250 (62.19)	
	Sometimes reference	236 (20.52)	75 (16.27)	59 (19.22)	102 (26.70)		56 (11.00)	60 (25.10)	120 (29.85)	
	Occasionally reference	53 (4.61)	9 (1.95)	8 (2.61)	36 (9.42)	< 0.001	9 (1.77)	24 (10.04)	20 (4.98)	< 0.001
	Basically no reference	17 (1.48)	4 (0.87)	3 (0.98)	10 (2.62)		2 (0.39)	4 (1.67)	11 (2.74)	
	No reference	2 (0.17)	0 (0.00)	0 (0.00)	2 (0.52)		0 (0.00)	1 (0.42)	1 (0.25)	
TCM guidelines ^b	Frequent reference	389 (33.83)	167 (36.23)	112 (36.48)	110 (28.80)		187 (36.74)	61 (25.52)	141 (35.07)	
	Sometimes reference	459 (39.91)	182 (39.48)	127 (41.37)	150 (39.27)		204 (40.08)	93 (38.91)	162 (40.30)	
	Occasionally reference	186 (16.17)	66 (14.32)	41 (13.36)	79 (20.68)	0.071	69 (13.56)	52 (21.76)	65 (16.17)	0.716
	Basically no reference	89 (7.74)	34 (7.38)	25 (8.14)	30 (7.85)		39 (7.66)	25 (10.46)	25 (6.22)	
	No reference	27 (2.35)	12 (2.60)	2 (0.65)	13 (3.40)		10 (1.96)	8 (3.35)	9 (2.24)	

a. Modern medicine guidelines including the standards of medical care in diabetes issued by American Diabetes Association, the T2DM guideline issued by Chinese Diabetes Society, and the national primary care guideline issued by Chinese Diabetes Society.

b. TCM guidelines including the TCM diabetes guideline issued by China Association of Chinese Medicine.

3.4 Physicians' awareness and practice of content from diabetes guidelines

The goal of this section is to evaluate physicians' awareness and practice of the relevant contents in the diabetes guidelines, including dietary management, physical exercise management, self-monitoring of blood glucose (SMBG) instruction, health education, hypoglycemia, and treatment according to TCM differentiation.

Detailed information for specific recommendation in the guidelines is shown in supplemental appendix 2.

(1) Dietary and physical exercise management

In terms of dietary management for patients with diabetes, the proportion of TCPs, SCPs and PCPs choosing the option of "Hand over to a special nutritionist or professional nutrition team" were 39.48%, 25.73% and 22.77% respectively. Similarly, the proportion of endocrinologists, general practitioners and other physicians for this option were 34.77%, 22.59% and 29.10% respectively. The proportion of TCPs, SCPs and PCPs choosing the option of "Personally evaluate the nutritional status of patients and give detailed nutritional suggestions" were 61.39%, 61.56% and 43.98% respectively. In addition, 54.43% of respondents chose the option of "Recommend specific dietary patterns for patients, such as Mediterranean diet, low-fat and low-energy diet, etc". It should be noted that the PCPs (54.03%) had the highest rate of choosing the option of "Due to the limited time, only given the oral instruction of paying attention to diet" compared with TCPs (27.98%) and SCPs (24.43%).

As for physical exercise management, the proportion of TCPs, SCPs and PCPs choosing the option of "Hand over to a special health manager or professional manager team" were 29.28%, 21.17% and 20.16% respectively. This option reported by different professional physicians also indicated a similar trend. The proportion of TCPs, SCPs and PCPs choosing the option of "Personally evaluate the athletic ability of patients and give detailed physical exercise suggestions" were 66.59%, 69.71% and 52.88% respectively. Similarly, this option reported by endocrinologists, general practitioners and other physicians were 71.12%, 53.14% and 58.21% respectively. Additionally, another result we noted by physicians from different groups was that there were more than one-third (39.39%) of physicians chose the option of "Increase exercise and improve physical fitness for the patients with frequent hypoglycemia". Detailed results are illustrated in Table 2.

Table 2. Physicians practice of dietary recommendations and exercise recommendations according to diabetes guidelines [n(%)]

Categories	Physicians in different level hospitals					Physicians in different departments			
	Overall (n = 1150)	Tertiary care physicians (n = 461)	Secondary care physicians (n = 307)	Primary care practitioners (n = 382)	<i>P</i> -value	Endocrinologists (n = 509)	General practitioners (n = 239)	Other physicians (n = 402)	<i>P</i> -value
	Hand over to a special nutritionist or professional nutrition team	348 (30.26)	182 (39.48)	79 (25.73)	87 (22.77)	< 0.001	177 (34.77)	54 (22.59)	117 (29.10)
Personally evaluate the nutritional status of patients and give detailed nutritional suggestions	640 (55.65)	283 (61.39)	189 (61.56)	168 (43.98)	< 0.001	339 (66.60)	105 (43.93)	196 (48.76)	< 0.001
Recommend specific dietary patterns for patients, such as Mediterranean diet, low-fat and low-energy diet, etc	626 (54.43)	263 (57.05)	163 (53.09)	200 (52.36)	0.340	278 (54.62)	130 (54.39)	218 (54.23)	0.993
Distribute brochures	701 (60.96)	265 (57.48)	199 (64.82)	237 (62.04)	0.108	314 (61.69)	165 (69.04)	222 (55.22)	0.002
Dietary guidance based on TCM	546 (47.48)	208 (45.12)	147 (47.88)	191 (50.00)	0.364	231 (45.38)	99 (41.42)	216 (53.73)	0.005
Due to the limited time, only given the orders of paying attention to diet simply	334 (29.04)	129 (27.98)	75 (24.43)	130 (54.03)	0.018	135 (26.52)	81 (33.89)	118 (29.35)	0.116
Hand over to a special health manager or professional manager team	277 (24.09)	135 (29.28)	65 (21.17)	77 (20.16)	0.003	137 (26.92)	49 (20.50)	91 (22.64)	0.113

1	Personally evaluate the									
2	athletic ability of patients and									
3	give detailed physical exercise	723 (62.87)	307 (66.59)	214 (69.71)	202 (52.88)	< 0.001	362 (71.12)	127 (53.14)	234 (58.21)	< 0.001
4	suggestions									
5	Increase exercise and improve									
6	physical fitness for patients	453 (39.39)	161 (34.92)	120 (39.09)	172 (45.03)	0.011	171 (33.60)	105 (43.93)	177 (44.03)	0.002
7	with frequent hypoglycemia									
8	Distribute brochures	716 (62.26)	258 (55.97)	208 (67.75)	250 (65.45)	0.001	314 (61.69)	169 (70.71)	233 (57.96)	0.005
9	Physical exercises of TCM,									
10	such as Tai Chi and Baduanjin	539 (46.87)	207 (44.90)	152 (49.51)	180 (47.12)	0.452	222 (43.61)	109 (45.61)	208 (51.74)	0.046
11	Due to the limited time, only									
12	regular exercise orders were	389 (33.83)	158 (34.27)	97 (31.60)	134 (35.08)	0.609	167 (32.81)	82 (34.31)	140 (34.83)	0.803
13	given									

(2) Instruction of SMBG and health education management

The results showed that the TCPs had the highest SMBG instruction rate based on "all guidance and regular guidance" (96.53%), followed by SCPs (94.47%) and PCPs (87.96%). Meanwhile, in this exploratory analysis, we found that endocrinologists had the highest SMBG instruction rate on both "all guidance" and "regular guidance" (97.05%), followed by other physicians (90.80%) and general practitioners (88.70%). Finally, as for health education management, 75.70% of the TCPs reported they have equipped the diabetes health management team, followed by SCPs (57.00%) and PCPs (27.49%). A similar trend was reported by the groups of physicians with different majors (endocrinologists (77.21%), general practitioners (31.80%), and other physicians (39.80%)). Detailed results are illustrated in Table 3.

Table 3. Physicians' practice of self-monitoring blood glucose and the availability of diabetes health management teams in their affiliated units [n(%)]

Categories	Overall (n = 1150)	Physicians in different level hospitals			<i>P</i> -value	Physicians in different departments			<i>P</i> -value
		Tertiary care physicians (n = 461)	Secondary care physicians (n = 307)	Primary care practitioners (n = 382)		Endocrinologists (n = 509)	General practitioners (n = 239)	Other physicians (n = 402)	
Instruction of self-monitoring blood glucose									
All guidance	475 (41.30)	237 (51.41)	139 (45.28)	99 (25.92)		269 (52.85)	60 (25.10)	146 (36.32)	
Frequent guidance	596 (51.83)	208 (45.12)	151 (49.19)	237 (62.04)		225 (44.20)	152 (63.60)	219 (54.48)	
Occasional guidance	59 (5.13)	12 (2.60)	13 (4.23)	34 (8.90)	< 0.001	13 (2.55)	21 (8.79)	25 (6.22)	< 0.001
Rare guidance	12 (1.04)	2 (0.43)	2 (0.65)	8 (2.09)		0 (0)	5 (2.09)	7 (1.74)	
Never guidance	8 (0.70)	2 (0.43)	2 (0.65)	4 (1.05)		2 (0.39)	1 (0.42)	5 (1.24)	
Have diabetes health management team									
Yes	629 (54.70)	349 (75.70)	175 (57.00)	105 (27.49)	< 0.001	393 (77.21)	76 (31.80)	160 (39.80)	< 0.001
No	521 (45.30)	112 (24.30)	132 (43.00)	277 (72.51)		116 (22.79)	163 (68.20)	242 (60.20)	

(3) Knowledge identification of hypoglycemia and TCM differentiation treatment

According to the definition of the hypoglycemia characteristics in the guidelines (supplemental appendix2), the accurate characteristics of hypoglycemia included all options (a, b, c and d) of contents in Table 4. However, TCPs, SCPs, and PCPs choosing the option of “a, b, c and d” in our exploratory analysis were 63.56%, 65.15% and 49.48% respectively. This result suggested that about 40% of physicians may not know the guideline recommendations about hypoglycemia

well enough. A similar result trend was reported by endocrinologists (68.57%), general practitioners (46.03%) and other physicians (55.47%).

According to the recommended prescription for diabetes based on TCM syndrome differentiation in the guidelines (supplemental appendix2), prescriptions for diabetes with Qi-Yin deficiency syndrome included options a, b and c in Table 4. TCPs, SCPs and PCPs choosing the option of “a, b or c” without “d or e”, in other words, the accuracy rate were 86.12%, 86.32% and 83.51% respectively. As for diabetic neuropathy with Qi-deficiency and collateral-obstruction syndrome, prescriptions or interventions for this syndrome differentiation included the options a, b and c in Table 5 based on the guidelines. The accuracy rate of TCPs, SCPs and PCPs were 68.55%, 65.80% and 54.97% respectively. The similar results were reported by endocrinologists (70.33%), general practitioners (58.16%) and other physicians (57.46%).

Table4. Knowledge identification and the accuracy rate based on contents of diabetes guidelines [n(%)]

Categories	Overall (n = 1150)	Physicians in different level hospitals			<i>P</i> -value	Physicians in different departments			<i>P</i> -value
		Tertiary care physicians (n = 461)	Secondary care physicians (n = 307)	Primary care practitioners (n = 382)		Endocrinologists (n = 509)	General practitioners (n = 239)	Other physicians (n = 402)	
The characteristics of hypoglycemia including:									
a. Blood glucose < 3.9 mmol/l	1045 (90.87)	409 (88.72)	282 (91.86)	354 (92.67)	0.110	465 (91.36)	221 (92.47)	359 (89.30)	0.355
b. Hypoglycemia with no specific blood glucose limit, accompanied by serious events of consciousness and/or physical changes, and requiring help from others	788 (68.52)	336 (72.89)	223 (72.64)	229 (59.95)	< 0.001	383 (75.25)	134 (56.07)	271 (67.41)	< 0.001
c. sympathetic excitement (such as palpitations, anxiety, sweating, dizziness,	1124 (97.74)	453 (98.26)	304 (99.02)	367 (96.07)	0.022	507 (99.61)	229 (95.82)	388 (96.52)	0.001

handshaking, hunger sensation, etc.)

d. central nervous symptoms (such as

mental changes, cognitive impairment,

convulsions, and coma)

Accuracy rate (All above option)

Prescriptions for diabetes with Qi-Yin

deficiency syndrome

a. Shenqi Jiangtang granule

b. Jinlida granule

c. Shengmai Powder

d. Gegen Qinlian decoction

e. Dachaihu decoction

Accuracy rate (choosing “a, b or c” without

“d or e”)

Prescriptions or interventions for diabetic

neuropathy with Qi-deficiency and

collateral-obstruction syndrome

a. Mudan granule

b. Acupuncture

c. TCM fumigation

d. Qiming granule

Accuracy rate (choosing “a, b or c” without

“d”)

1013 (88.09)	424 (91.97)	289 (94.14)	300 (78.53)	< 0.001	486 (95.48)	198 (82.85)	329 (81.84)	< 0.001
682 (59.30)	293 (63.56)	200 (65.15)	189 (49.48)	0.000	349 (68.57)	110 (46.03)	223 (55.47)	< 0.001
931 (80.96)	370 (80.26)	256 (83.39)	305 (79.84)	0.443	419 (82.32)	194 (81.17)	318 (79.10)	0.469
507 (44.09)	221 (47.94)	157 (51.14)	129 (33.77)	< 0.001	263 (51.67)	81 (33.89)	163 (40.55)	< 0.001
616 (53.57)	270 (58.57)	150 (48.86)	196 (51.31)	0.017	268 (52.65)	107 (44.77)	241 (59.95)	0.001
143 (12.43)	51 (11.06)	37 (12.05)	55 (14.40)	0.335	47 (9.23)	27 (11.30)	69 (17.16)	0.001
63 (5.48)	27 (5.86)	16 (5.21)	20 (5.24)	0.899	23 (4.52)	11 (4.60)	29 (7.21)	0.165
981 (85.30)	397 (86.12)	265 (86.32)	319 (83.51)	0.477	452 (88.80)	206 (86.19)	323 (80.35)	0.002
608 (52.87)	281 (60.95)	170 (55.37)	157 (41.10)	< 0.001	324 (63.65)	95 (39.75)	189 (47.01)	< 0.001
510 (44.35)	216 (46.85)	134 (43.65)	160 (41.88)	0.337	222 (43.61)	84 (35.15)	204 (50.75)	0.001
650 (56.52)	282 (61.17)	179 (58.31)	189 (49.48)	0.002	319 (62.67)	110 (46.03)	221 (54.98)	< 0.001
422 (36.70)	145 (31.45)	105 (34.20)	172 (45.03)	< 0.001	151 (29.67)	100 (41.84)	171 (42.54)	< 0.001
728 (63.30)	316 (68.55)	202 (65.80)	210 (54.97)	< 0.001	358 (70.33)	139 (58.16)	231 (57.46)	< 0.001

3.5 Facilitating factors and barriers to diabetes guidelines implementation

Standardizing clinical behavior, guiding patients' self-care, and a high level of evidence were the three most frequently selected facilitating factors behind adherence to diabetes guidelines by all groups of physicians (supplemental appendix 3). The majority of physicians in different level hospitals hold the opinion that "Guidelines can standardize clinical behavior and improve medical quality" (TCPs (96.10%), SCPs (97.07%) and PCPs (93.98%). Similarly, this facilitating factor reported by endocrinologists, general practitioners and other physicians were 97.45%, 95.82% and 93.28% respectively. About 80% physicians in all groups chose the option of "Diabetes guidelines can guide patients in self-care and nursing" is the facilitating factor. Besides, the selection trend for the option of "Guidelines have a high level of evidence and is convincing" among all physicians in different level hospitals is statistically significant. In other words, the results suggested that PCPs (46.07%) paid less attention to the evidence level of guidelines, compared with TCPs (71.80%) and SCPs (67.43%).

As for barriers to guideline implementation, the majority of physicians in different level hospitals (TCPs 68.76%, SCPs 68.73% and PCPs 61.52%) listed "there are fewer TCM diabetes guidelines, and it is difficult to access" as a major barrier to TCM diabetes guidelines implementation. In addition, PCPs (65.45%), SCPs (59.93%) and TCPs (52.49%) chose "It takes a lot of time to communicate with patients" as the second common barrier to guideline implementation. Endocrinologists, general practitioners and other physicians also hold similar attitudes towards the above two barriers.

4. DISCUSSION

This national survey of 1150 physicians examined the physicians' awareness and adherence to four different diabetes guidelines. Our results provide information on physicians' familiarity to the diabetes guidelines, and also provide real-world evidence on their awareness and practice toward relevant content in these guidelines as well as the facilitating factors and barriers in guideline implementation.

The main finding of this study is that the level of familiarity and adherence to the diabetes guidelines

varied with different clinician titles and specialties. Overall, the TCPs and endocrinologists had the highest familiarity and adherence to the four diabetes guidelines, followed by SCPs and PCPs. These differences may be attributed to additional training in diabetes management for the TCPs / endocrinologists than PCPs^[18]. In particular, the results suggested that the PCPs' familiarity and adherence to all the four guidelines is relatively poor and need to be improved, especially to the T2DM guideline issued by CDS which is essential for guiding clinical practice in China^[19]. Moreover, when evaluating physicians' self-reported familiarity and adherence to different diabetes guidelines, we found that there was a significant discrepancy between western medicine guidelines and TCM guidelines. Indeed, physicians' reference rate for western medical guidelines was twice of that for TCM guidelines. These differences may arise from several factors, including the relatively late establishment of TCM diabetes guidelines, the complicate characteristics of the TCM syndrome differentiation, and high degree of relies on their clinical experience during treatment by most TCM physicians^[20, 21]. Therefore, it is necessary to conduct studies focusing on the TCM diabetes guidelines in the future.

It is well known that T2DM is a complex chronic disease, treatment of which should be managed through multiple interventions. For the treatment of diabetes, in addition to the medication treatment, SMBG, diet management, increasing physical activity, and health education management are all essential components^[22]. These management measurements were emphasized in each diabetes guideline and were known by many physicians as "five carriages" management in China^[15]. In our survey, physicians' awareness and practice of content from diabetes guidelines were designed based on "five carriages" management.

In terms of dietary management for diabetes, the result showed that less than one-third of physicians (30.26%) choose "Hand over to a special nutritionist or professional nutrition team". In addition, the results suggested that more than half (54.03%) of PCPs "only give medical advice of paying attention to diet simply to patients due to the limited time". However, "Patients with T2DM or pre-diabetes need to receive individualized medical nutrition guidance, which should be performed under the guidance of nutritionists (physicians) or comprehensive management teams (including diabetes educators) familiar with the nutritional treatment for

1 diabetes” in the guidelines was a strong recommendation^[13]. Therefore, it is necessary to train and guide PCPs
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3 in dietary management for diabetes.
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5 For the physical exercise guidance for diabetes, most physicians have chosen the "Personally evaluate the
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7 athletic ability of patients and give detailed physical exercise suggestions", and more than 40% of physicians
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9 reported that they would recommend patients to adopt TCM-related exercise methods such as Tai Chi and
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11 Baduanjin. But surprisingly, we found that more than a third of the physicians from different level hospitals
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13 have chosen "increase exercise and improve physical fitness for those with frequent hypoglycemia". It's well
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15 known that exercise is forbidden for diabetics in the case of severe hypoglycemia, the physical exercise can
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17 only be gradually adopted after hypoglycemia is controlled and stabilized^[14, 23]. These data suggested that there
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19 is a big gap between clinical practice and guidelines, a previous study conducted by Johanna Fürthauer in
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21 Austria also reported similar results^[24].
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28 As for SMBG instruction and health education management, our survey showed that the majority of
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30 physicians have instructed patients to conduct SMBG and reported that they were equipped with diabetes health
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32 management team, which is comparatively ideal. However, the result varied among physicians in different
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34 hospitals or specialties. Additionally, regarding the knowledge identification for hypoglycemia and TCM
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36 differentiation treatment, the result of this survey suggested that some physicians may not master the guideline
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38 contents well enough, particularly about 40% of physicians' judgment on hypoglycemia is inaccurate or
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40 omitted. Therefore, continuing education and training for physicians in all levels of hospitals are needed and it
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42 will help improve the management of diabetes in China^[19].
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49 Regarding the facilitating factors to diabetes guidelines' implementation, most physicians hold the opinion
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51 that “Guidelines can standardize clinical behavior and improve medical quality” is one of the main facilitating
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53 factors according to our survey results, which indicated that the significance of guidelines is recognized by
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55 majority of physicians^[25]. Other facilitating factors of adherence to diabetes guidelines selected by all groups of
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57 physicians included guiding patients in self-care and nursing, and having a high level of evidence, etc.
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1 Although our study reveals important insights regarding facilitating factors in the implementation of guidelines,
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3 some barriers to guideline implementation must be considered. The result indicated that a major barrier to the
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5 implementation of TCM diabetes guidelines is that “There are fewer TCM diabetes guidelines, and it is difficult
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7 to access”. Indeed, a previous study illustrated that the establishment of TCM guidelines is relatively late, to
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9 date, there is no TCM practice guideline specifically applicable to the management of diabetes for primary
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11 healthcare and further researches focusing on the TCM diabetes guidelines are expected^[20], and it is essential to
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13 publish these guidelines on multiple platforms even free platforms so that all physicians can download and
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15 study these guidelines.
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20 21 **Strengths and limitations**

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23 This study has several strengths. Firstly, this nationally representative questionnaire survey provided
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25 reliable data on the physicians’ awareness and adherence to several Chinese and international diabetes
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27 guidelines. Our analysis sample covered 192 cities in 30 provinces in China including physicians located in
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29 different medical institutions and departments, which are highly representative. Secondly, we conducted a
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31 stratified analysis of the survey samples to obtain more specific and sufficient results, including the
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33 stratification of physicians in different medical institutions and physicians in different departments. Thirdly, in
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35 addition to the self-reported awareness and adherence questionnaire items, we also designed a broad range of
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37 specific questions that included multiple key recommendations within the current guidelines, including SMBG,
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39 dietary guidance, physical exercise guidance, diabetes health education management, hypoglycemia, and TCM
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41 syndrome differentiation to evaluate the physicians’ awareness to contents in the guidelines. Our findings could
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43 provide the latest evidence for future studies of diabetes guidelines in China.
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52 Our study also has some limitations. Firstly, although the sample is representative of Chinese medical
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54 physicians and a substantial number of physicians participated (>1000), the findings cannot be automatically
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56 applied to other countries. Secondly, we have not examined whether awareness of physicians, adoption of
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58 physicians, and barriers to treatment varied in age, gender, education, or number of diabetic patients received
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1 by the physician per week. A further analysis focusing on the influencing factor of physicians' compliance with
2 diabetes guidelines will be carried out in future research. Finally, although we have designed some
3 multiple-choice questions to investigate more information, the survey questionnaire has not been generalizable
4 to the physicians' awareness of all specific contents of the diabetes guidelines.
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10 **5. CONCLUSION**

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13 In conclusion, the level of familiarity and adherence to the screening guidelines varied among physicians
14 with different clinician titles and specialties. Overall, the TCPs and endocrinologists had the highest familiarity
15 and adherence to diabetes guidelines. The PCPs' familiarity and adherence to all the four guidelines is relatively
16 poor and need to be improved. In addition, there is a gap between clinical practice and guidelines in terms of
17 physicians' self-reported adherence and practice of diabetes guidelines. Therefore, continuing education and
18 training for physicians in all levels of hospitals, especially for PCPs are essential. Of note, there was a
19 significant discrepancy between western medicine guidelines and TCM guidelines, and further studies focusing
20 on the TCM diabetes guidelines are needed.
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35 Association of Chinese Medicine, majority of physicians as members of the Specialist Committee for Primary
36 Diabetes Care have participated in the survey questionnaire. We would like to express our gratitude to all the
37 participating physicians.
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44 **Contributors** Li-yan Jia, Shu-yu Yang designed the research and took full responsibility for the work as a
45 whole. Li-yan Jia designed the survey questionnaire, Neng-jiang Zhao, Shun-qin Wang, Bing Yan, Jian-ping
46 Liu were all involved in critically revising the questionnaire and provided valuable advice for designing the
47 study. Neng-jiang Zhao, Zhi-hai Zhang, Le Li, Na Zhan, Yuan-bing Lin, Miao-na Cai, participated in
48 questionnaire distribution and collection. Na Zhan, Yuan-bing Lin participated in questionnaire data checking.
49 Li-yan Jia analyzed and interpreted the data, and wrote the paper. Bao-yong Lai, Cao-xin Huang, Jian-ping Liu,
50 Shu-yu Yang contributed to critically revising the manuscript.
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Conflict of interest

All authors declare that they have no conflicts of interest.

Ethics approval The study was provided expedited review and approval by the medical ethics committee of the First Affiliated Hospital of Xiamen University.

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Figure legends

Figure1. Physicians' familiarity with four diabetes guidelines (the CDS T2DM guideline, the CDS national primary care diabetes guideline, the CACM TCM diabetes guideline, the ADA diabetes guideline). (A) Analysis based on the groups of physicians in different level hospitals. (B) Additional analysis based on the

1 groups of physicians in different professional physicians. *Note.* ADA, the American Diabetes Association;
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3 CDS, the Chinese Diabetes Society; TCM, traditional Chinese medicine; CACM, the China Association of
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5 Chinese Medicine.
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8 **Supporting information**

10 Appendix1. Physicians demographic and profession characteristics

12 Appendix2. Recommendations excerpted from the diabetes guidelines

14 Appendix3. Facilitating factors and barriers to diabetes guideline implementation

16 Appendix4. Original drawing of Figure 1

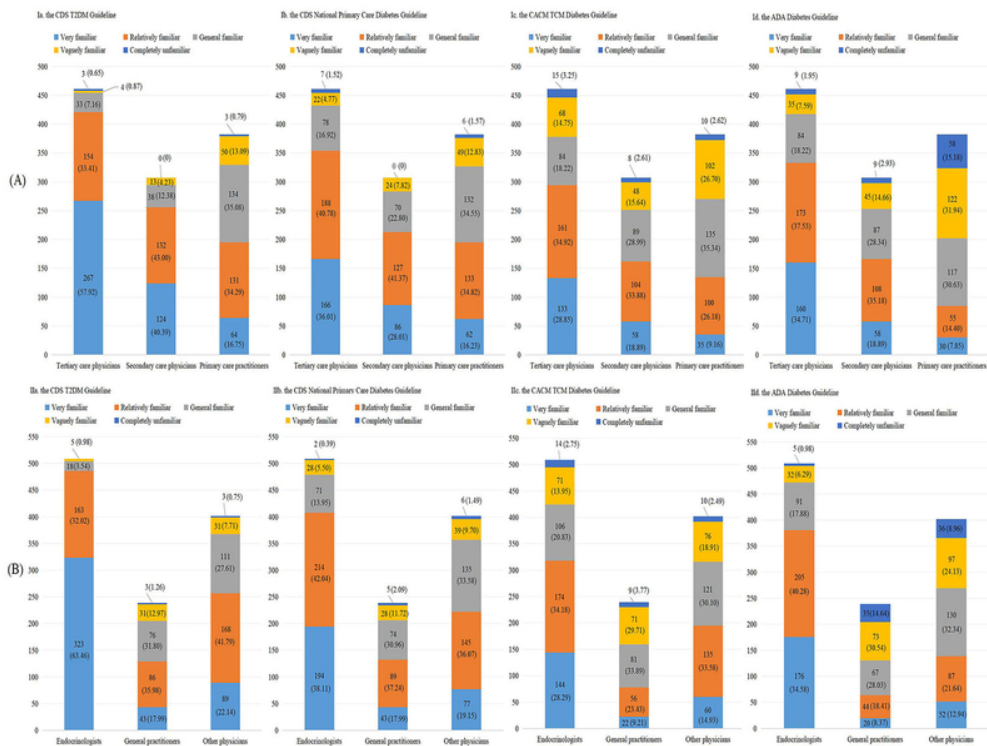


Figure 1. Physicians' familiarity with four diabetes guidelines

67x50mm (300 x 300 DPI)

Appendix 1. Physicians demographic and profession characteristics [n(%)]

Variable	Physicians in different level hospitals			P-value
	Tertiary care physicians (n = 461)	Secondary care physicians (n = 307)	Primary care practitioners (n = 382)	
Age (mean years \pm s.d.)	40.82 \pm 9.21	40.42 \pm 8.78	41.27 \pm 8.13	0.215
Male gender	189 (41.00)	158 (51.47)	209 (54.71)	< 0.001
Education level				< 0.001
Technical secondary and below	0 (0)	1 (0.33)	35 (9.16)	
College degree	7 (1.52)	17 (5.54)	107 (28.01)	
Bachelor degree	169 (36.66)	231 (75.24)	213 (55.76)	
Master degree	222 (48.16)	58 (18.89)	26 (6.81)	
Doctoral degree	63 (13.67)	0 (0)	1 (0.26)	
Professional category				< 0.001
TCM	135 (29.28)	76 (24.76)	88 (23.04)	
Integrated TCM and WM	137 (29.72)	89 (28.99)	81 (21.20)	
Modern clinical medicine	188 (40.78)	140 (45.60)	200 (52.36)	
Other categories	1 (0.22)	2 (0.65)	13 (3.40)	
Years in practice (mean years \pm s.d.)	15.50 \pm 9.82	15.12 \pm 9.00	17.30 \pm 9.05	0.001
Technical title				< 0.001
Junior (Resident physicians)	71 (15.40)	53 (17.26)	170 (44.50)	
Intermediate (Attending physicians)	131 (28.42)	121 (39.41)	137 (35.86)	
Sub-senior (Associate chief physicians)	138 (29.93)	92 (29.97)	67 (17.54)	
Senior (Chief physicians)	121 (26.25)	41 (13.36)	8 (2.09)	
Diabetes practice setting				< 0.001
Department of endocrinology and diabetes	327 (70.93)	171 (55.70)	11 (2.88)	
Department of general practice	14 (3.04)	13 (4.23)	212 (55.50)	
Other departments	120 (26.03)	123 (40.07)	159 (41.63)	
Number of DM patients (per week)				< 0.001
None	4 (0.87)	2 (0.65)	9 (2.36)	
1 ~ 10	99 (21.48)	75 (24.43)	163 (42.67)	
11 ~ 50	133 (28.85)	120 (39.09)	150 (39.27)	
51 ~ 100	115 (24.95)	60 (19.54)	44 (11.52)	
101 ~ 300	98 (21.26)	36 (11.73)	15 (3.93)	
\geq 301	12 (2.6)	14 (4.56)	1 (0.26)	

Note. TCM, traditional Chinese medicine; WM, western medicine; DM, diabetes mellitus.

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- ①Physical exercise intervention should be carried out under the guidance of relevant professionals. Recommendation
- ②Necessary health evaluation and exercise ability evaluation should be evaluated to ensure the safety and rationality of exercise therapy. Recommendation
- ③Physical exercise should be forbidden under severe hypoglycemia, which can be gradually resumed after the condition is controlled and stabilized. Recommendation
- ①Hypoglycemia classification
Grade 1 hypoglycemia: $3.0 \text{ mmol/l} \leq \text{Blood glucose} < 3.9 \text{ mmol/l}$; Grade 2 hypoglycemia: $\text{Blood glucose} < 3.0 \text{ mmol/l}$; Grade 3 hypoglycemia: Hypoglycemia with no specific blood glucose limit, accompanied by serious events of consciousness and / or physical changes, and requiring help from others. Recommendation
- ②The clinical manifestations of hypoglycemia are related to the level of blood glucose and the decline rate of blood glucose, it can be manifested as sympathetic excitement (such as palpitations, anxiety, sweating, dizziness, handshaking, hunger sensation, etc.) and central nervous symptoms (such as mental changes, cognitive impairment, convulsions, and coma). Recommendation
- ①The treatment of Qi-Yin deficiency syndrome in type 2 diabetes, Jinlida granule and Shenqi Jiangtang granule can be combined use with routine treatment. Recommendation
- ②Shengmai Powder adds or subtraction can be used to alleviate the symptoms of fatigue and Qi-Yin deficiency syndrome in patients with diabetes. Recommendation
3. Physical exercise management
4. Hypoglycemia
5. Diabetes with Qi-Yin deficiency syndrome

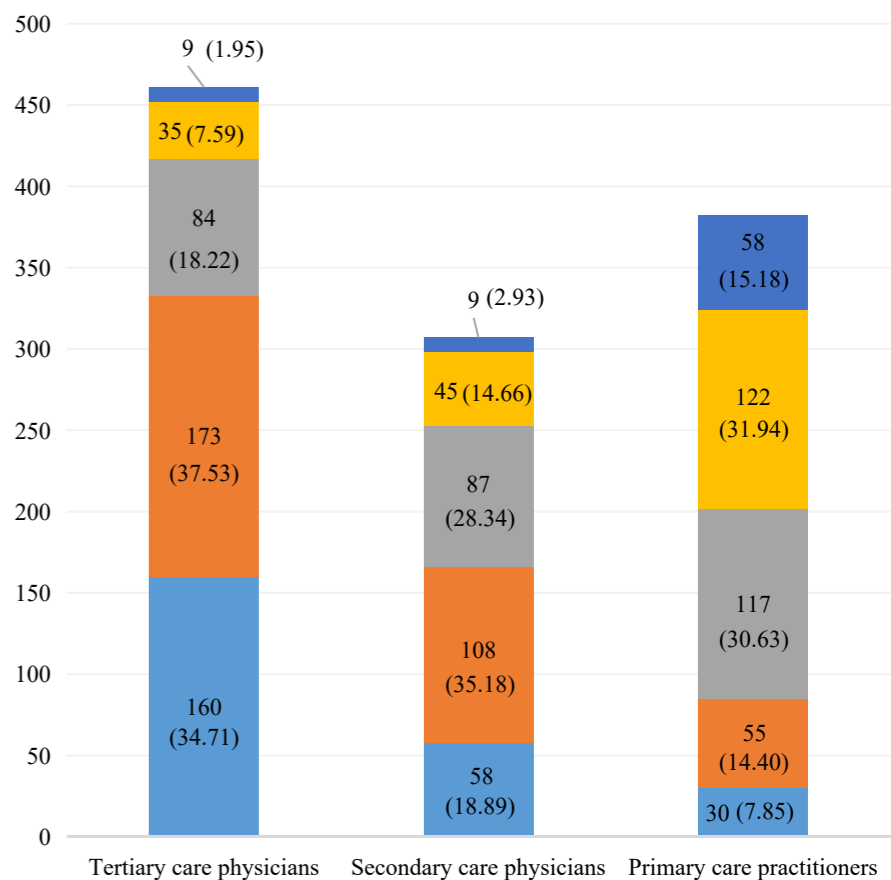
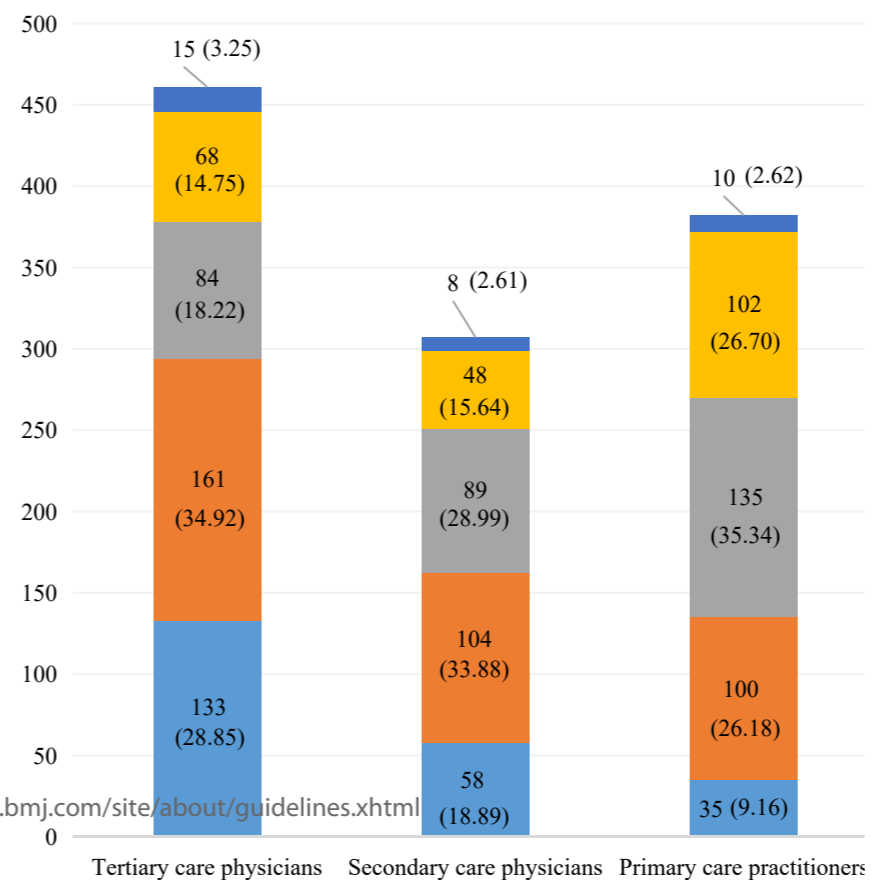
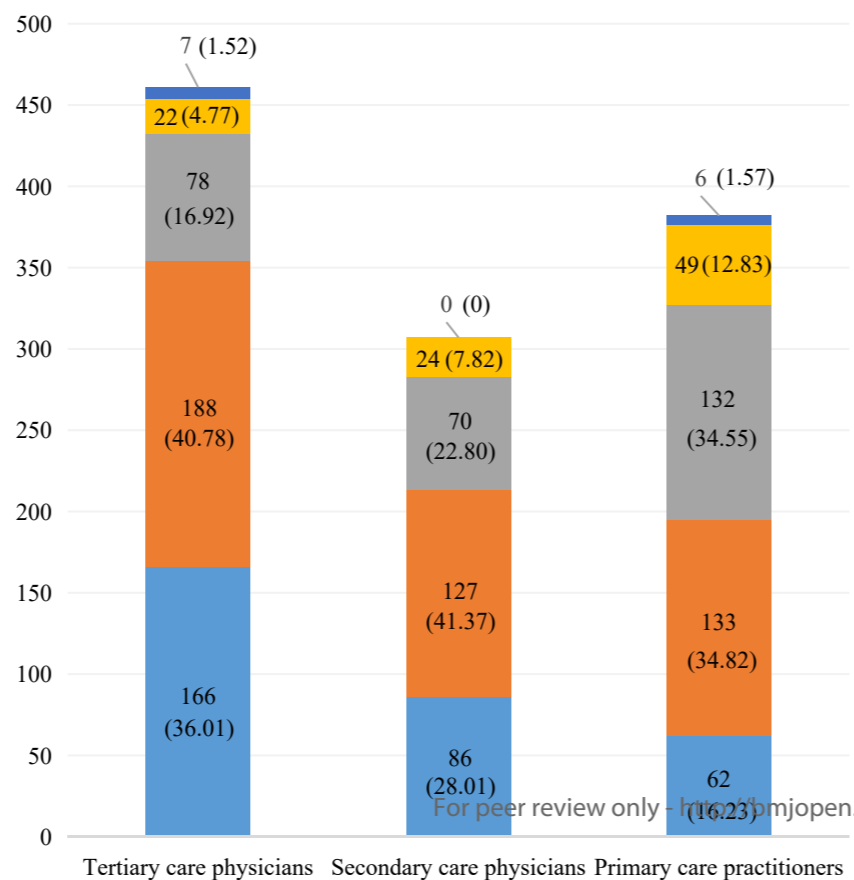
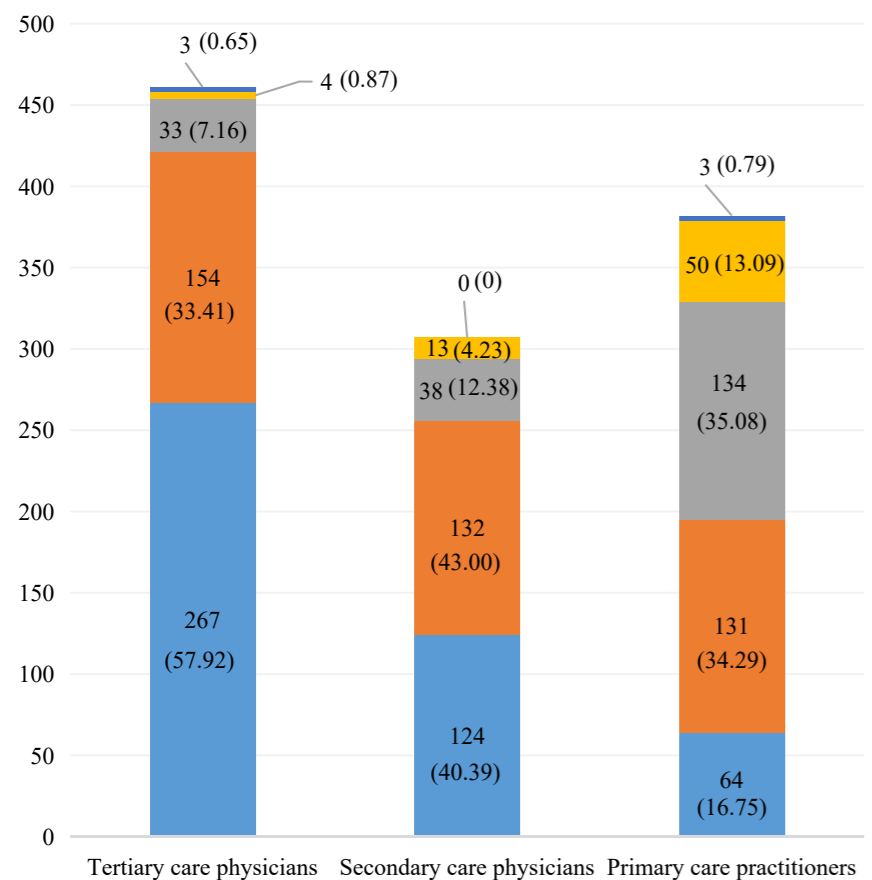
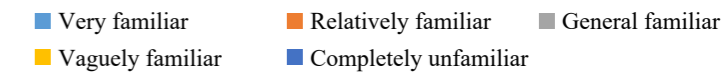
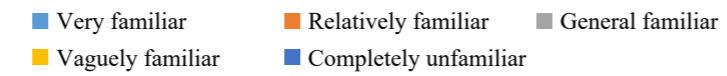
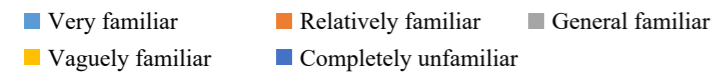
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4 ③For the early and middle stages of type 2 diabetes,
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6 Gegen Qinlian decoction can be taken orally for
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8 intestinal-damp-heat syndrome; Dachaihu Decoction Recommendation
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10 can be taken orally for the stagnated-heat in liver and
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12 stomach syndrome.

13 6. Diabetic ①For diabetic neuropathy patients with
14 neuropathy with Qi-deficiency and collateral-obstruction syndrome,
15 Qi-deficiency and Mudan granule can be taken orally, combined with Recommendation
16 collateral-obstruction syndrome
17 acupuncture and fumigation to improve symptoms.
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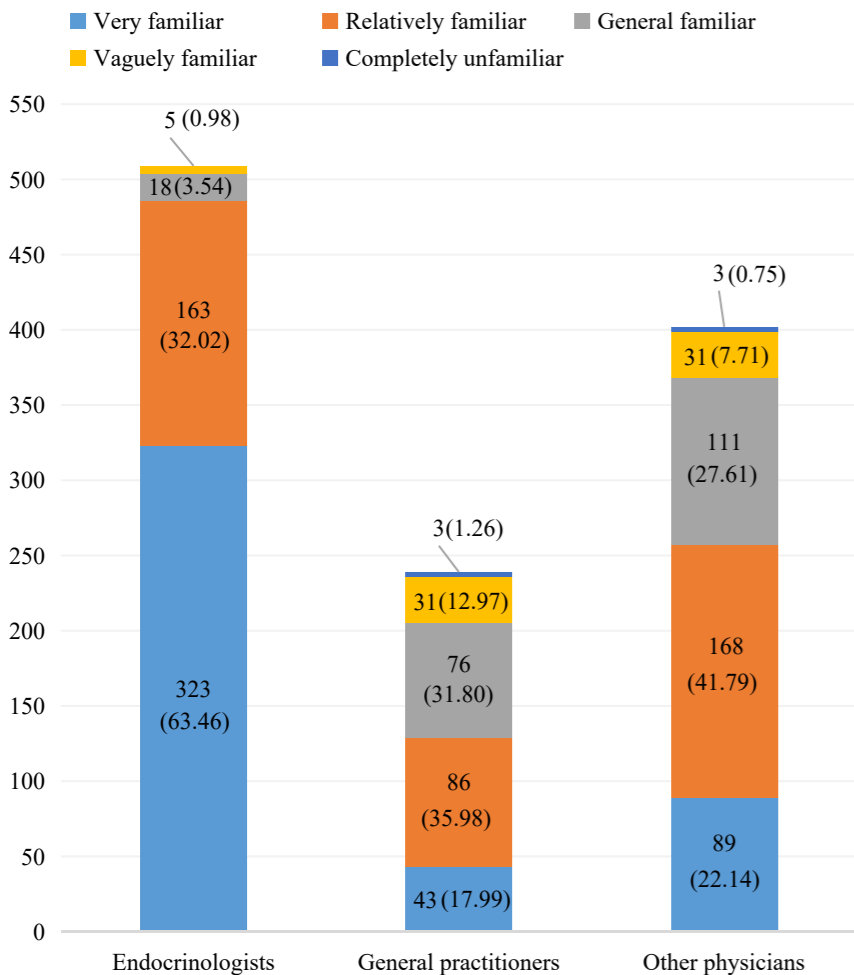
Appendix3. Facilitating factors and barriers to diabetes guideline implementation [n(%)]

Categories	Overall (n = 1150)	Physicians in different level hospitals			<i>P</i> -value	Physicians in different departments			<i>P</i> -value
		Tertiary care physicians (n = 461)	Secondary care physicians (n = 307)	Primary care practitioners (n = 382)		Endocrinologists (n = 509)	General practitioners (n = 239)	Other physicians (n = 402)	
Facilitating factors									
The guideline can standardize clinical behavior and improve medical quality	1100 (95.65)	443 (96.10)	298 (97.07)	359 (93.98)	0.118	496 (97.45)	229 (95.82)	375 (93.28)	0.009
Guide patients in self-care and nursing	907 (78.87)	359 (77.87)	247 (80.46)	301 (78.80)	0.691	398 (78.19)	186 (77.82)	323 (80.35)	0.662
The guideline has a high level of evidence and is convincing	714 (62.09)	331 (71.80)*	207 (67.43)*	176 (46.07)*	< 0.001	369 (72.50)	115 (48.12)	230 (57.21)	< 0.001
The format of the guidelines is standardized and easy for reading	657 (57.13)	273 (59.22)*	190 (61.89)*	194 (50.79)*	0.007	306 (60.12)	124 (51.88)	227 (56.47)	0.100
The guideline can facilitate communication with patients	686 (59.65)	260 (56.40)*	201 (65.47)*	225 (58.90)*	0.040	301 (59.14)	143 (59.83)	242 (60.20)	0.947
Reduce medical costs	627 (54.52)	266 (57.70)	169 (55.05)	192 (50.26)	0.095	282 (55.40)	113 (47.28)	232 (57.71)	0.032
Barriers									
Restricted the autonomy of doctors	376 (32.70)	155 (33.62)	96 (31.27)	125 (32.72)	0.793	163 (32.02)	79 (33.05)	134 (33.33)	0.908
It takes a lot of time to communicate with patients	676 (58.78)	242 (52.49)*	184 (59.93)*	250 (65.45)*	0.001	287 (56.39)	153 (64.02)	236 (58.71)	0.141
It will cause physicians should take more responsibility for medical malpractice	239 (20.78)	81 (17.57)	69 (22.48)	89 (23.30)	0.087	88 (17.29)	51 (21.34)	100 (24.88)	0.019
There are fewer TCM diabetes guidelines, and it is difficult to access	763 (66.35)	317 (68.76)	211 (68.73)	235 (61.52)	0.0504	342 (67.19)	152 (63.60)	269 (66.92)	0.598
The guideline unable to be downloaded for reading	353 (30.70)	153 (33.19)	99 (32.25)	101 (26.44)	0.084	163 (32.02)	65 (27.20)	125 (31.09)	0.401
The guideline recommendation lacks basis and can not be convincing	276 (24.00)	135 (29.28)*	70 (22.80)*	71 (18.59)*	0.001	141 (27.70)	51 (21.34)	84 (20.90)	0.032

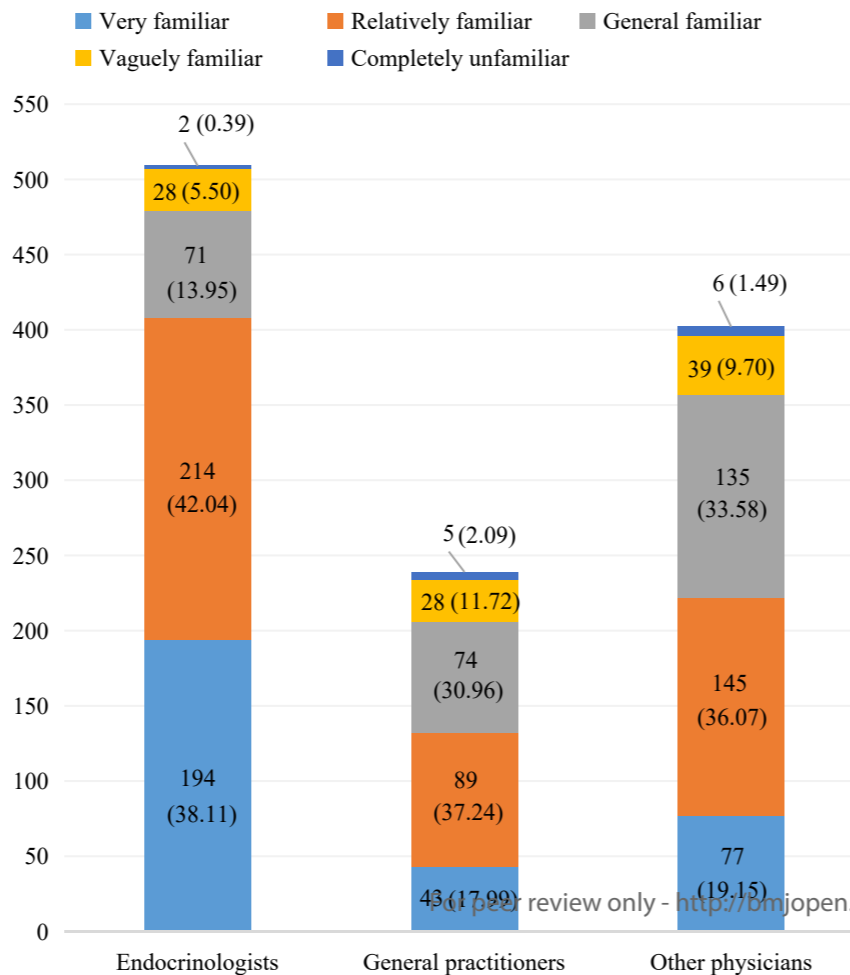
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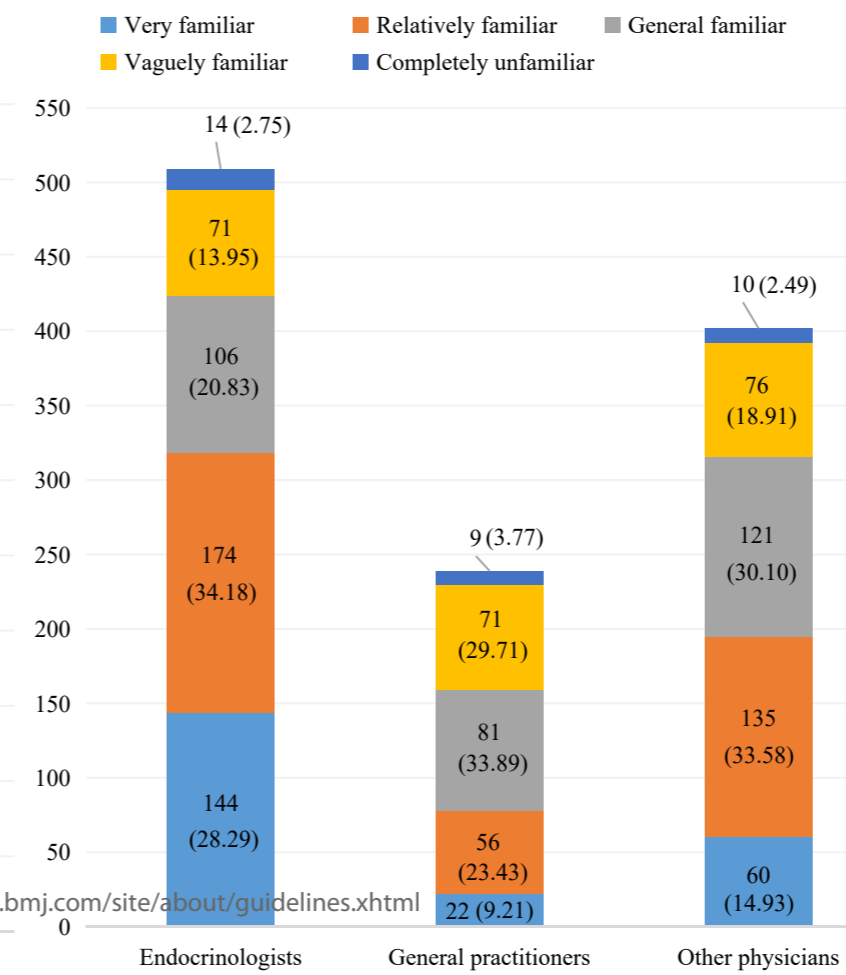
Iia. the CDS T2DM Guideline



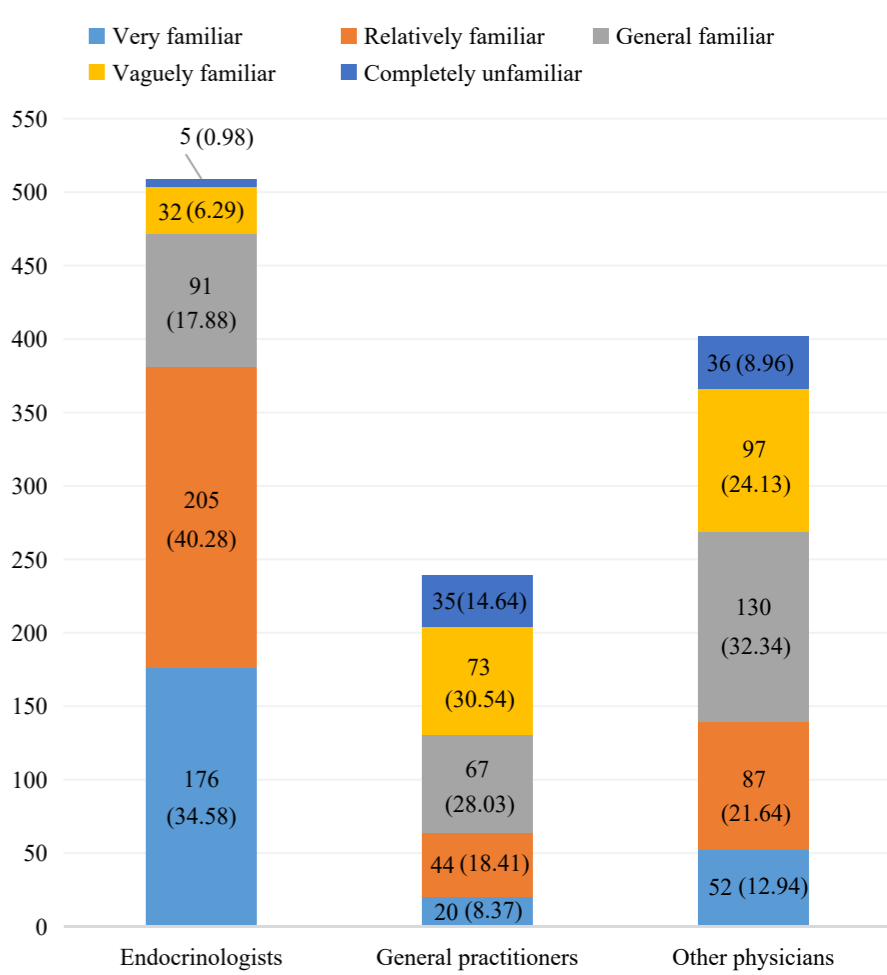
Iib. the CDS National Primary Care Diabetes Guideline



Iic. the CACM TCM Diabetes Guideline



Iid. the ADA Diabetes Guideline



BMJ Open

Nationwide Survey of Physicians' Familiarity and Awareness of Diabetes Guidelines in China: A Cross-sectional Study

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Nationwide Survey of Physicians' Familiarity and Awareness of Diabetes Guidelines in China: A

Cross-sectional Study

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ABSTRACT

Objective: To investigate physicians' familiarity and awareness of four diabetes guidelines, and their practice of the recommendations outlined in these guidelines.

Design: A cross-sectional study.

Setting: An online questionnaire survey was conducted among physicians affiliated with the Specialist Committee for Primary Diabetes Care of China Association of Chinese Medicine, using the snowball sampling method to ensure a broader representation of physicians.

Participants: 1150 physicians from 192 cities across 30 provinces in China provided complete data.

Results: Tertiary care hospital physicians (TCPs) exhibited the highest familiarity with the *Guideline for the Prevention and Treatment of Type 2 Diabetes Mellitus in China* (91.3%), followed by the *National Guidelines for the Prevention and Control of Diabetes in Primary Care* (76.8%), the *Standards of Medical Care in Diabetes* (72.2%) and the *Guidelines for Prevention and Treatment of Diabetes in Chinese Medicine* (63.8%). Primary care practitioners (PCPs) exhibited familiarity with these four guidelines at about 50% or less. Self-reported reference to modern diabetes guidelines by physicians more frequent than traditional Chinese medicine (TCM) diabetes guidelines, with rates at 73.2% and 33.8%, respectively. Approximately 90% of physicians provided instructions on self-monitoring of blood glucose to their patients with diabetes. Less than one-third of physicians referred patients to a specialized nutritionist. In terms of health education management, TCPs reported having a diabetes health management team at the rate of 75.7%, followed by secondary care hospital physicians (SCPs) at 57.0% and PCPs at 27.5%. Furthermore, approximately 40% of physicians did not fully grasp hypoglycemia characteristics.

Conclusions: Familiarity and awareness of the screening guidelines varied among physicians in different hospital settings. Importantly, significant discrepancies were observed between physicians' awareness and their self-reported reference to modern medicine guidelines and TCM guidelines. It is essential to consistently provide education and training on diabetes management for all physicians, particularly PCPs.

KEY WORDS: Diabetes Mellitus; Guidelines; Physician Awareness

Strengths and limitations of this study

1 This nationwide questionnaire survey involved 1150 physicians from hospitals of different levels in China, aiming
2 to analyze the differences in familiarity and awareness of both Chinese and international diabetes guidelines
3 among different physician groups. The results provided nationally representative evidence regarding physicians'
4 familiarity and awareness of these guidelines.
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10 Apart from the self-reported familiarity and reference questionnaire items, our study also identified several
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13 facilitating factors and barriers to the implementation of diabetes guidelines in different physician groups.
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15 Although we have included multiple-choice questions to gather more comprehensive information, we acknowledge
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18 that the survey questionnaire may not cover all specific aspects related to physicians' awareness of the diabetes
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21 guidelines.
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23 1. INTRODUCTION

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26 Diabetes is a metabolic disorder caused by the interplay of genetic and environmental factors, which has
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28 become a critical global health concern worldwide due to its high prevalence and associated disability and
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30 mortality rates [1,2]. According to the latest data published by International Diabetes Federation (IDF), an
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32 estimated 537 million adults worldwide have been diagnosed with diabetes [3]. China currently bears the
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34 highest burden of diabetes globally, with approximately 141 million individuals living with the disease aged
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36 between 20 and 79 years. Moreover, it is predicted that the number of diabetes cases in China will continue to
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38 grow significantly [4]. However, recent national data on chronic diseases and their risk factors in China indicate
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41 that awareness, treatment, and control rates for diabetes were 36.7%, 32.9%, and 50.1%, respectively, which
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44 have not changed significantly since 2013[5,6]. Therefore, addressing this substantial public health issue is
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47 crucial, with the objective of enhancing the national diabetes awareness rate, treatment rate, and control rate.
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52 Clinical practice guidelines (CPGs) are statements that facilitate optimal disease management for health
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54 professionals and patients. However, to ensure effective implementation and adherence to guidelines, it is
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57 crucial to enhance health professionals' familiarity and awareness of CPGs [7]. Previous studies have
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60 emphasized the significance of physician awareness in the successful adoption of cardiovascular disease

1 prevention guidelines, asthma guidelines, chronic kidney disease guidelines, etc [8-10]. A systematic review
2 identified lack of physician awareness and familiarity with guidelines as the primary factors contributing to
3 deviation from recommended therapy [11]. Notably, a cross-sectional study highlighted that physicians' lack of
4 knowledge and patients' unawareness of guidelines could account for about 70% of non-adherence [12].
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6 Therefore, emphasizing physicians' familiarity and awareness of clinical guidelines is essential for optimizing
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8 patient management.

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16 Modern medicine plays a crucial role in preventing and treating diabetes, meanwhile, traditional Chinese
17 medicine (TCM) is increasingly used for the treatment of diabetes in China. Some clinical trials have been
18 conducted to investigate the beneficial effect of TCM as adjunctive treatment for diabetes, such as reducing
19 blood sugar, alleviating symptoms, preventing complications, improving quality of life, and promoting tertiary
20 prevention. Additionally, to effectively enhance the prevention and standardized management of diabetes
21 mellitus, a series of clinical guideline documents have been released both domestically and internationally.
22
23 Including annually updated *Standards of Medical Care in Diabetes* issued by the American Diabetes
24 Association (ADA) [13], the *Guideline for the Prevention and Treatment of Type 2 Diabetes Mellitus (T2DM)*
25 *in China* and the *National Guidelines for the Prevention and Control of Diabetes in Primary Care* issued by
26 Chinese Diabetes Society (CDS), which are updated on average every 3 years [14,15], and the *Guidelines for*
27 *Prevention and Treatment of Diabetes in Chinese Medicine* issued by China Association of Chinese Medicine
28 (CACM) [16]. The recommendations for the treatment of diabetes by western medicine and TCM mainly refer
29 to these guidelines. Therefore, four guidelines mentioned above are considered as the screening guidelines
30 investigated in this study.

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52 To provide nationally representative evidence regarding the familiarity and awareness of physicians with
53 diabetes guidelines in China, we conducted a nationwide survey to compare physicians' awareness,
54 self-reported reference status and practice of different diabetes guidelines. Additionally, we examined the
55 differences among physicians from hospitals at different levels. Furthermore, the facilitating factors and
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1 barriers to implementation of diabetes guidelines in different physician groups were identified in this study.

2 3 **2. RESEARCH DESIGN AND METHODS**

4 5 **2.1 Survey design**

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8 This is an investigator-initiated, non-commercial survey of physicians at various levels of hospitals in
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10 China. This work was conducted by the Specialist Committee for Primary Diabetes Care of China Association
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12 of Chinese Medicine, a national academic institution. A majority of physicians who are members of the
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14 Specialist Committee participated in the survey questionnaire. The questionnaire was distributed electronically
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16 to the participants, and electronic written informed consent from respondents was required before proceeding
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18 with the survey. Additionally, participants were requested to assist in forwarding the questionnaire to other
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20 general practitioners, physicians, and experts using the snowball sampling method. In the overall design of this
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22 survey, we aimed to ensure broader representation of respondents by recruiting physicians from different grades
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24 of hospitals in China, including tertiary to primary medical institutions. Additionally, the endocrinology
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26 diabetes specialists, general practitioners, and TCM physicians were mainly recruited.
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33 34 **2.2 Questionnaire and pretest**

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36 A questionnaire comprising four sections was established with a total of 42 items. Section I assessed
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38 participants' clinical background and basic demographic data. Section II evaluated participants' familiarity with
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40 and self-reported reference status regarding various diabetes guidelines, presented as single-choice questions in
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42 the form of Likert scales. Section III examined participants' awareness and practice of specific measures
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44 outlined in diabetes guidelines, accompanied by a list of guideline-based recommendations provided in
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46 Appendix 1. The guideline action statements were rephrased as options in both single-choice and
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48 multiple-choice formats, enabling respondents to choose the most appropriate answers. Lastly, section IV
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50 investigated the facilitating factors and barriers during the process of guideline implementation.
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57 The questionnaire underwent a pilot test involving 24 physicians from Fujian and Gansu provinces in
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59 China from Aug 20, 2021 to Aug 27, 2021. Additionally, experts familiar with these diabetes guidelines were
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invited to evaluate the contents of the questionnaire. Subsequently, the questionnaire was optimized based on feedback received during the pilot survey and expert consultation meeting.

2.3 Sample and administration

The sample size calculation was completed in accordance with the cross-sectional survey formula $N = (Z_{\alpha}^2 * pq) / (d^2)$ [17]. According to a literature search, the estimated value of p is 26.2% (the projected rate of Chinese physicians being very familiar with the diabetes guidelines), $q=1-p$, and $d=0.1*p$. Assuming a 5% two-tailed type-I error ($Z_{\alpha} = 1.96$) and a two-sided 95% confidence level, the estimated result of N was 1082. The investigation was performed from Sep 22, 2021 to Oct 29, 2021, a total of 1 162 participants completed the survey. The logical discrepancies or potential errors found in the questionnaires were resolved through telephone communication with the respondents.

2.4 Statistical analysis

Statistics analysis was performed using SAS Version 9.4. Continuous variables were presented as means with \pm SDs, and categorical variables as counts (n) and percentages (%). Pearson's Chi-square test was used to compare categorical variables, and the Wilcoxon rank-sum test was used for non-parametric numerical variables. Moreover, the Cochran-Mantel-Haenszel (CMH) test was used for ordinal categorical variables. Differences in guidelines familiarity and awareness among different physician groups, including tertiary care hospital physicians (TCPs), secondary care hospital physicians (SCPs), and primary care practitioners (PCPs), were analyzed. In this study, the percentage differences among groups were reported, with statistically significant differences indicated by P -value < 0.05 .

2.5 Patient and Public Involvement

Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of our research.

3. RESULTS

3.1 Sample characteristics

1 A total of 1,162 questionnaires were collected. Among these, we finally included 1,150 questionnaires
2 (99.0%) from physicians after excluding 12 questionnaires (7 from nurses, 2 from pharmacists, and 3 from
3 medical teachers). Among the included questionnaires, 461 (40.1%) were obtained from TCPs, 307 (26.7%)
4 were obtained from SCPs, and 382 (33.2%) were obtained from PCPs. There were significant differences
5 among the three groups of physicians in terms of gender, educational level, professional category, years in
6 practice, technical title, diabetes practice setting and number of patients with diabetes treated per week ($P <$
7 0.05). The full characteristics of the physicians are presented in Supplemental Appendix1.
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10 3.2 Physicians' familiarity with diabetes guidelines

11 Physicians' familiarity with diabetes guidelines is demonstrated in Figure1. In the overall sample, the
12 rankings of familiarity (including both very familiar and relatively familiar) with the four guidelines were as
13 follows: *Guideline for the Prevention and Treatment of Type 2 Diabetes Mellitus in China* (75.8%), *National*
14 *Guidelines for the Prevention and Control of Diabetes in Primary Care* (66.3%), *Guidelines for Prevention and*
15 *Treatment of Diabetes in Chinese Medicine* (51.4%), and *Standards of Medical Care in Diabetes* (50.8%).
16 TCPs exhibited a higher likelihood of familiarity with these four guidelines compared to other groups.
17 Particularly, TCPs demonstrated the highest familiarity with the *Guideline for the Prevention and Treatment of*
18 *Type 2 Diabetes Mellitus in China* (91.3%), followed by SCPs (83.4%), and PCPs (51.0%) ($P < 0.001$).
19 Similarly, TCPs exhibited a higher level of familiarity (76.8%) with the *National Guidelines for the Prevention*
20 *and Control of Diabetes in Primary Care* compared to SCPs (69.4%) and PCPs (51.1%) ($P < 0.001$). In terms
21 of the *Guidelines for Prevention and Treatment of Diabetes in Chinese Medicine*, TCPs exhibited the highest
22 level of familiarity (72.2%), followed by SCPs (52.8%), and PCPs (35.3%) ($P < 0.001$). Lastly, various degrees
23 of familiarities with the *Standards of Medical Care in Diabetes* were observed among TCPs (63.8%), SCPs
24 (54.1%), and PCPs (22.3%) ($P < 0.001$).
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59 Insert "Figure1. Familiarity of physicians from different levels of hospitals with four diabetes guidelines (TCPs,
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tertiary care hospital physicians; SCPs, secondary care hospital physicians; PCPs, primary care practitioners)”

3.3 Physicians' self-reported reference status of diabetes guidelines

Physicians' self-reported reference status of diabetes guidelines summarized in Table 1. In terms of modern medicine guidelines, the rates of “frequent reference” were 80.9%, 77.2% and 60.7% for TCPs, SCPs and PCPs, respectively, indicating a stronger compliance in TCPs group ($P < 0.001$). In comparison, the rates of “frequent reference” to TCM guidelines were 36.2% for TCPs, 36.5% for SCPs and 28.8% for PCPs, suggesting that the compliance to TCM guidelines was relatively low across all groups. No significant differences about the compliance to TCM guidelines were observed among these three physicians groups ($P = 0.071$).

Table 1. Physicians' self-reported reference status of diabetes guidelines [n(%)]

Categories		Overall (n = 1150)	Physicians in different level hospitals			P-value
			Tertiary care hospital physicians (n = 461)	Secondary care hospital physicians (n = 307)	Primary care practitioners (n = 382)	
Modern medicine guidelines ^a	Frequent reference	842 (73.2)	373 (80.9)	237 (77.2)	232 (60.7)	< 0.001
	Occasional reference	236 (20.5)	75 (16.3)	59 (19.2)	102 (26.7)	
	Infrequent reference	53 (4.6)	9 (2.0)	8 (2.6)	36 (9.4)	
	Rare reference	17 (1.5)	4 (0.9)	3 (1.0)	10 (2.6)	
	No reference	2 (0.2)	0 (0.0)	0 (0.0)	2 (0.5)	
TCM guidelines ^b	Frequent reference	389 (33.8)	167 (36.2)	112 (36.5)	110 (28.8)	0.071
	Occasional reference	459 (39.9)	182 (39.5)	127 (41.4)	150 (39.3)	
	Infrequent reference	186 (16.2)	66 (14.3)	41 (13.4)	79 (20.7)	
	Rare no reference	89 (7.7)	34 (7.4)	25 (8.1)	30 (7.9)	
	No reference	27 (2.4)	12 (2.6)	2 (0.7)	13 (3.4)	

a. Modern medicine guidelines including *Standards of Medical Care in Diabetes* issued by the American Diabetes Association, *Guideline for the Prevention and Treatment of Type 2 Diabetes Mellitus in China* and *National Guidelines for the Prevention and Control of Diabetes in Primary Care* issued by Chinese Diabetes Society. b. TCM guidelines including *Guidelines for Prevention and Treatment of Diabetes in Chinese Medicine* issued by China Association of Chinese Medicine.

3.4 Physicians' awareness and practice of contents from diabetes guidelines

The objective of this section is to assess physicians' awareness and practice of the recommendations outlined in the diabetes guidelines. These recommendations encompass various aspects, including dietary management, physical exercise, self-monitoring of blood glucose (SMBG), health education, hypoglycemia

knowledge, as well as treatment approaches based on TCM differentiation. Detailed information regarding specific recommendations can be found in supplemental appendix 2.

(1) Management of diet and physical exercise

In terms of dietary management for patients with diabetes, the proportions of TCPs, SCPs and PCPs choosing "Hand over to a specialized nutritionist or comprehensive management team" were 39.5%, 25.7% and 22.8% respectively ($P < 0.001$). In addition, the proportions of TCPs, SCPs and PCPs choosing "Personally evaluate the nutritional status of patients and provide detailed nutritional treatment suggestions and goals" were 61.4%, 61.6% and 44.0% respectively ($P < 0.001$). It is noteworthy that PCPs had the highest proportions (54%) to choose "Due to the limited consultation time, patients are only given basic dietary advice" compared to TCPs (28.0%) and SCPs (24.4%) ($P = 0.018$).

In terms of physical exercise management, the proportions of TCPs, SCPs and PCPs choosing "Hand over to a specialized health manager or professional manager team" were 29.3%, 21.2% and 20.2% respectively ($P = 0.003$). Similarly, the proportions of TCPs, SCPs and PCPs choosing "Personally evaluate the health and athletic ability of patients, then provide detailed exercise recommendations" were 66.6%, 69.7% and 52.9% respectively ($P < 0.001$). Furthermore, regarding the distribution of brochures, the preference ranked from highest to lowest as follows: SCPs (67.8%), PCPs (65.5%), and TCPs (56.0%) ($P = 0.001$). Detailed results are illustrated in Table 2.

Table 2. Physicians' practice of dietary and exercise recommendations according to diabetes guidelines [n(%)]

Categories	Overall (n = 1150)	Physicians in different level hospitals			P-value	
		Tertiary care hospital physicians (n = 461)	Secondary care hospital physicians (n = 307)	Primary care practitioners (n = 382)		
Dietary management	Hand over to a specialized nutritionist or comprehensive management team	348 (30.3)	182 (39.5)	79 (25.7)	87 (22.8)	< 0.001
	Personally evaluate the nutritional status of patients and provide detailed nutritional treatment suggestions and goals	640 (55.7)	283 (61.4)	189 (61.6)	168 (44.0)	< 0.001
	Advise patients to follow specific dietary patterns, for example, the	626 (54.4)	263 (57.1)	163 (53.1)	200 (52.4)	0.340

1		Mediterranean diet, a low-fat and				
2		low-energy diet				
3		Distribute brochures	701 (61.0)	265 (57.5)	199 (64.8)	237 (62.0) 0.108
4		Provide dietary guidance based				
5		on the TCM principle of food and	546 (47.5)	208 (45.1)	147 (47.9)	191 (50.0) 0.364
6		medicine sharing the same source				
7		Due to the limited consultation				
8		time, patients are only given	334 (29.0)	129 (28.0)	75 (24.4)	130 (54.0) 0.018
9		basic dietary advice				
10						
11		Hand over to a specialized health				
12		manager or professional manager	277 (24.1)	135 (29.3)	65 (21.2)	77 (20.2) 0.003
13		team				
14		Personally evaluate the health				
15		and athletic ability of patients,	723 (62.9)	307 (66.6)	214 (69.7)	202 (52.9) < 0.001
16		then provide detailed exercise				
17		recommendations				
18		For patients with frequent				
19		hypoglycemia, increase physical	453 (39.4)	161 (34.9)	120 (39.1)	172 (45.0) 0.011
20		exercise and improve physical				
21	Physical	fitness				
22	exercise	Distribute brochures	716 (62.3)	258 (56.0)	208 (67.8)	250 (65.5) 0.001
23	management	Guidance on TCM physical				
24		exercises, such as Tai Chi and	539 (46.9)	207 (44.9)	152 (49.5)	180 (47.1) 0.452
25		Baduanjin				
26		Due to the limited consultation				
27		time, patients are only advised to	389 (33.8)	158 (34.3)	97 (31.6)	134 (35.1) 0.609
28		exercise regularly				
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(2) Instruction on self-monitoring of blood glucose and health education management

Physicians' instruction on self-monitoring of blood glucose and the availability of health management

team was also observed. These results revealed that TCPs (96.5%) exhibited the highest rate of SMBG instruction (including both comprehensive guidance and frequent guidance) compared to SCPs (94.5%) and PCPs (88.0%) ($P < 0.001$). In terms of health education management, 75.7% of TCPs reported the presence of diabetes health management teams, followed by SCPs (57.0%) and PCPs (27.5%) ($P < 0.001$). Detailed results are demonstrated in Figure2.

Insert "Figure2. Physicians' instruction on self-monitoring of blood glucose and the availability of health management team (TCPs, tertiary care hospital physicians; SCPs, secondary care hospital physicians; PCPs, primary care practitioners)"

(3) Physicians' knowledge of hypoglycemia identification and TCM differentiation treatment

According to the guideline recommendations (supplemental appendix 2), the accurate characteristics of hypoglycemia include options a, b, c and d, as defined in Table 3. In our exploratory analysis, the percentages of TCPs, SCPs, and PCPs choosing “a, b, c and d” were 63.6%, 65.2% and 49.5% respectively. Notably, the accuracy rate of TCPs was higher compared to SCPs and PCPs ($P < 0.001$). These results indicate that approximately 40% of physicians may have insufficient understanding of the guideline recommendations on hypoglycemia. Similarly, the guidelines recommend specific prescriptions for diabetes based on TCM syndrome differentiation (supplemental appendix 2). For diabetes with Qi-Yin deficiency syndrome, prescriptions including options a, b and c in Table 3 are indicated. The accuracy rates of TCPs, SCPs, and PCPs were 86.1%, 86.3% and 83.5% respectively, showing no significant differences among these three groups of physicians ($P = 0.477$). When considering diabetic neuropathy with Qi-deficiency and collateral-obstruction syndrome, interventions or prescriptions based on this syndrome differentiation involve the options a, b and c as outlined in Table 3 based on the guidelines. The accuracy rate was higher for TCPs (68.6%) than for SCPs (65.8%) and PCPs (55.0%) ($P < 0.001$).

Table 3. Physicians' knowledge of hypoglycemia identification and TCM differentiation treatment [n(%)]

Categories	Overall (n = 1150)	Physicians in different level hospitals			P-value
		Tertiary care hospital physicians (n = 461)	Secondary care hospital physicians (n = 307)	Primary care practitioners (n = 382)	
The characteristics of hypoglycemia including:					
a. Blood glucose < 3.9 mmol/l	1045 (90.9)	409 (88.7)	282 (91.9)	354 (92.7)	0.110
b. Hypoglycemia without a specific blood glucose limit, accompanied by serious events involving changes in consciousness and/or physical condition	788 (68.5)	336 (72.9)	223 (72.6)	229 (60.0)	< 0.001
c. Symptoms of sympathetic excitement such as palpitations, anxiety, sweating, dizziness, hand tremors, and feelings of hunger	1124 (97.7)	453 (98.3)	304 (99.0)	367 (96.1)	0.022
d. Central nervous system symptoms such as changes in mental status, cognitive impairment,	1013 (88.1)	424 (92.0)	289 (94.1)	300 (78.5)	< 0.001

convulsions, and coma					
1 Accuracy rate (All above option)	682 (59.3)	293 (63.6)	200 (65.2)	189 (49.5)	< 0.001
2 Prescriptions for diabetes with Qi-Yin deficiency					
3 syndrome					
4					
5 a. Shenqi Jiangtang granule	931 (81.0)	370 (80.3)	256 (83.4)	305 (79.8)	0.443
6 b. Jinlida granule	507 (44.1)	221 (47.9)	157 (51.1)	129 (33.8)	< 0.001
7 c. Shengmai Powder	616 (53.6)	270 (58.6)	150 (48.9)	196 (51.3)	0.017
8 d. Gegen Qinlian decoction	143 (12.4)	51 (11.1)	37 (12.1)	55 (14.4)	0.335
9 e. Dachaihu decoction	63 (5.5)	27 (5.9)	16 (5.2)	20 (5.2)	0.899
10 Accuracy rate (choosing “a, b or c” without “d	981 (85.3)	397 (86.1)	265 (86.3)	319 (83.5)	0.477
11 or e”)					
12					
13 Prescriptions or interventions for diabetic					
14 neuropathy with Qi-deficiency and					
15 collateral-obstruction syndrome					
16					
17					
18 a. Mudan granule	608 (52.9)	281 (61.0)	170 (55.4)	157 (41.1)	< 0.001
19 b. Acupuncture	510 (44.4)	216 (46.9)	134 (43.7)	160 (41.9)	0.337
20 c. TCM fumigation	650 (56.5)	282 (61.2)	179 (58.3)	189 (49.5)	0.002
21 d. Qiming granule	422 (36.7)	145 (31.5)	105 (34.2)	172 (45.0)	< 0.001
22 Accuracy rate (choosing “a, b or c” without	728 (63.3)	316 (68.6)	202 (65.8)	210 (55.0)	< 0.001
23 “d”)					
24					
25					

3.5 Facilitating factors and barriers to implementation of diabetes guidelines

Standardizing clinical practices, guiding patients' self-care, and the presence of high-level evidence were consistently considered as the top three facilitating factors for adherence to diabetes guidelines across the majority of physicians (see supplemental appendix 3). The majority of physicians, regardless of their level of hospital, concur on the pivotal role of guidelines in standardizing their clinical practices and improving medical quality, with no significant differences observed among the three groups (TCPs = 96.1%; SCPs = 97.1%; PCPs = 94.0%; $P = 0.118$). Importantly, approximately 80% of physicians in all the groups acknowledged the potential of diabetes guidelines in guiding patients' nursing practices. Notably, a statistical difference was observed among physicians from different levels of hospitals regarding their preference for “Guidelines with a high-level of evidence can be convincing” (TCPs = 71.8%; SCPs = 67.4%; PCPs = 46.1%; $P < 0.001$). This finding suggests that TCPs exhibit a stronger inclination towards evidence-based recommendations compared to SCPs and PCPs.

In terms of barriers to the implementation of diabetes guidelines, the majority of physicians from different-level hospitals chose “Limited availability and accessibility of TCM diabetes guidelines” as a major

1 obstacle (TCPs = 68.8%; SCPs = 68.7%; PCPs = 61.5%; $P = 0.050$), with no significant difference observed
2 among the three groups. Additionally, “Time-consuming communication with patients” was identified as the
3 second most prevalent barrier to the implementation of diabetes guidelines, with the selection rates ranking
4 highest to lowest as follows: PCPs (65.5%), SCPs (59.9%) and TCPs (52.5%) ($P = 0.001$). Lastly, in line with
5 the pattern displayed by the facilitating factors, physicians from different levels of hospitals showed a
6 statistically significant difference in selecting “The guideline recommendation lacks a convincing basis” (TCPs
7 = 29.3%; SCPs = 22.8%; PCPs = 18.6%; $P = 0.001$).

18 4. DISCUSSION

21 This national survey of 1150 physicians aimed to investigate their familiarity and awareness of four
22 different diabetes guidelines. Two main findings were revealed from this nationwide survey. First of all, the
23 level of familiarity and self-reported reference status with the diabetes guidelines varied among clinicians in
24 hospitals at different levels. Secondly, a significant discrepancy was observed between physicians’ awareness
25 of modern medicine guidelines and TCM guidelines. Overall, TCPs exhibited the highest awareness of the
26 diabetes guidelines, followed by SCPs and PCPs. These findings are in line with several previous studies that
27 have reported relatively poor attitudes and adherence to guidelines among general practitioners and PCPs
28 compared to other medical doctors [18,19]. These differences may be attributed to the additional training in
29 diabetes management received by physicians in tertiary hospital compared to PCPs [20].

31 Additionally, the results indicated that rate of physicians’ self-reported reference for modern medical
32 guidelines was approximately twice of that for TCM guidelines. This discrepancy may be attributed to several
33 factors. Firstly, modern medical guidelines, such as *Guideline for the Prevention and Treatment of Type 2*
34 *Diabetes Mellitus in China* issued by the CDS, are based on a larger body of high level evidence from modern
35 medicine, making them crucial for guiding clinical practice in China [21]. In contrast, the establishment of
36 TCM guidelines is relatively recent with limited availability of high-level evidence. Moreover, the complex
37 nature of TCM syndrome differentiation and TCM physicians’ heavy reliance on clinical experience may

1 further worsen the discrepancy [22, 23]. Therefore, it is necessary to provide training and guidance on health
2 management for diabetes to physicians, especially PCPs. Future studies should focus on further exploration and
3 in-depth research of TCM diabetes guidelines.
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8 Regarding physicians' knowledge of specific recommendations from diabetes guidelines, our study
9 revealed that the majority of physicians instruct patients to conduct SMBG. However, recent national data
10 indicate that there has been no significant improvement in the awareness, treatment, and control rates of
11 diabetes over the past decade [5,6]. In addition, our study also revealed unsatisfactory management of diet,
12 physical exercise, and health education. In terms of diet and physical exercise management, less than one-third
13 of physicians choose to refer to specialized professional management teams. Furthermore, due to time
14 constraints, more than half of PCPs provide only basic dietary advice to patients such as "paying attention to
15 diet". However, the guidelines strongly recommend that "Patients with T2DM or pre-diabetes need to receive
16 individualized medical nutrition guidance, which should be conducted under the guidance of nutritionists
17 (physicians) or comprehensive management teams familiar with the nutritional treatment for diabetes" [14].
18
19 The results also indicated that PCPs reported a lower rate of assistance by health management team, which is
20 consistent with their lower self-reported rate of choosing to "Hand over to a special professional manager
21 team". Lastly, our results suggested that some physicians may not have mastered the content of the guidelines
22 well enough, as evidenced by approximately 40% of physicians providing inaccurate or omitted judgement
23 about the characteristics of hypoglycemia. These data suggest a significant disparity between clinical practice
24 and guidelines, which is consistent with previous studies [24]. Therefore, it is necessary to provide physicians
25 with more specific training and guidance on diabetes health management, and it is imperative to further
26 enhance the allocation of diabetes-related professional personnel and teams in primary medical institutions.
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54 Similar to findings from other studies, our study also identified several facilitating factors and barriers to
55 the implementation of diabetes guidelines [25,26]. Regarding the facilitating factors for the implementation of
56 diabetes guidelines, most physicians believed that guidelines can standardize clinical practice, improve medical
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1 quality, and guide patients in self-care. This indicates that the significance of guidelines is recognized by the
2 majority of physicians [27]. Although our study provides important insights into facilitating factors in the
3 implementation of guidelines, some barriers to guideline implementation must be considered. Our results
4 indicate that limited availability and accessibility of TCM diabetes guidelines are major barriers. Indeed,
5 previous studies have shown that TCM guidelines have been established relatively recently, indicating that
6 further investigation focusing on the TCM diabetes guidelines should be required [20]. Meanwhile, it is
7 essential to publish these guidelines on multiple platforms, including freely accessible ones, so that all
8 physicians can download and study them. In addition, consistent with previous studies, PCPs demonstrated less
9 awareness about the latest evidence, in contrast to TCPs. Research conducted by B Carlsen highlighted that
10 general practitioners are often confused about the evidence base of extensive guidelines relevant to their
11 practice and they experience more practical constraints on guideline implementation [26]. Therefore, while it is
12 crucial to prioritize high-level evidence to improve reliability of these guidelines, equal emphasis should also be
13 placed on training of primary care practitioners.

34 **Strengths and limitations**

36 This study has several strengths. Firstly, this questionnaire survey was nationally representative and
37 provided reliable data on the physicians' familiarity and awareness of both Chinese and international diabetes
38 guidelines. Our analysis sample included physicians from different medical institutions across 192 cities in 30
39 provinces of China, which is highly representative. Secondly, we conducted a stratified analysis approach to
40 obtain more specific and comprehensive results, including the stratification of physicians in different medical
41 institutions. Thirdly, apart from the self-reported familiarity and reference questionnaire items, we also
42 designed a wide range of specific questions concerning multiple key recommendations within the current
43 guidelines, which will allow us to evaluate the physicians' awareness to contents in the guidelines effectively.
44 Thus, our findings could provide the latest evidence for future studies focusing on diabetes guidelines in China.

45 Our study also has certain limitations. Firstly, although the sample is representative of Chinese medical

1 physicians and a substantial number of physicians (>1000), the findings cannot be automatically applied to
2
3 other countries. Secondly, we have not examined variations regarding awareness of physicians, self-reported
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5 reference status of physicians, and barriers to treatment among different age, gender, education, or number of
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7 patients with diabetes received by the physician. Future studies focusing on the influencing factors of
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9 physicians' compliance with diabetes guidelines will be conducted. Lastly, although we have included
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11 multiple-choice questions to investigate more information, the survey questionnaire has not been generalizable
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13 to test all specific aspects related to the physicians' awareness of the diabetes guidelines.
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18 5. CONCLUSION

21 In conclusion, the level of familiarity and awareness of these four evaluated guidelines varies among
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23 physicians in different-level hospitals. Overall, TCPs generally exhibited the highest familiarity and awareness
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25 of diabetes guidelines. In contrast, the familiarity and awareness of all four guidelines among PCPs are
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27 relatively poor, indicating a necessity of improvement. In addition, there is a significant discrepancy between
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29 modern medicine guidelines and TCM guidelines, highlighting the necessity for further studies focusing on
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31 TCM diabetes guidelines. Moreover, it's crucial to provide consistent education and training for physicians, in
32
33 particular, PCPs.
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41 Association of Chinese Medicine, majority of physicians as members of the Specialist Committee for Primary
42
43 Diabetes Care have participated in the survey questionnaire. We would like to express our gratitude to all the
44
45 participating physicians.
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49 **Contributors** Li-yan Jia, Shu-yu Yang designed the research and took full responsibility for the work as a
50
51 whole. Li-yan Jia designed the survey questionnaire, Neng-jiang Zhao, Shun-qin Wang, Bing Yan, Jian-ping
52
53 Liu were all involved in critically revising the questionnaire and provided valuable advice for designing the
54
55 study. Neng-jiang Zhao, Zhi-hai Zhang, Le Li, Na Zhan, Yuan-bing Lin, Miao-na Cai, participated in
56
57 questionnaire distribution and collection. Na Zhan, Yuan-bing Lin participated in questionnaire data checking.
58
59
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1 Li-yan Jia analyzed and interpreted the data, and wrote the paper. Cao-xin Huang, Bao-yong Lai, Jian-ping Liu,
2
3 Shu-yu Yang contributed to critically revising the manuscript.
4

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14
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20 21 **Conflict of interest**

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23 All authors declare that they have no conflicts of interest.
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26 **Patient and Public Involvement** Patients and/or the public were not involved in the design, or conduct, or
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28 reporting, or dissemination plans of our research.
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30

31 **Ethics approval** This study involves human participants and has obtained ethical approval from the Medical
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33 Ethics Committee of the First Affiliated Hospital of Xiamen University (No. XMY Y-2021KY027-02).
34
35 Participants gave informed consent to participate in the study before taking part.
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39 **Abbreviations**

40
41 ADA American Diabetes Association
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44 CACM China Association of Chinese Medicine
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47 CDS Chinese Diabetes Society
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50 CPGs Clinical practice guidelines
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53 IDF International Diabetes Federation
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56 PCPs Primary care practitioners
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59 SCPs Secondary care hospital physicians
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SMBG Self-monitoring of blood glucose

1 T2DM Type 2 diabetes mellitus

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3 TCM Traditional Chinese medicine

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5 TCPs Tertiary care hospital physicians

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8 **Data availability statement** Data are available upon reasonable request.

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11 **Reference**

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39 **Figure legends**

40
41 Figure 1. Familiarity of physicians from different levels of hospitals with four diabetes guidelines (TCPs,
42
43 tertiary care hospital physicians; SCPs, secondary care hospital physicians; PCPs, primary care practitioners).

44
45 Figure 2. Physicians' instruction on self-monitoring of blood glucose and the availability of health management
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47 team (TCPs, tertiary care hospital physicians; SCPs, secondary care hospital physicians; PCPs, primary care
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1 practitioners)

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3 **Supporting information**

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5 Appendix1. Physicians demographic and profession characteristics

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8 Appendix2. Recommendations excerpted from the diabetes guidelines

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10 Appendix3. Facilitating factors and barriers to diabetes guideline implementation

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For peer review only

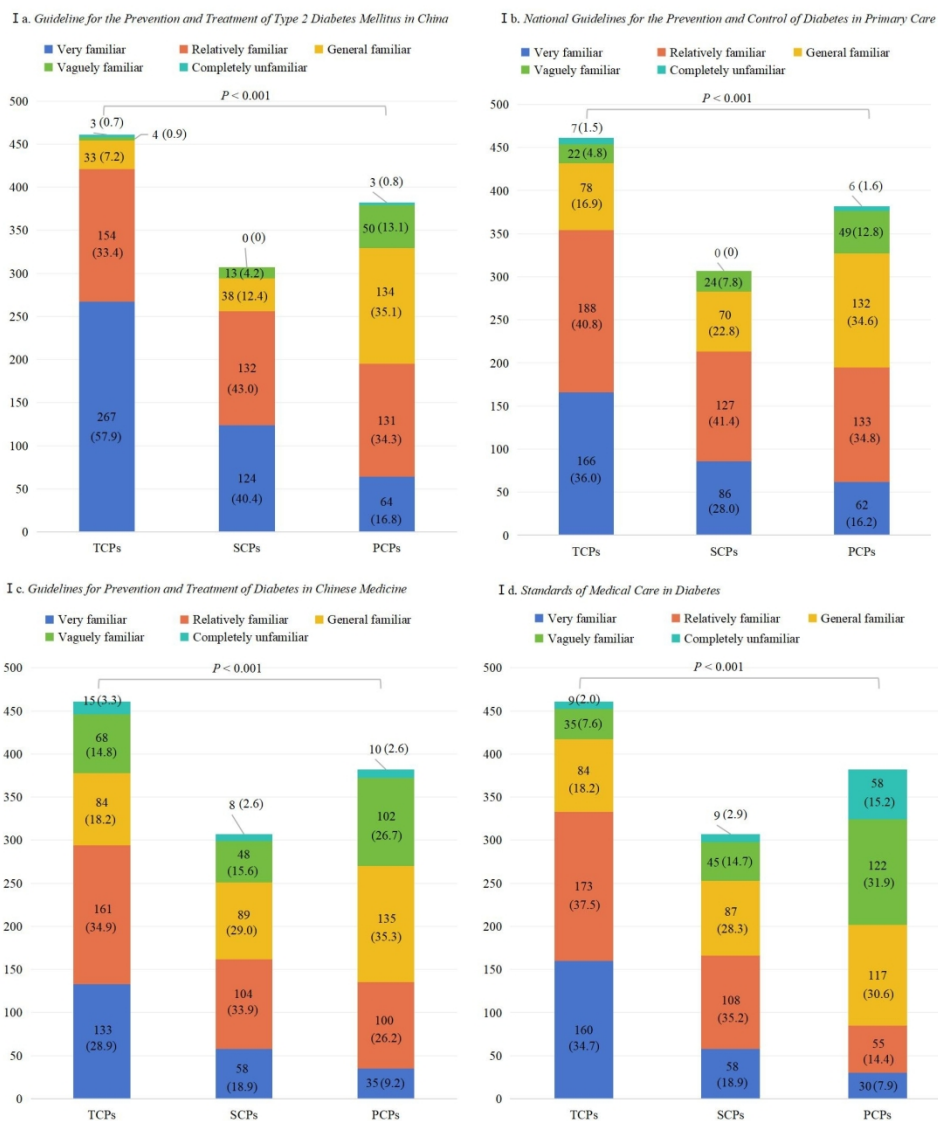


Figure 1. Familiarity of physicians from different levels of hospitals with four diabetes guidelines (TCPs, tertiary care hospital physicians; SCPs, secondary care hospital physicians; PCPs, primary care practitioners)

399x456mm (120 x 120 DPI)

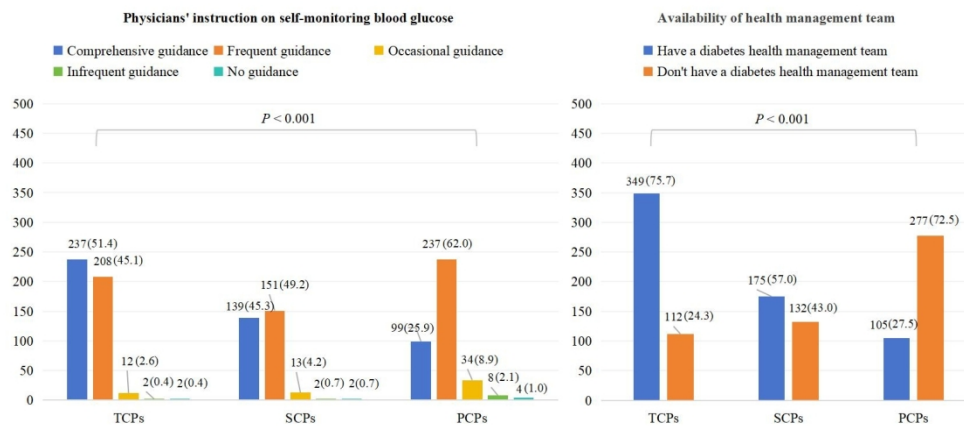


Figure 2. Physicians' instruction on self-monitoring of blood glucose and the availability of health management team (TCPs, tertiary care hospital physicians; SCPs, secondary care hospital physicians; PCPs, primary care practitioners)

365x160mm (120 x 120 DPI)

Appendix 1. Physicians demographic and profession characteristics [n(%)]

Variable	Physicians in different level hospitals			<i>P</i> -value
	Tertiary care hospital physicians (n = 461)	Secondary care hospital physicians (n = 307)	Primary care practitioners (n = 382)	
Age (mean years \pm s.d.)	40.82 \pm 9.21	40.42 \pm 8.78	41.27 \pm 8.13	0.215
Male gender	189 (41.00)	158 (51.47)	209 (54.71)	< 0.001
Education level				< 0.001
Technical secondary and below	0 (0)	1 (0.33)	35 (9.16)	
College degree	7 (1.52)	17 (5.54)	107 (28.01)	
Bachelor degree	169 (36.66)	231 (75.24)	213 (55.76)	
Master degree	222 (48.16)	58 (18.89)	26 (6.81)	
Doctoral degree	63 (13.67)	0 (0)	1 (0.26)	
Professional category				< 0.001
TCM	135 (29.28)	76 (24.76)	88 (23.04)	
Integrated traditional Chinese medicine and western medicine	137 (29.72)	89 (28.99)	81 (21.20)	
Modern clinical medicine	188 (40.78)	140 (45.60)	200 (52.36)	
Other categories	1 (0.22)	2 (0.65)	13 (3.40)	
Years in practice (mean years \pm s.d.)	15.50 \pm 9.82	15.12 \pm 9.00	17.30 \pm 9.05	0.001
Technical title				< 0.001
Junior (Resident physicians)	71 (15.40)	53 (17.26)	170 (44.50)	
Intermediate (Attending physicians)	131 (28.42)	121 (39.41)	137 (35.86)	
Sub-senior (Associate chief physicians)	138 (29.93)	92 (29.97)	67 (17.54)	
Senior (Chief physicians)	121 (26.25)	41 (13.36)	8 (2.09)	
Diabetes practice setting				< 0.001
Department of endocrinology and diabetes	327 (70.93)	171 (55.70)	11 (2.88)	
Department of general practice	14 (3.04)	13 (4.23)	212 (55.50)	
Other departments	120 (26.03)	123 (40.07)	159 (41.63)	
Number of patients with diabetes (per week)				< 0.001
None	4 (0.87)	2 (0.65)	9 (2.36)	
1 ~ 10	99 (21.48)	75 (24.43)	163 (42.67)	
11 ~ 50	133 (28.85)	120 (39.09)	150 (39.27)	
51 ~ 100	115 (24.95)	60 (19.54)	44 (11.52)	
101 ~ 300	98 (21.26)	36 (11.73)	15 (3.93)	
\geq 301	12 (2.6)	14 (4.56)	1 (0.26)	

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3
4 need to be regularly monitored.
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6 ①Physical exercise therapy should be conducted
7 Recommendation
8 under the guidance of relevant professionals.
9
10 ②Prior to exercise, necessary health and
11
12 physical ability assessments should be conducted
13 Recommendation
14 3. Physical exercise to ensure the safety and effectiveness of the
15 management exercise therapy.
16
17 ③Physical exercise should be avoided in cases
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19 of severe hypoglycemia, and can be gradually
20 Recommendation
21 resumed once the condition is under control and
22
23 stabilized.
24
25 ①Classification of hypoglycemia:
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27 Grade 1 hypoglycemia: Blood glucose levels are
28
29 between 3.0 mmol/l and 3.9 mmol/l; Grade 2
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31 hypoglycemia: Blood glucose levels are less than
32
33 3.0 mmol/l; Grade 3 hypoglycemia: Recommendation
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35 Hypoglycemia without a specific blood glucose
36
37 limit, accompanied by severe alterations in
38
39 consciousness and / or physical changes,
40
41 4. Hypoglycemia requiring assistance from others.
42
43 ②The clinical symptoms of hypoglycemia are
44
45 related to the level and rate of decline of blood
46
47 glucose. They can manifest as symptoms of
48
49 sympathetic activation (such as palpitations,
50 Recommendation
51 anxiety, sweating, dizziness, trembling hands,
52
53 and feelings of hunger) and central nervous
54
55 symptoms (such as changes in mental status,
56
57 cognitive impairment, convulsions, and coma).
58
59 5. Diabetes with Qi-Yin ①For the treatment of Qi-Yin deficiency Recommendation
60

deficiency syndrome	syndrome in type 2 diabetes, Jinlida granules and Shenqi Jiangtang granules can be used in combination with routine treatment.	
	②Shengmai Powder, with appropriate adjustments to dosage, can be used to alleviate the symptoms of fatigue and Qi-Yin deficiency syndrome in patients with diabetes.	Recommendation
	③For the early and middle stages of type 2 diabetes, Gegen Qinlian decoction can be administered orally for intestinal-damp-heat syndrome, and Dachaihu Decoction can be administered orally for stagnated-heat in liver and stomach syndrome.	Recommendation
6. Diabetic neuropathy with Qi-deficiency and collateral-obstruction syndrome	①For diabetic neuropathy patients with Qi-deficiency and collateral-obstruction syndrome, Mudan granule can be administered orally, and can be combined with acupuncture and fumigation treatment to improve symptoms.	Recommendation

Appendix 3. Facilitating factors and barriers to diabetes guideline implementation [n(%)]

Categories	Overall (n = 1150)	Physicians in different level hospitals			<i>P</i> -value
		Tertiary care hospital physicians (n = 461)	Secondary care hospital physicians (n = 307)	Primary care practitioners (n = 382)	
Facilitating factors					
The guideline can standardize clinical practices and improve the quality of medical care	1100 (95.65)	443 (96.10)	298 (97.07)	359 (93.98)	0.118
Guide patients in self-care and nursing	907 (78.87)	359 (77.87)	247 (80.46)	301 (78.80)	0.691
Guidelines with a high level of evidence can be highly convincing	714 (62.09)	331 (71.80)*	207 (67.43)*	176 (46.07)*	< 0.001
The format of the guidelines is standardized and easy to navigate	657 (57.13)	273 (59.22)*	190 (61.89)*	194 (50.79)*	0.007
The guideline can facilitate communication with patients	686 (59.65)	260 (56.40)*	201 (65.47)*	225 (58.90)*	0.040
Reduce medical costs	627 (54.52)	266 (57.70)	169 (55.05)	192 (50.26)	0.095
Barriers					
Restricted the autonomy of doctors	376 (32.70)	155 (33.62)	96 (31.27)	125 (32.72)	0.793
Requires time-consuming communication with patients	676 (58.78)	242 (52.49)*	184 (59.93)*	250 (65.45)*	0.001
Increases the risk of physicians taking more responsibility for medical malpractice	239 (20.78)	81 (17.57)	69 (22.48)	89 (23.30)	0.087
Limited availability and accessibility of TCM diabetes guidelines	763 (66.35)	317 (68.76)	211 (68.73)	235 (61.52)	0.050
The guideline cannot be downloaded for reading	353 (30.70)	153 (33.19)	99 (32.25)	101 (26.44)	0.084
The guideline recommendation lacks a convincing basis	276 (24.00)	135 (29.28)*	70 (22.80)*	71 (18.59)*	0.001

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page/line numbers
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	Page 1, 2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	Page 2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Page 3, 4
Objectives	3	State specific objectives, including any prespecified hypotheses	Page 4
Methods			
Study design	4	Present key elements of study design early in the paper	Page 5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Page 5, 6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	Page 5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Page 5
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Page 5, 6
Bias	9	Describe any efforts to address potential sources of bias	Page 5
Study size	10	Explain how the study size was arrived at	Page 6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Page 6
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	Page 6
		(b) Describe any methods used to examine subgroups and interactions	Page 6
		(c) Explain how missing data were addressed	NA
		(d) If applicable, describe analytical methods taking account of sampling strategy	NA
		(e) Describe any sensitivity analyses	NA
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Page 6
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Page 6
		(b) Indicate number of participants with missing data for each variable of interest	Page 6
Outcome data	15*	Report numbers of outcome events or summary measures	NA
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear	NA

		which confounders were adjusted for and why they were included	
		(b) Report category boundaries when continuous variables were categorized	NA
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Page 8 to page 12
Discussion			
Key results	18	Summarise key results with reference to study objectives	Page 13
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Page 15
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Page 13 to page 15
Generalisability	21	Discuss the generalisability (external validity) of the study results	Page 15
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Page 16

*Give information separately for exposed and unexposed groups.

NA: Not applicable.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Nationwide Survey of Physicians' Familiarity and Awareness of Diabetes Guidelines in China: A Cross-sectional Study

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Nationwide Survey of Physicians' Familiarity and Awareness of Diabetes Guidelines in China: A

Cross-sectional Study

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ABSTRACT

Objective: To investigate physicians' familiarity and awareness of four diabetes guidelines, and their practice of the recommendations outlined in these guidelines.

Design: A cross-sectional study.

Setting: An online questionnaire survey was conducted among physicians affiliated with the Specialist Committee for Primary Diabetes Care of China Association of Chinese Medicine, using the snowball sampling method to ensure a broader representation of physicians.

Participants: 1150 physicians from 192 cities across 30 provinces in China provided complete data.

Results: Tertiary care hospital physicians (TCPs) exhibited the highest familiarity with the *Guideline for the Prevention and Treatment of Type 2 Diabetes Mellitus in China* (91.3%), followed by the *National Guidelines for the Prevention and Control of Diabetes in Primary Care* (76.8%), the *Standards of Medical Care in Diabetes* (72.2%) and the *Guidelines for Prevention and Treatment of Diabetes in Chinese Medicine* (63.8%). Primary care practitioners (PCPs) exhibited familiarity with these four guidelines at about 50% or less. Self-reported reference to modern diabetes guidelines by physicians more frequent than traditional Chinese medicine (TCM) diabetes guidelines, with rates at 73.2% and 33.8%, respectively. Approximately 90% of physicians provided instructions on self-monitoring of blood glucose to their patients with diabetes. Less than one-third of physicians referred patients to a specialized nutritionist. In terms of health education management, TCPs reported having a diabetes health management team at the rate of 75.7%, followed by secondary care hospital physicians (SCPs) at 57.0% and PCPs at 27.5%. Furthermore, approximately 40% of physicians did not fully grasp hypoglycemia characteristics.

Conclusions: Familiarity and awareness of the screening guidelines varied among physicians in different hospital settings. Importantly, significant discrepancies were observed between physicians' awareness and their self-reported reference to modern medicine guidelines and TCM guidelines. It is essential to consistently provide education and training on diabetes management for all physicians, particularly PCPs.

KEY WORDS: Diabetes Mellitus; Guidelines; Physician Awareness

Strengths and limitations of this study

① This nationwide questionnaire survey involved 1150 physicians from hospitals of different levels in China, aiming to analyze the differences in familiarity and awareness of both Chinese and international diabetes guidelines among different physician groups. The results provided nationally representative evidence regarding physicians' familiarity and awareness of these guidelines.

② Apart from the self-reported familiarity and reference questionnaire items, our study also identified several facilitating factors and barriers to the implementation of diabetes guidelines among different physician groups.

③ Although we have included multiple-choice questions to gather more comprehensive information, we acknowledge that the survey questionnaire may not cover all specific aspects related to physicians' awareness of the diabetes guidelines.

1. INTRODUCTION

Diabetes is a metabolic disorder caused by the interplay of genetic and environmental factors, which has become a critical global health concern worldwide due to its high prevalence and associated disability and mortality rates [1,2]. According to the latest data published by International Diabetes Federation (IDF), an estimated 537 million adults worldwide have been diagnosed with diabetes [3]. China currently bears the highest burden of diabetes globally, with approximately 141 million individuals living with the disease aged between 20 and 79 years. Moreover, it is predicted that the number of diabetes cases in China will continue to grow significantly [4]. However, recent national data on chronic diseases and their risk factors in China indicate that awareness, treatment, and control rates for diabetes were 36.7%, 32.9%, and 50.1%, respectively, which have not changed significantly since 2013[5,6]. Therefore, addressing this substantial public health issue is crucial, with the objective of enhancing the national diabetes awareness rate, treatment rate, and control rate.

Clinical practice guidelines (CPGs) are statements that facilitate optimal disease management for health professionals and patients. However, to ensure effective implementation and adherence to guidelines, it is crucial to enhance health professionals' familiarity and awareness of CPGs [7]. Previous studies have emphasized the significance of physician awareness in the successful adoption of cardiovascular disease

1 prevention guidelines, asthma guidelines, chronic kidney disease guidelines, etc [8-10]. A systematic review
2
3 identified lack of physician awareness and familiarity with guidelines as the primary factors contributing to
4
5 deviation from recommended therapy [11]. Notably, a cross-sectional study highlighted that physicians' lack of
6
7 knowledge and patients' unawareness of guidelines could account for about 70% of non-adherence [12].
8
9
10 Therefore, emphasizing physicians' familiarity and awareness of clinical guidelines is essential for optimizing
11
12
13 patient management.
14

15
16 Modern medicine, with strategies like insulin injections and oral medications like *Metformin*, is vital for
17
18 managing diabetes. However, the effectiveness of these methods isn't always absolute and they are not
19
20 consistently well-tolerated [13]. The full potential of managing Type 2 Diabetes Mellitus (T2DM) side effects,
21
22 discomfort, and complications with Western medicine alone has not yet been realized. Traditional Chinese
23
24 medicine (TCM) methods may be a potential complementary approach, given the relatively minor side effects
25
26 of natural herbs, non-drug therapies, and external treatment [14]. Previous studies have reported that TCM
27
28 therapies are beneficial for the comprehensive prevention and treatment of diabetes, particularly when
29
30 combined with Western medicine, where it can play a significant role in enhancing effectiveness. Studies
31
32 showed TCM therapies used in conjunction with Western medicine can potentially not only improve clinical
33
34 outcomes (such as weight loss, self-reported symptoms, glucose metabolism), but also reduce medicinal
35
36 dosages and delay diabetes progression [15,16]. For example, the use of TCM in conjunction with Western
37
38 medicine can alleviate discomforts from drugs, such as bloating induced by *Acarbose* [17]. Additionally,
39
40 diabetic peripheral neuropathy characterized by sensations of coolness, numbness, and limb pain, an integrated
41
42 approach using specific TCM prescriptions, such as *Buyang Huanwu Decoction* and *Danggui Sini Decoction*,
43
44 as well as external treatments like herbal foot baths, can significantly enhance therapy's effectiveness [18].
45
46
47 Therefore, specific TCM measures were suggested as adjuvant therapy for individuals with diabetes in a wide
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49
50 range of clinical research studies. Furthermore, the TCM treatment measures for diabetes (including the
51
52 integration of TCM into the comprehensive treatment of diabetes, alleviating patient-reported symptoms,
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1 preventing or alleviating complications, TCM non-drug therapies and external treatments, etc.) are
2
3 recommended as adjuvant therapies for diabetes prevention and treatment in the '*Guideline for the Prevention*
4
5 *and Treatment of T2DM in China (2020)*' and the '*National Guidelines for the Prevention and Control of*
6
7 *Diabetes in Primary Care (2022)*' [19,20].
8
9

10 To effectively enhance the prevention and standardized management of diabetes mellitus, a series of
11
12 clinical guideline documents have been released both domestically and internationally. Including annually
13
14 updated *Standards of Medical Care in Diabetes* issued by the American Diabetes Association (ADA) since
15
16 1994. This is one of the diabetes guidelines that is widely recognized internationally [21]. China has been
17
18 publishing its first 'Clinical Diabetes Guidelines in China' since 2000, which are updated on average every 3
19
20 years. The most recent update is *Guideline for the Prevention and Treatment of T2DM in China (2020)*
21
22 issued by Chinese Diabetes Society (CDS) [19]. Additionally, the '*National Guidelines for the Prevention and*
23
24 *Control of Diabetes in Primary Care (2018)*' was published for the first time in 2018, and it was updated in
25
26 2022 [20]. Notably, the first diabetes guideline within the field of TCM, '*Guidelines for Prevention and*
27
28 *Treatment of Diabetes in Chinese Medicine*', issued by China Association of Chinese Medicine (CACM) in
29
30 2007 [22]. In China, the recommendations for the treatment of diabetes by Western medicine combined with
31
32 Chinese medicine mainly refer to these four guidelines. Therefore, four guidelines mentioned above are
33
34 considered as the screening guidelines investigated in this study. To provide nationally representative evidence
35
36 regarding the familiarity and awareness of physicians with diabetes guidelines in China, we conducted a
37
38 nationwide survey to compare physicians' awareness, self-reported reference status and practice of different
39
40 diabetes guidelines. Additionally, we examined the differences among physicians from hospitals at different
41
42 levels. Furthermore, the facilitating factors and barriers to implementation of diabetes guidelines among
43
44 different physician groups were identified in this study.
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56 **2. RESEARCH DESIGN AND METHODS**

57 **2.1 Survey design**

1 This is an investigator-initiated, non-commercial survey of physicians at various levels of hospitals in
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3 China. This work was conducted by the Specialist Committee for Primary Diabetes Care of China Association
4
5 of Chinese Medicine, a national academic institution. A majority of physicians who are members of the
6
7 Specialist Committee participated in the survey questionnaire. The questionnaire was distributed electronically
8
9 to the participants, and electronic written informed consent from respondents was required before proceeding
10
11 with the survey. Additionally, participants were requested to assist in forwarding the questionnaire to other
12
13 general practitioners, physicians, and experts using the snowball sampling method. In the overall design of this
14
15 survey, we aimed to ensure broader representation of respondents by recruiting physicians from different grades
16
17 of hospitals in China, including tertiary to primary medical institutions. Additionally, the endocrinology
18
19 diabetes specialists, general practitioners, and TCM physicians were mainly recruited.
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26 **2.2 Questionnaire and pretest**

29 A questionnaire comprising four sections was established with a total of 42 items. Section I assessed
30
31 participants' clinical background and basic demographic data. Section II evaluated participants' familiarity with
32
33 and self-reported reference status regarding various diabetes guidelines, presented as single-choice questions in
34
35 the form of Likert scales. Section III examined participants' awareness and practice of specific measures
36
37 outlined in diabetes guidelines, accompanied by a list of guideline-based recommendations provided in
38
39 Appendix 1. The guideline action statements were rephrased as options in both single-choice and
40
41 multiple-choice formats, enabling respondents to choose the most appropriate answers. Lastly, section IV
42
43 investigated the facilitating factors and barriers during the process of guideline implementation.
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50 The questionnaire underwent a pilot test involving 24 physicians from Fujian and Gansu provinces in
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52 China from Aug 20, 2021 to Aug 27, 2021. Additionally, experts familiar with these diabetes guidelines were
53
54 invited to evaluate the contents of the questionnaire. Subsequently, the questionnaire was optimized based on
55
56 feedback received during the pilot survey and expert consultation meeting.
57
58
59

60 **2.3 Sample and administration**

1 The sample size calculation was completed in accordance with the cross-sectional survey formula $N =$
2
3 $(Z_{\alpha}^2 * pq) / (d^2)$ [23]. According to a literature search, the estimated value of p is 26.2% (the projected rate of
4
5 Chinese physicians being very familiar with the diabetes guidelines), $q = 1 - p$, and $d = 0.1 * p$. Assuming a 5%
6
7 two-tailed type-I error ($Z_{\alpha} = 1.96$) and a two-sided 95% confidence level, the estimated result of N was 1082.
8
9
10 The investigation was performed from Sep 22, 2021 to Oct 29, 2021, a total of 1 162 participants completed the
11
12 survey. The logical discrepancies or potential errors found in the questionnaires were resolved through
13
14 telephone communication with the respondents.
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16

17 18 **2.4 Statistical analysis**

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20
21 Statistics analysis was performed using SAS Version 9.4. Continuous variables were presented as means
22
23 with \pm SDs, and categorical variables as counts (n) and percentages (%). Pearson's Chi-square test was used to
24
25 compare categorical variables, and the Wilcoxon rank-sum test was used for non-parametric numerical
26
27 variables. Moreover, the Cochran-Mantel-Haenszel (CMH) test was used for ordinal categorical variables.
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29 Differences in guidelines familiarity and awareness among different physician groups, including tertiary care
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31 hospital physicians (TCPs), secondary care hospital physicians (SCPs), and primary care practitioners (PCPs),
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33 were analyzed. In this study, the percentage differences among groups were reported, with statistically
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35 significant differences indicated by P -value < 0.05 .
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42 **2.5 Patient and Public Involvement**

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44 Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans
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46 of our research.
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49 **3. RESULTS**

50 51 **3.1 Sample characteristics**

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53 A total of 1,162 questionnaires were collected. Among these, we finally included 1,150 questionnaires
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55 (99.0%) from physicians after excluding 12 questionnaires (7 from nurses, 2 from pharmacists, and 3 from
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57 medical teachers). Among the included questionnaires, 461 (40.1%) were obtained from TCPs, 307 (26.7%)
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1 were obtained from SCPs, and 382 (33.2%) were obtained from PCPs. There were significant differences
2
3 among the three groups of physicians in terms of gender, educational level, professional category, years in
4
5 practice, technical title, diabetes practice setting and number of patients with diabetes treated per week ($P <$
6
7 0.05). The full characteristics of the physicians are presented in Supplemental Appendix1.
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9

10 **3.2 Physicians' familiarity with diabetes guidelines**

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12
13 Physicians' familiarity with diabetes guidelines is demonstrated in Figure1. In the overall sample, the
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15 rankings of familiarity (including both very familiar and relatively familiar) with the four guidelines were as
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17 follows: *Guideline for the Prevention and Treatment of Type 2 Diabetes Mellitus in China* (75.8%), *National*
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19 *Guidelines for the Prevention and Control of Diabetes in Primary Care* (66.3%), *Guidelines for Prevention and*
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21 *Treatment of Diabetes in Chinese Medicine* (51.4%), and *Standards of Medical Care in Diabetes* (50.8%).
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TCPs exhibited a higher likelihood of familiarity with these four guidelines compared to other groups. Particularly, TCPs demonstrated the highest familiarity with the *Guideline for the Prevention and Treatment of Type 2 Diabetes Mellitus in China* (91.3%), followed by SCPs (83.4%), and PCPs (51.0%) ($P < 0.001$). Similarly, TCPs exhibited a higher level of familiarity (76.8%) with the *National Guidelines for the Prevention and Control of Diabetes in Primary Care* compared to SCPs (69.4%) and PCPs (51.1%) ($P < 0.001$). In terms of the *Guidelines for Prevention and Treatment of Diabetes in Chinese Medicine*, TCPs exhibited the highest level of familiarity (72.2%), followed by SCPs (52.8%), and PCPs (35.3%) ($P < 0.001$). Lastly, various degrees of familiarities with the *Standards of Medical Care in Diabetes* were observed among TCPs (63.8%), SCPs (54.1%), and PCPs (22.3%) ($P < 0.001$).

51 Insert "Figure1. Familiarity of physicians from different levels of hospitals with four diabetes guidelines (TCPs,
52
53 tertiary care hospital physicians; SCPs, secondary care hospital physicians; PCPs, primary care practitioners)"
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56

57 **3.3 Physicians' self-reported reference status of diabetes guidelines**

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Physicians' self-reported reference status of diabetes guidelines summarized in Table1. In terms of modern

medicine guidelines, the rates of “frequent reference” were 80.9%, 77.2% and 60.7% for TCPs, SCPs and PCPs, respectively, indicating a stronger compliance in TCPs group ($P < 0.001$). In comparison, the rates of “frequent reference” to TCM guidelines were 36.2% for TCPs, 36.5% for SCPs and 28.8% for PCPs, suggesting that the compliance to TCM guidelines was relatively low across all groups. No significant differences about the compliance to TCM guidelines were observed among these three physicians groups ($P = 0.071$).

Table 1. Physicians’ self-reported reference status of diabetes guidelines [n(%)]

Categories		Overall (n = 1150)	Physicians in different level hospitals			P-value
			Tertiary care hospital physicians (n = 461)	Secondary care hospital physicians (n = 307)	Primary care practitioners (n = 382)	
Modern medicine guidelines ^a	Frequent reference	842 (73.2)	373 (80.9)	237 (77.2)	232 (60.7)	< 0.001
	Occasional reference	236 (20.5)	75 (16.3)	59 (19.2)	102 (26.7)	
	Infrequent reference	53 (4.6)	9 (2.0)	8 (2.6)	36 (9.4)	
	Rare reference	17 (1.5)	4 (0.9)	3 (1.0)	10 (2.6)	
	No reference	2 (0.2)	0 (0.0)	0 (0.0)	2 (0.5)	
TCM guidelines ^b	Frequent reference	389 (33.8)	167 (36.2)	112 (36.5)	110 (28.8)	0.071
	Occasional reference	459 (39.9)	182 (39.5)	127 (41.4)	150 (39.3)	
	Infrequent reference	186 (16.2)	66 (14.3)	41 (13.4)	79 (20.7)	
	Rare no reference	89 (7.7)	34 (7.4)	25 (8.1)	30 (7.9)	
	No reference	27 (2.4)	12 (2.6)	2 (0.7)	13 (3.4)	

a. Modern medicine guidelines including *Standards of Medical Care in Diabetes* issued by the American Diabetes Association, *Guideline for the Prevention and Treatment of Type 2 Diabetes Mellitus in China* and *National Guidelines for the Prevention and Control of Diabetes in Primary Care* issued by Chinese Diabetes Society. b. TCM guidelines including *Guidelines for Prevention and Treatment of Diabetes in Chinese Medicine* issued by China Association of Chinese Medicine.

3.4 Physicians’ awareness and practice of contents from diabetes guidelines

The objective of this section is to assess physicians' awareness and practice of the recommendations outlined in the diabetes guidelines. These recommendations encompass various aspects, including dietary management, physical exercise, self-monitoring of blood glucose (SMBG), health education, hypoglycemia knowledge, as well as treatment approaches based on TCM differentiation. Detailed information regarding specific recommendations can be found in supplemental appendix 2.

(1) Management of diet and physical exercise

In terms of dietary management for patients with diabetes, the proportions of TCPs, SCPs and PCPs

choosing "Hand over to a specialized nutritionist or comprehensive management team" were 39.5%, 25.7% and 22.8% respectively ($P < 0.001$). In addition, the proportions of TCPs, SCPs and PCPs choosing "Personally evaluate the nutritional status of patients and provide detailed nutritional treatment suggestions and goals" were 61.4%, 61.6% and 44.0% respectively ($P < 0.001$). It is noteworthy that PCPs had the highest proportions (54%) to choose "Due to the limited consultation time, patients are only given basic dietary advice" compared to TCPs (28.0%) and SCPs (24.4%) ($P = 0.018$).

In terms of physical exercise management, the proportions of TCPs, SCPs and PCPs choosing "Hand over to a specialized health manager or professional manager team" were 29.3%, 21.2% and 20.2% respectively ($P = 0.003$). Similarly, the proportions of TCPs, SCPs and PCPs choosing "Personally evaluate the health and athletic ability of patients, then provide detailed exercise recommendations" were 66.6%, 69.7% and 52.9% respectively ($P < 0.001$). Furthermore, regarding the distribution of brochures, the preference ranked from highest to lowest as follows: SCPs (67.8%), PCPs (65.5%), and TCPs (56.0%) ($P = 0.001$). Detailed results are illustrated in Table 2.

Table 2. Physicians' practice of dietary and exercise recommendations according to diabetes guidelines [n(%)]

Categories	Overall (n = 1150)	Physicians in different level hospitals			P-value
		Tertiary care hospital physicians (n = 461)	Secondary care hospital physicians (n = 307)	Primary care practitioners (n = 382)	
Hand over to a specialized nutritionist or comprehensive management team	348 (30.3)	182 (39.5)	79 (25.7)	87 (22.8)	< 0.001
Personally evaluate the nutritional status of patients and provide detailed nutritional treatment suggestions and goals	640 (55.7)	283 (61.4)	189 (61.6)	168 (44.0)	< 0.001
Dietary management Advise patients to follow specific dietary patterns, for example, the Mediterranean diet, a low-fat and low-energy diet	626 (54.4)	263 (57.1)	163 (53.1)	200 (52.4)	0.340
Distribute brochures	701 (61.0)	265 (57.5)	199 (64.8)	237 (62.0)	0.108
Provide dietary guidance based on the TCM principle of food and medicine sharing the same source	546 (47.5)	208 (45.1)	147 (47.9)	191 (50.0)	0.364
Due to the limited consultation	334 (29.0)	129 (28.0)	75 (24.4)	130 (54.0)	0.018

time, patients are only given
basic dietary advice

1						
2						
3						
4		277 (24.1)	135 (29.3)	65 (21.2)	77 (20.2)	0.003
5						
6						
7						
8		723 (62.9)	307 (66.6)	214 (69.7)	202 (52.9)	< 0.001
9						
10						
11						
12	Physical					
13	exercise					
14	management	453 (39.4)	161 (34.9)	120 (39.1)	172 (45.0)	0.011
15						
16						
17		716 (62.3)	258 (56.0)	208 (67.8)	250 (65.5)	0.001
18						
19		539 (46.9)	207 (44.9)	152 (49.5)	180 (47.1)	0.452
20						
21						
22						
23		389 (33.8)	158 (34.3)	97 (31.6)	134 (35.1)	0.609
24						
25						

(2) Instruction on self-monitoring of blood glucose and health education management

Physicians' instruction on self-monitoring of blood glucose and the availability of health management team was also observed. These results revealed that TCPs (96.5%) exhibited the highest rate of SMBG instruction (including both comprehensive guidance and frequent guidance) compared to SCPs (94.5%) and PCPs (88.0%) ($P < 0.001$). In terms of health education management, 75.7% of TCPs reported the presence of diabetes health management teams, followed by SCPs (57.0%) and PCPs (27.5%) ($P < 0.001$). Detailed results are demonstrated in Figure2.

Insert "Figure2. Physicians' instruction on self-monitoring of blood glucose and the availability of health management team (TCPs, tertiary care hospital physicians; SCPs, secondary care hospital physicians; PCPs, primary care practitioners)"

(3) Physicians' knowledge of hypoglycemia identification and TCM differentiation treatment

According to the guideline recommendations (supplemental appendix 2), the accurate characteristics of

hypoglycemia include options a, b, c and d, as defined in Table 3. In our exploratory analysis, the percentages of TCPs, SCPs, and PCPs choosing “a, b, c and d” were 63.6%, 65.2% and 49.5% respectively. Notably, the accuracy rate of TCPs was higher compared to SCPs and PCPs ($P < 0.001$). These results indicate that approximately 40% of physicians may have insufficient understanding of the guideline recommendations on hypoglycemia. Similarly, the guidelines recommend specific prescriptions for diabetes based on TCM syndrome differentiation (supplemental appendix 2). For diabetes with Qi-Yin deficiency syndrome, prescriptions including options a, b and c in Table 3 are indicated. The accuracy rates of TCPs, SCPs, and PCPs were 86.1%, 86.3% and 83.5% respectively, showing no significant differences among these three groups of physicians ($P = 0.477$). When considering diabetic neuropathy with Qi-deficiency and collateral-obstruction syndrome, interventions or prescriptions based on this syndrome differentiation involve the options a, b and c as outlined in Table 3 based on the guidelines. The accuracy rate was higher for TCPs (68.6%) than for SCPs (65.8%) and PCPs (55.0%) ($P < 0.001$).

Table 3. Physicians' knowledge of hypoglycemia identification and TCM differentiation treatment [n(%)]

Categories	Overall (n = 1150)	Physicians in different level hospitals			P-value
		Tertiary care hospital physicians (n = 461)	Secondary care hospital physicians (n = 307)	Primary care practitioners (n = 382)	
The characteristics of hypoglycemia including:					
a. Blood glucose < 3.9 mmol/l	1045 (90.9)	409 (88.7)	282 (91.9)	354 (92.7)	0.110
b. Hypoglycemia without a specific blood glucose limit, accompanied by serious events involving changes in consciousness and/or physical condition	788 (68.5)	336 (72.9)	223 (72.6)	229 (60.0)	< 0.001
c. Symptoms of sympathetic excitement such as palpitations, anxiety, sweating, dizziness, hand tremors, and feelings of hunger	1124 (97.7)	453 (98.3)	304 (99.0)	367 (96.1)	0.022
d. Central nervous system symptoms such as changes in mental status, cognitive impairment, convulsions, and coma	1013 (88.1)	424 (92.0)	289 (94.1)	300 (78.5)	< 0.001
Accuracy rate (All above option)	682 (59.3)	293 (63.6)	200 (65.2)	189 (49.5)	< 0.001
Prescriptions for diabetes with Qi-Yin deficiency syndrome					
a. Shenqi Jiangtang granule	931 (81.0)	370 (80.3)	256 (83.4)	305 (79.8)	0.443
b. Jinlida granule	507 (44.1)	221 (47.9)	157 (51.1)	129 (33.8)	< 0.001

c. Shengmai Powder	616 (53.6)	270 (58.6)	150 (48.9)	196 (51.3)	0.017
d. Gegen Qinlian decoction	143 (12.4)	51 (11.1)	37 (12.1)	55 (14.4)	0.335
e. Dachaihu decoction	63 (5.5)	27 (5.9)	16 (5.2)	20 (5.2)	0.899
Accuracy rate (choosing “a, b or c” without “d or e”)	981 (85.3)	397 (86.1)	265 (86.3)	319 (83.5)	0.477
<hr/>					
Prescriptions or interventions for diabetic neuropathy with Qi-deficiency and collateral-obstruction syndrome					
a. Mudan granule	608 (52.9)	281 (61.0)	170 (55.4)	157 (41.1)	< 0.001
b. Acupuncture	510 (44.4)	216 (46.9)	134 (43.7)	160 (41.9)	0.337
c. TCM fumigation	650 (56.5)	282 (61.2)	179 (58.3)	189 (49.5)	0.002
d. Qiming granule	422 (36.7)	145 (31.5)	105 (34.2)	172 (45.0)	< 0.001
Accuracy rate (choosing “a, b or c” without “d”)	728 (63.3)	316 (68.6)	202 (65.8)	210 (55.0)	< 0.001

3.5 Facilitating factors and barriers to implementation of diabetes guidelines

Standardizing clinical practices, guiding patients' self-care, and the presence of high-level evidence were consistently considered as the top three facilitating factors for adherence to diabetes guidelines across the majority of physicians (see supplemental appendix 3). The majority of physicians, regardless of their level of hospital, concur on the pivotal role of guidelines in standardizing their clinical practices and improving medical quality, with no significant differences observed among the three groups (TCPs = 96.1%; SCPs = 97.1%; PCPs = 94.0%; $P=0.118$). Importantly, approximately 80% of physicians in all the groups acknowledged the potential of diabetes guidelines in guiding patients' nursing practices. Notably, a statistical difference was observed among physicians from different levels of hospitals regarding their preference for “Guidelines with a high-level of evidence can be convincing” (TCPs = 71.8%; SCPs = 67.4%; PCPs = 46.1%; $P < 0.001$). This finding suggests that TCPs exhibit a stronger inclination towards evidence-based recommendations compared to SCPs and PCPs.

In terms of barriers to the implementation of diabetes guidelines, the majority of physicians from different-level hospitals chose “Limited availability and accessibility of TCM diabetes guidelines” as a major obstacle (TCPs = 68.8%; SCPs = 68.7%; PCPs = 61.5%; $P = 0.050$), with no significant difference observed among the three groups. Additionally, “Time-consuming communication with patients” was identified as the second most prevalent barrier to the implementation of diabetes guidelines, with the selection rates ranking

highest to lowest as follows: PCPs (65.5%), SCPs (59.9%) and TCPs (52.5%) ($P = 0.001$). Lastly, in line with the pattern displayed by the facilitating factors, physicians from different levels of hospitals showed a statistically significant difference in selecting “The guideline recommendation lacks a convincing basis” (TCPs = 29.3%; SCPs = 22.8%; PCPs = 18.6%; $P = 0.001$).

4. DISCUSSION

This national survey of 1150 physicians aimed to investigate their familiarity and awareness of four different diabetes guidelines. Two main findings were revealed from this nationwide survey. First of all, the level of familiarity and self-reported reference status with the diabetes guidelines varied among clinicians in hospitals at different levels. Secondly, a significant discrepancy was observed between physicians’ awareness of modern medicine guidelines and TCM guidelines. Overall, TCPs exhibited the highest awareness of the diabetes guidelines, followed by SCPs and PCPs. These findings are in line with several previous studies that have reported relatively poor attitudes and adherence to guidelines among general practitioners and PCPs compared to other medical doctors [24,25]. These differences may be attributed to the additional training in diabetes management received by physicians in tertiary hospital compared to PCPs [26].

Additionally, the results indicated that rate of physicians’ self-reported reference for modern medical guidelines was approximately twice of that for TCM guidelines. This discrepancy may be attributed to several factors. Firstly, modern medical guidelines, such as *Guideline for the Prevention and Treatment of Type 2 Diabetes Mellitus in China* issued by the CDS, are based on a larger body of high level evidence from modern medicine, making them crucial for guiding clinical practice in China [27]. In contrast, the establishment of TCM guidelines is relatively recent with limited availability of high-level evidence. Moreover, the complex nature of TCM syndrome differentiation and TCM physicians’ heavy reliance on clinical experience may further worsen the discrepancy [28, 29]. Therefore, it is necessary to provide training and guidance on health management for diabetes to physicians, especially PCPs. Future studies should focus on further exploration and in-depth research of TCM diabetes guidelines.

1 Regarding physicians' knowledge of specific recommendations from diabetes guidelines, our study
2 revealed that the majority of physicians instruct patients to conduct SMBG. However, recent national data
3 indicate that there has been no significant improvement in the awareness, treatment, and control rates of
4 diabetes over the past decade [5,6]. In addition, our study also revealed unsatisfactory management of diet,
5 physical exercise, and health education. In terms of diet and physical exercise management, less than one-third
6 of physicians choose to refer to specialized professional management teams. Furthermore, due to time
7 constraints, more than half of PCPs provide only basic dietary advice to patients such as "paying attention to
8 diet". However, the guidelines strongly recommend that "Patients with T2DM or pre-diabetes need to receive
9 individualized medical nutrition guidance, which should be conducted under the guidance of nutritionists
10 (physicians) or comprehensive management teams familiar with the nutritional treatment for diabetes" [19].
11 The results also indicated that PCPs reported a lower rate of assistance by health management team, which is
12 consistent with their lower self-reported rate of choosing to "Hand over to a special professional manager
13 team". Lastly, our results suggested that some physicians may not have mastered the content of the guidelines
14 well enough, as evidenced by approximately 40% of physicians providing inaccurate or omitted judgement
15 about the characteristics of hypoglycemia. These data suggest a significant disparity between clinical practice
16 and guidelines, which is consistent with previous studies [30]. Therefore, it is necessary to provide physicians
17 with more specific training and guidance on diabetes health management, and it is imperative to further
18 enhance the allocation of diabetes-related professional personnel and teams in primary medical institutions.

19 Similar to findings from other studies, our study also identified several facilitating factors and barriers to
20 the implementation of diabetes guidelines [31,32]. Regarding the facilitating factors for the implementation of
21 diabetes guidelines, most physicians believed that guidelines can standardize clinical practice, improve medical
22 quality, and guide patients in self-care. This indicates that the significance of guidelines is recognized by the
23 majority of physicians [33]. Although our study provides important insights into facilitating factors in the
24 implementation of guidelines, some barriers to guideline implementation must be considered. Our results

1 indicate that limited availability and accessibility of TCM diabetes guidelines are major barriers. Indeed,
2
3 previous studies have shown that TCM guidelines have been established relatively recently, indicating that
4
5 further investigation focusing on the TCM diabetes guidelines should be required [26]. Meanwhile, it is
6
7 essential to publish these guidelines on multiple platforms, including freely accessible ones, so that all
8
9 physicians can download and study them. In addition, consistent with previous studies, PCPs demonstrated less
10
11 awareness about the latest evidence, in contrast to TCPs. Research conducted by B Carlsen highlighted that
12
13 general practitioners are often confused about the evidence base of extensive guidelines relevant to their
14
15 practice and they experience more practical constraints on guideline implementation [32]. Therefore, while it is
16
17 crucial to prioritize high-level evidence to improve reliability of these guidelines, equal emphasis should also be
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19 placed on training of primary care practitioners.
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25 26 **Strengths and limitations**

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29 This study has several strengths. Firstly, this questionnaire survey was nationally representative and
30
31 provided reliable data on the physicians' familiarity and awareness of both Chinese and international diabetes
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33 guidelines. Our analysis sample included physicians from different medical institutions across 192 cities in 30
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35 provinces of China, which is highly representative. Secondly, we conducted a stratified analysis approach to
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37 obtain more specific and comprehensive results, including the stratification of physicians in different medical
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39 institutions. Thirdly, apart from the self-reported familiarity and reference questionnaire items, we also
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41 designed a wide range of specific questions concerning multiple key recommendations within the current
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43 guidelines, which will allow us to evaluate the physicians' awareness to contents in the guidelines effectively.
44
45 Thus, our findings could provide the latest evidence for future studies focusing on diabetes guidelines in China.
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52 Our study also has certain limitations. Firstly, although the sample is representative of Chinese medical
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54 physicians and a substantial number of physicians (>1000), the findings cannot be automatically applied to
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56 other countries. Secondly, we have not examined variations regarding awareness of physicians, self-reported
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58 reference status of physicians, and barriers to treatment among different age, gender, education, or number of
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1 patients with diabetes received by the physician. Future studies focusing on the influencing factors of
2
3 physicians' compliance with diabetes guidelines will be conducted. Lastly, although we have included
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5 multiple-choice questions to investigate more information, the survey questionnaire has not been generalizable
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7
8 to test all specific aspects related to the physicians' awareness of the diabetes guidelines.
9

10 **5. CONCLUSION**

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13 In conclusion, the level of familiarity and awareness of these four evaluated guidelines varies among
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15 physicians in different-level hospitals. Overall, TCPs generally exhibited the highest familiarity and awareness
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17 of diabetes guidelines. In contrast, the familiarity and awareness of all four guidelines among PCPs are
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19 relatively poor, indicating a necessity of improvement. In addition, there is a significant discrepancy between
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21 modern medicine guidelines and TCM guidelines, highlighting the necessity for further studies focusing on
22
23 TCM diabetes guidelines. Moreover, it's crucial to provide consistent education and training for physicians, in
24
25 particular, PCPs.
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32
33 Association of Chinese Medicine, majority of physicians as members of the Specialist Committee for Primary
34
35 Diabetes Care have participated in the survey questionnaire. We would like to express our gratitude to all the
36
37 participating physicians.
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41
42 **Contributors** Li-yan Jia, Shu-yu Yang designed the research and took full responsibility for the work as a
43
44 whole. Li-yan Jia designed the survey questionnaire, Neng-jiang Zhao, Shun-qin Wang, Bing Yan, Jian-ping
45
46 Liu were all involved in critically revising the questionnaire and provided valuable advice for designing the
47
48 study. Neng-jiang Zhao, Zhi-hai Zhang, Le Li, Na Zhan, Yuan-bing Lin, Miao-na Cai, participated in
49
50 questionnaire distribution and collection. Na Zhan, Yuan-bing Lin participated in questionnaire data checking.
51
52 Li-yan Jia analyzed and interpreted the data, and wrote the paper. Cao-xin Huang, Bao-yong Lai, Jian-ping Liu,
53
54
55 Shu-yu Yang contributed to critically revising the manuscript.
56
57
58
59

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13 **Conflict of interest**

16 All authors declare that they have no conflicts of interest.

18 **Patient and Public Involvement** Patients and/or the public were not involved in the design, or conduct, or
19 reporting, or dissemination plans of our research.

24 **Ethics approval** This study involves human participants and has obtained ethical approval from the Medical
25 Ethics Committee of the First Affiliated Hospital of Xiamen University (No. XMY-2021KY027-02).
26 Participants gave informed consent to participate in the study before taking part.

31 **Abbreviations**

34 ADA American Diabetes Association

36 CACM China Association of Chinese Medicine

39 CDS Chinese Diabetes Society

42 CPGs Clinical practice guidelines

44 IDF International Diabetes Federation

47 PCPs Primary care practitioners

49 SCPs Secondary care hospital physicians

52 SMBG Self-monitoring of blood glucose

55 T2DM Type 2 diabetes mellitus

57 TCM Traditional Chinese medicine

60 TCPs Tertiary care hospital physicians

Data availability statement Data are available upon reasonable request.

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16 17 18 **Figure legends**

19
20
21 Figure 1. Familiarity of physicians from different levels of hospitals with four diabetes guidelines (TCPs,
22
23 tertiary care hospital physicians; SCPs, secondary care hospital physicians; PCPs, primary care practitioners).

24
25
26 Figure 2. Physicians' instruction on self-monitoring of blood glucose and the availability of health management
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28 team (TCPs, tertiary care hospital physicians; SCPs, secondary care hospital physicians; PCPs, primary care
29
30 practitioners)

31 32 33 **Supporting information**

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36 Appendix1. Physicians demographic and profession characteristics

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39 Appendix2. Recommendations excerpted from the diabetes guidelines

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42 Appendix3. Facilitating factors and barriers to diabetes guideline implementation

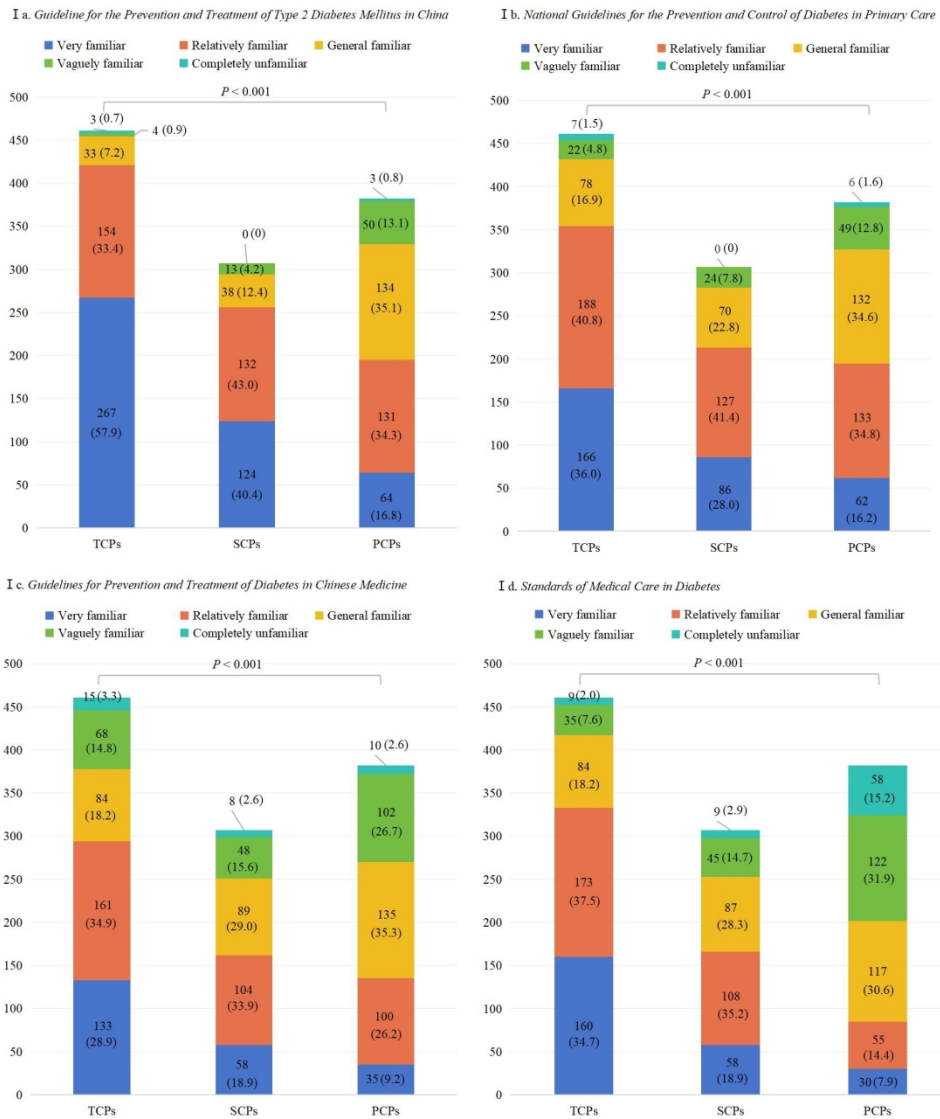


Figure 1. Familiarity of physicians from different levels of hospitals with four diabetes guidelines (TCPs, tertiary care hospital physicians; SCPs, secondary care hospital physicians; PCPs, primary care practitioners)

399x456mm (120 x 120 DPI)

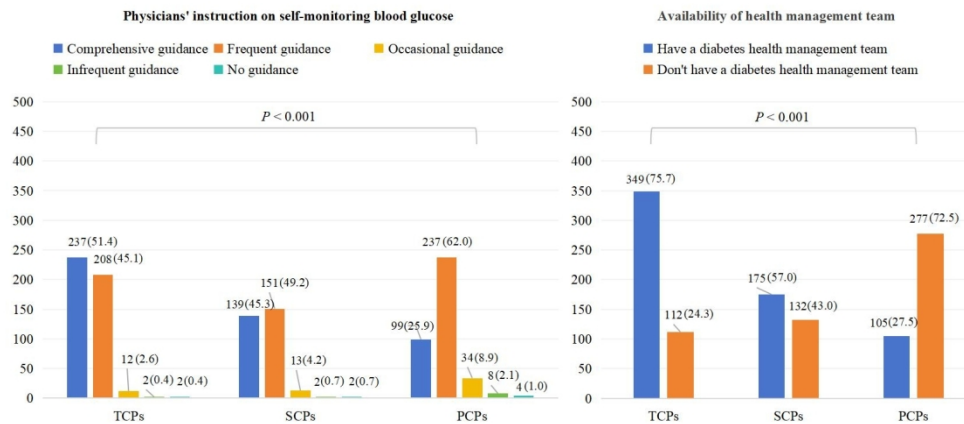


Figure 2. Physicians' instruction on self-monitoring of blood glucose and the availability of health management team (TCPs, tertiary care hospital physicians; SCPs, secondary care hospital physicians; PCPs, primary care practitioners)

365x160mm (120 x 120 DPI)

Appendix 1. Physicians demographic and profession characteristics [n(%)]

Variable	Physicians in different level hospitals			<i>P</i> -value
	Tertiary care hospital physicians (n = 461)	Secondary care hospital physicians (n = 307)	Primary care practitioners (n = 382)	
Age (mean years \pm s.d.)	40.82 \pm 9.21	40.42 \pm 8.78	41.27 \pm 8.13	0.215
Male gender	189 (41.00)	158 (51.47)	209 (54.71)	< 0.001
Education level				< 0.001
Technical secondary and below	0 (0)	1 (0.33)	35 (9.16)	
College degree	7 (1.52)	17 (5.54)	107 (28.01)	
Bachelor degree	169 (36.66)	231 (75.24)	213 (55.76)	
Master degree	222 (48.16)	58 (18.89)	26 (6.81)	
Doctoral degree	63 (13.67)	0 (0)	1 (0.26)	
Professional category				< 0.001
TCM	135 (29.28)	76 (24.76)	88 (23.04)	
Integrated traditional Chinese medicine and western medicine	137 (29.72)	89 (28.99)	81 (21.20)	
Modern clinical medicine	188 (40.78)	140 (45.60)	200 (52.36)	
Other categories	1 (0.22)	2 (0.65)	13 (3.40)	
Years in practice (mean years \pm s.d.)	15.50 \pm 9.82	15.12 \pm 9.00	17.30 \pm 9.05	0.001
Technical title				< 0.001
Junior (Resident physicians)	71 (15.40)	53 (17.26)	170 (44.50)	
Intermediate (Attending physicians)	131 (28.42)	121 (39.41)	137 (35.86)	
Sub-senior (Associate chief physicians)	138 (29.93)	92 (29.97)	67 (17.54)	
Senior (Chief physicians)	121 (26.25)	41 (13.36)	8 (2.09)	
Diabetes practice setting				< 0.001
Department of endocrinology and diabetes	327 (70.93)	171 (55.70)	11 (2.88)	
Department of general practice	14 (3.04)	13 (4.23)	212 (55.50)	
Other departments	120 (26.03)	123 (40.07)	159 (41.63)	
Number of patients with diabetes (per week)				< 0.001
None	4 (0.87)	2 (0.65)	9 (2.36)	
1 ~ 10	99 (21.48)	75 (24.43)	163 (42.67)	
11 ~ 50	133 (28.85)	120 (39.09)	150 (39.27)	
51 ~ 100	115 (24.95)	60 (19.54)	44 (11.52)	
101 ~ 300	98 (21.26)	36 (11.73)	15 (3.93)	
\geq 301	12 (2.6)	14 (4.56)	1 (0.26)	

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4 need to be regularly monitored.
5
6 ①Physical exercise therapy should be conducted
7 Recommendation
8 under the guidance of relevant professionals.
9
10 ②Prior to exercise, necessary health and
11
12 physical ability assessments should be conducted
13 Recommendation
14 3. Physical exercise to ensure the safety and effectiveness of the
15 management exercise therapy.
16
17 ③Physical exercise should be avoided in cases
18
19 of severe hypoglycemia, and can be gradually
20 Recommendation
21 resumed once the condition is under control and
22
23 stabilized.
24
25 ①Classification of hypoglycemia:
26
27 Grade 1 hypoglycemia: Blood glucose levels are
28
29 between 3.0 mmol/l and 3.9 mmol/l; Grade 2
30
31 hypoglycemia: Blood glucose levels are less than
32
33 3.0 mmol/l; Grade 3 hypoglycemia: Recommendation
34
35 Hypoglycemia without a specific blood glucose
36
37 limit, accompanied by severe alterations in
38
39 consciousness and / or physical changes,
40
41 4. Hypoglycemia requiring assistance from others.
42
43 ②The clinical symptoms of hypoglycemia are
44
45 related to the level and rate of decline of blood
46
47 glucose. They can manifest as symptoms of
48
49 sympathetic activation (such as palpitations,
50 Recommendation
51 anxiety, sweating, dizziness, trembling hands,
52
53 and feelings of hunger) and central nervous
54
55 symptoms (such as changes in mental status,
56
57 cognitive impairment, convulsions, and coma).
58
59 5. Diabetes with Qi-Yin ①For the treatment of Qi-Yin deficiency Recommendation
60

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4	deficiency syndrome	syndrome in type 2 diabetes, Jinlida granules and	
5		Shenqi Jiangtang granules can be used in	
6		combination with routine treatment.	
7			
8			
9		②Shengmai Powder, with appropriate	
10		adjustments to dosage, can be used to alleviate	
11		the symptoms of fatigue and Qi-Yin deficiency	Recommendation
12		syndrome in patients with diabetes.	
13			
14		③For the early and middle stages of type 2	
15		diabetes, Gegen Qinlian decoction can be	
16		administered orally for intestinal-damp-heat	
17		syndrome, and Dachaihu Decoction can be	Recommendation
18		administered orally for stagnated-heat in liver	
19		and stomach syndrome.	
20			
21		①For diabetic neuropathy patients with	
22		Qi-deficiency and collateral-obstruction	
23	6. Diabetic neuropathy	syndrome, Mudan granule can be administered	Recommendation
24	with Qi-deficiency and	orally, and can be combined with acupuncture	
25	collateral-obstruction	and fumigation treatment to improve symptoms.	
26	syndrome		
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Appendix3. Facilitating factors and barriers to diabetes guideline implementation [n(%)]

Categories	Overall (n = 1150)	Physicians in different level hospitals			<i>P</i> -value
		Tertiary care hospital physicians (n = 461)	Secondary care hospital physicians (n = 307)	Primary care practitioners (n = 382)	
Facilitating factors					
The guideline can standardize clinical practices and improve the quality of medical care	1100 (95.65)	443 (96.10)	298 (97.07)	359 (93.98)	0.118
Guide patients in self-care and nursing	907 (78.87)	359 (77.87)	247 (80.46)	301 (78.80)	0.691
Guidelines with a high level of evidence can be highly convincing	714 (62.09)	331 (71.80)*	207 (67.43)*	176 (46.07)*	< 0.001
The format of the guidelines is standardized and easy to navigate	657 (57.13)	273 (59.22)*	190 (61.89)*	194 (50.79)*	0.007
The guideline can facilitate communication with patients	686 (59.65)	260 (56.40)*	201 (65.47)*	225 (58.90)*	0.040
Reduce medical costs	627 (54.52)	266 (57.70)	169 (55.05)	192 (50.26)	0.095
Barriers					
Restricted the autonomy of doctors	376 (32.70)	155 (33.62)	96 (31.27)	125 (32.72)	0.793
Requires time-consuming communication with patients	676 (58.78)	242 (52.49)*	184 (59.93)*	250 (65.45)*	0.001
Increases the risk of physicians taking more responsibility for medical malpractice	239 (20.78)	81 (17.57)	69 (22.48)	89 (23.30)	0.087
Limited availability and accessibility of TCM diabetes guidelines	763 (66.35)	317 (68.76)	211 (68.73)	235 (61.52)	0.050
The guideline cannot be downloaded for reading	353 (30.70)	153 (33.19)	99 (32.25)	101 (26.44)	0.084
The guideline recommendation lacks a convincing basis	276 (24.00)	135 (29.28)*	70 (22.80)*	71 (18.59)*	0.001

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60STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page/line numbers
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	Page 1, 2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	Page 2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Page 3, 4
Objectives	3	State specific objectives, including any prespecified hypotheses	Page 4
Methods			
Study design	4	Present key elements of study design early in the paper	Page 5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Page 5, 6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	Page 5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Page 5
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Page 5, 6
Bias	9	Describe any efforts to address potential sources of bias	Page 5
Study size	10	Explain how the study size was arrived at	Page 6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Page 6
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	Page 6
		(b) Describe any methods used to examine subgroups and interactions	Page 6
		(c) Explain how missing data were addressed	NA
		(d) If applicable, describe analytical methods taking account of sampling strategy	NA
		(e) Describe any sensitivity analyses	NA
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Page 6
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Page 6
		(b) Indicate number of participants with missing data for each variable of interest	Page 6
Outcome data	15*	Report numbers of outcome events or summary measures	NA
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear	NA

		which confounders were adjusted for and why they were included	
		(b) Report category boundaries when continuous variables were categorized	NA
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Page 8 to page 12
Discussion			
Key results	18	Summarise key results with reference to study objectives	Page 13
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Page 15
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Page 13 to page 15
Generalisability	21	Discuss the generalisability (external validity) of the study results	Page 15
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Page 16

*Give information separately for exposed and unexposed groups.

NA: Not applicable.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.