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Electronic Health Literacy and its associated factors among adult patients with Type 2 Diabetes Mellitus attending a General Out-patient Clinic in Hong Kong

Chun Kei Ho, Sin Man Kwan, Man Chi Dao, Sau Nga Fu, Chi Wai Chan

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Abstract

Background: Previous studies have suggested a higher electronic health literacy (eHealth literacy) level is associated with better self-care behaviour in Type 2 Diabetes Mellitus (T2DM) patients. There is limited knowledge about the level of eHealth literacy and its predictors in local public healthcare setting.

Objective: This study aims to explore the eHealth literacy level and identifies the association of low eHealth literacy with sociodemographic factors, internet use behaviour and diabetic control among T2DM patients in a General Out-patient Clinic (GOPC) in Hong Kong.

Methods: This is a cross sectional questionnaire study assessing the eHealth Literacy Scale (eHEALS), socio-demographic factors, internet use behaviour and diabetic control of the participants

Results: 360 patients were interviewed with a response rate of 94.8%. The mean age of participants was 63.2 ± 9.8 and 57.2% participants were male. 56.7% of participants had low eHealth literacy and the median eHEALS score was 24 (IQR 21). The associated factors of low eHealth literacy included being older age (p=0.02), lower education (p=0.01), not having searched health information online (p<0.01) and having lower self-perceived health (p<0.01). There was no statistically significant association between eHealth literacy and diabetic control.

Conclusions: More than half of the participants in this study had low eHealth literacy. They were older, with lower educational level, had lower self-perceived health and many of them never search online health information. Further interventions targeting on those patients could be designed. Clinical Trial: Ethics approval has been applied under local Research Ethics Committee with the reference (KW/EX-23-064(187-09).
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Conclusion: More than half of the participants in this study had low eHealth literacy. They were older, with lower educational level, had lower self-perceived health and many of them never search online health information. Further interventions targeting on those patients could be designed.

Keywords: Type 2 Diabetes Mellitus; Electronic Health Literacy; eHEALS; socio-demographic factors

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Background

The number of people with Type 2 Diabetes Mellitus (T2DM) is growing with 1 in 10 people living with DM globally[CITATION Fac24 \l 2057]. In Hong Kong, the prevalence stands at 8.5% [CITATION Cen23 \l 2057] making it the 11th leading cause of death[CITATION Cen \l 2057]. In our local public sector, around 65% of diabetic patients are managed in primary care[CITATION Hos191 \l 2057] and 40% of them were living with at least one complication[CITATION Kun1 \l 2057]. T2DM is an important disease in primary care and a major health burden worldwide.

Patient's active participation and self-care are the cornerstone in the management of T2DM[CITATION Shr13 \l 2057]. In the post-COVID era, the source of health information has transformed from traditional methods, such as doctor consultations or leaflets, to electronic resources. While technology offers the potential to enhance healthcare accessibility, disparities in access remain a significant issue[CITATION Mis22 \l 2057]. Electronic health literacy (eHealth literacy) refers to a person's ability to appraise health information from electronic sources and apply the knowledge gained to addressing or solving a health problem[CITATION Nor06 \l 2057]. Studying the level of eHealth literacy among T2DM patients allows us to explore the gap in skills and access to electronic resources and would guide us in the development of tailored telehealth intervention.

Previous research showed that T2DM patients with higher eHealth literacy engaged better in health-promoting behaviours [CITATION Kim18 \l 2057] and self-management[CITATION Lee24 \l 2057]. There is limited data directly linking eHealth literacy and diabetic control. In contrast, studies on health literacy, which is defined as an individual's ability to find, understand and use information and services to inform health-related decisions and actions for themselves [CITATION Cen03 \l 2057], have shown a positive association with better diabetic control and fewer complications [CITATION Sch02 \l 2057]. It is yet to find out whether the association between eHealth literacy and diabetic control follows that of previous studies on Health Literacy.

There is limited data on the general level of eHealth literacy among diabetic patients. A study involving 453 patients with elevated cardiovascular risk in Australia revealed that 34% of patients belonged to low eHealth literacy group[CITATION Ric17 \l 2057]. Similarly, research among 277

healthy elderlies in China showed that 30% had low eHealth literacy[CITATION Xie23 \l 2057]. In contrast, a local pilot study in Hong Kong among elderlies found out 66% had low eHealth literacy[CITATION HKU23 \l 2057]. There is conflicting data on factors affecting eHealth literacy among different patient groups. Among patients with chronic diseases, lower education level, female gender and lower income were associated with worse eHealth literacy [CITATION Ric17 \m Roj21 \l 2057]. Conversely, a study in the United States on T2DM patients found male gender was associated with lower eHealth literacy while age did not play a part[CITATION Apo15 \l 2057]. A study in Korean T2DM patients showed older age, lower education and less frequent internet use were associated with worse eHealth literacy[CITATION Kim18 \l 2057]. Locally, there has been limited research on eHealth literacy among T2DM patients and a study among the general public showed older age, lower education and personal income were negatively correlated with eHealth literacy[CITATION Guo21 \l 2057]. There is gap in knowledge on the level of eHealth literacy among diabetic patients in government funded primary care services. It is difficult to identify generalisable predictors of eHealth literacy to all populations and limited investigation has been done on the demographic, social and economic determinants among local T2DM patients.

The aim of this study is to identify the demand and characteristics of T2DM patients in General-Outpatient Clinic (GOPC) who may need enhancement in using DM electronic resources. The primary objective is to determine the proportion of T2DM patients with low eHealth literacy in a GOPC in Hong Kong. The secondary objective is to identify the association between low eHealth literacy with sociodemographic factors, habit of using internet, smart phone, mobile apps and their diabetic control.

Methodology

Study design

The study was a cross-sectional study carried out in a GOPC in Hong Kong from 15 October 2023 to 31 January 2024. The inclusion criteria included T2DM patients who attended GOPC, had at least 2 regular follows-up for T2DM in this GOPC in the past 12 months, aged 18 or above and could read or write Chinese and give informed consent. The exclusion criteria were patients who were not internet user and Type 1 DM patients. Those who had not used electronic devices, internet service,

had not searched health or DM information online were excluded.

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Sampling

A list of patients with International Classification of Primary Care (ICPC) code T90 (Diabetes; non-insulin-dependent) was drawn by the Hospital Authority's Clinical Data Analysis and Reporting System (CDARS). Simple random sampling was used. The selected patients were approached by doctors during consultation or nurses during complication screening sessions. The doctors and nurses marked down the questionnaire handed out for calculating the response rate.

Sample size calculation

Sample size was calculated with the equation $n=Np(1-p)/[(d^2/Z^2_{1-\alpha/2}*(N-1)+p*(1-p))$. Given a confidence level (d) of 95%, a population proportion (p) of 34% in similar patient group[CITATION Ric17 \l 2057], population of T2DM patient (N) in this clinic of 4000, the sample size calculated is 318. With a potential non-respondent rate of 10%, around 9% who were not internet user [CITATION Sta22 \l 2057], at least 388 patients have to be recruited.

Assessing eHealth Literacy Level: The eHealth Literacy Scale (eHEALS)

eHealth literacy Level can be measured by different tools, common tools including eHEALS, Digital Health Literacy Instrument and eHealth Literacy Questionnaire. eHEALS is chosen because it is the most commonly used and well validated tool for measuring eHealth literacy[CITATION Ngu16 \l 2057]. It assesses an individual's self-perceived skills in using information technology for health management [CITATION Nor06 \l 2057]. It contains 8 questions on a 5 point Likert Scale and the sum of the 8 questions adds up to give the total eHEALS score. The score ranges from 8 – 40. The translated Chinese version of eHealth literacy Scale was adopted with permission from the author. It is validated with a Cronbach alpha of 0.891 and a Content validity index of 1.00 [CITATION Won19 \l 2057]. As suggested by previous literature, we divided eHEALS into 2 groups with high eHEALS (≥ 26) and low eHEALS (<26) [CITATION Ric17 \l 2057 \m Lee23 \m Lea22].

Questionnaire

The questionnaire was constructed after review of literature to identify factors that affect electronic health literacy among T2DM patients. It includes 4 parts namely eHEALS, socio-demographics factors (Gender, Age, Smoking Status, Education Level, Employment status, Living condition, Marital status, Comprehensive Social Security Assistance), internet use behaviour (use of smart phone, use

of HA GO (Hospital Authority mobile application), Availability of Computer at home, Able to use Computer, Use of internet, Search health information online, Search diabetes information) and the diabetic control and complications (duration of DM, Number of oral hypoglycaemic agent, use of insulin, HbA1c level, DM complications and whether DMCS done in the past 3 years). (Appendix 1)

Statistical Analysis

The data were analysed with IBM Statistical Product and Service Solutions (SPSS) version 25 software. The mean, median, interquartile range and standard deviation were derived. Normality test was done for continuous variable. Univariable analysis was explored with Chi Square test, Student's t-test and Mann Whitney U test to compare the demographics, internet use behaviour and diabetic control between high eHEALS and low eHEALS groups. Statistically significant variables were put into Binary Logistic Regression for Multivariable Analysis.

Ethical Considerations

Participants were asked to give informed consent before enrolling in the study. Information sheet was provided and the study design was explained to the patient. Ethics approval has been applied under local Research Ethics Committee with the reference (KW/EX-23-064(187-09).

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Results

Demographics (Figure 1 and Table 1)

A total of 464 individuals were approached and response rate was 94.8% (420/464) (Figure 1). 86.3%(360/417) participants were internet user and 360 subjects entered statistical analysis. The mean age of participants was 63.2 (SD 9.8). 57.2% (206/360) participants were male, 36.4% (131/360) had an education level up to primary school, 68.9% (248/360) were married and 43.9% (158/360) were currently employed. Around 11% received Comprehensive Social Security Assistance (CSSA) which is the local social welfare protection for low-income group. Most participants (74.7%) perceived their health as average or below.

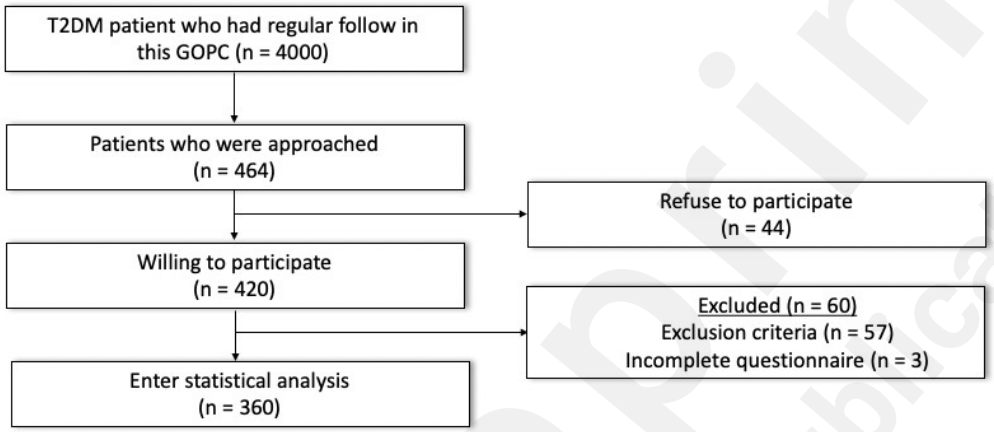


Figure 1. Flow chart of simple random sampling. T2DM: Type 2 Diabetes Mellitus

eHealth Literacy – level of eHEALS

Among all the participants, 56.7% of them had low eHEALS (eHEALS < 26). The median score of eHEALS was 24 (IQR = 21) and the mean was 22.4 (SD 9.8). The median eHEALS score for Low eHEALS group was 15 marks lower than high eHEALS group.

Internet use behaviour (Table 2)

Almost all the participants (96.7%) were smart phone user. Among those with low eHEALS, fewer used HAGO (40.7% vs 74.4%, p<0.01), which is the local Hospital Authority mobile application. Those with low eHEALS were less able to use computer (17.2% vs 66.0%, p<0.01) and did not have a habit of searching health information online (23.0% vs 81.4%, p<0.01) or DM information online (25.0% vs 76.3%, p<0.01).

Diabetic Control and Complication (Table 3)

There was no statistically significant difference for HbA1c control and diabetic complications between the two groups.

Associated factors of Low eHealth Literacy (Table 4)

After adjusting for the demographic, socioeconomic and internet use behaviour, the associated factors for low eHealth literacy were older age, lower education level, poor self-perceived health and no habit of searching health information online. Participants aged 65 and older were 2.25 times more likely to have low eHealth literacy (p=0.02). Having educated secondary or above made participants 0.42 times less likely to have low eHEALS (p=0.01). Individuals who perceived themselves as being in good health were 0.33 times less likely to have low eHEALS (p<0.01). Those who searched health information online were 0.18 times less likely to have low eHEALS (p<0.01). Among all, whether a participant searched health information online was the strongest protective factor against low eHealth literacy.

Discussion

Principal findings

This research revealed the proportion of T2DM patients in a GOPC with low eHealth literacy was 56.7%. The associated factors of low eHealth literacy included being older age, lower education, not having searched health information online and having lower self-perceived health. There was no statistically significant association between eHealth literacy and diabetic control.

The proportion of participants with low eHealth literacy aligns with a local pilot study which revealed around 66% elderly had low eHEALS[CITATION HKU23 \l 2057]. In contrast, a study conducted in Australia on patients at elevated cardiovascular risk revealed 34% belonged to low eHealth literacy[CITATION Sch02 \l 2057], while another research on Chinese elderlies showed 30.3% had low eHealth literacy[CITATION Xie23 \l 2057]. The mean eHEALS score in our study was 22.4, which was lower when compared to previous research on chronic diseases (eHEALS mean: 27–30/40 [CITATION Ric17 \l 2057 \m Guo211 \m Pai17]). Compared to research from China and Overseas, the participants in our study had a significantly lower education level where more than 90% had education below secondary school compared to studies in Australia (26.7%)

[CITATION Ric17 \l 2057] and Taiwan (39.5%)[CITATION Guo211 \l 2057]. Additionally, participants in our study belonged to older age group (Mean age 63.2, SD 9.8) compared to study in the United States (Mean age 47.4, SD 17.1)[CITATION Pai17 \l 2057].

Previous research in Korea also showed older age and lower education were associated factors for low eHealth literacy[CITATION Kim18 \l 2057].The younger generation has more exposure to internet technology and internet use is incorporated in the school curriculum. Higher education also allows participants to develop technical skills required to seek out electronic health information. They tend to be more proactive in utilising electronic tools to help their health. Previous research showed searching health information online helped improve eHealth literacy[CITATION Kim18 \l 2057]. Our study also showed patients with average or poor self-perceived health tended to have lower eHealth literacy which was also reported in local research[CITATION Won14 \l 2057]. Those with lower self-perceived health are usually less motivated in self-care and are less confident in using digital tools to help their health.

Although this research did not establish association between eHealth literacy and diabetic control, previous research had linked eHealth literacy with health-promoting behaviours among T2DM patients[CITATION Kim18 \l 2057]. These behaviours included checking blood sugar, diet control, exercise and foot care which are essential to diabetic self-care. The lack of association could be attributed to many of participants still relying on traditional routes to obtain health information such as television programmes, radio or newspapers. The diabetic control also relies on other factors such as medication compliance, diet or exercise, which may be further studied.

Implication for practice and future research

This research revealed 56.7% of T2DM patients had low eHealth literacy. This provides valuable insight in policy making for primary care sectors. Older individuals and those with lower education levels are more likely to have low eHealth literacy, to whom socially disadvantaged groups often belong. We could take advantage where around 95% of patients with low eHEALS are smartphone users and collaborate with non-government organisations to offer lessons on searching for health information online and utilising healthcare apps. For future research, we could conduct multi-centre research to map out the overall situation in Hong Kong. Studies can be done to investigate the

barriers to telehealth and to bridge disparity in digital access.

Strength and Limitation

This research is the first to examine eHealth literacy among T2DM patients in Hong Kong and we had a high response rate of up to 95%. There are several limitations. First, this study was a single-centre study which limited the generalisability of the results. A cause and effect relationship cannot be established with current study design. Second, the mean score of eHEALS in our study did not follow normal distribution and it could not be directly compared to other research. It was still included in the discussion as there was a marked difference in the mean eHEALS score when compared to other studies. Third, eHEALS was based on a scale and there was no set cut-off when it was designed in 2006. The cut-off we used in this study was adopted from previous similar research, which may affect its reliability. Last but not the least, eHEALS tool is a self-reported tool that does not directly measure skills and knowledge on use of the internet and It is also not tailored to diabetic patients.

Conclusion

More than half of the participants in this study has low eHealth literacy. They were older, with lower educational level, had lower self-perceived health and many of them never search online health information. Further interventions targeting on those patients could be designed.

Acknowledgement

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Conflicts of Interest

None declared

Reference

CITATION Fac24 \l 2057 : , (1),
CITATION Cen23 \l 2057 : , (2),
CITATION Cen \l 2057 : , (3),
CITATION Hos191 \l 2057 : , (4),
CITATION Kun1 \l 2057 : , (5),
CITATION Shr13 \l 2057 : , (6),

CITATION Mis22 \l 2057 : , (7),
CITATION Nor06 \l 2057 : , (8),
CITATION Kim18 \l 2057 : , (9),
CITATION Lee24 \l 2057 : , (10),
CITATION Cen03 \l 2057 : , (11),
CITATION Sch02 \l 2057 : , (12),
CITATION Ric17 \l 2057 : , (13),
CITATION Xie23 \l 2057 : , (14),
CITATION HKU23 \l 2057 : , (15),
CITATION Ric17 \m Roj21 \l 2057 : , (13,16),
CITATION Apo15 \l 2057 : , (17),
CITATION Kim18 \l 2057 : , (9),
CITATION Guo21 \l 2057 : , (18),
CITATION Sta22 \l 2057 : , (19),
CITATION Ngu16 \l 2057 : , (20),
CITATION Nor06 \l 2057 : , (8),
CITATION Won19 \l 2057 : , (21),
CITATION Ric17 \l 2057 \m Lee23 \m Lea22: , (13,22,23),
CITATION Sch02 \l 2057 : , (12),
CITATION Ric17 \l 2057 \m Guo211 \m Pai17: , (13,24,25),
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Table 1. Univariable analysis (Chi Square test and Mann Whitney U) of demographics in eHealth literacy

Variable	Low eHEALS (< 26), (n = 204) n (%)	High eHEALS (≥ 26) (n = 156), n (%)	Overall (n = 360), n (%)	*p* value
Age				< 0.01**
≤ 50	8 (3.9)	28 (17.9)	36 (10.0)	
51 – 64	73 (35.8)	86 (55.1)	159 (44.2)	
65 – 79	106 (52.0)	39 (25.0)	145 (40.3)	
≥ 80	17 (8.3)	3 (1.9)	20 (5.6)	
Gender				< 0.01**
Male	101 (49.5)	105 (67.3)	206 (57.2)	
Female	103 (50.5)	51 (32.7)	154 (42.8)	
Education level				< 0.01**
Primary or below	109 (53.4)	22 (14.1)	131 (36.4)	
Secondary	90 (44.1)	109 (69.9)	199 (55.3)	
Tertiary or above	5 (2.5)	24 (16.1)	30 (8.3)	
Work				< 0.01**
Unemployed	43 (21.1)	19 (12.2)	62 (17.2)	
Employed	68 (33.3)	90 (57.7)	158 (43.9)	
Retired	93 (45.6)	47 (30.1)	140 (38.9)	
Marital Status				< 0.01**
Married	150 (73.5)	98 (62.8)	248 (68.9)	
Not Married	54 (26.5)	58 (37.2)	112 (31.1)	
Living condition				0.13
Lives alone	25 (12.3)	28 (17.9)	53 (14.7)	
Lives with family	179 (87.7)	128 (82.1)	307 (85.3)	
CSSA				0.05
No	175 (85.8)	144 (92.3)	319 (88.6)	
Yes	29 (14.2)	12 (7.7)	41 (11.4)	
Self-perceived health				< 0.01**
Poor	19 (9.3)	6 (3.8)	25 (6.9)	
Average	153 (75.0)	91 (58.3)	244 (67.8)	
Good	28 (13.7)	53 (34.0)	81 (22.5)	
Very good	4 (2.0)	4 (3.4)	8 (2.2)	
Excellent	0 (0.0)	2 (1.3)	2 (0.6)	
eHEALS score, median (IDR)	16.0 (16.0)	31.0 (3.0)	24.0 (21.0)	< 0.01**
eHEALS score, mean (SD)	15.65 (7.36)	31.33 (3.52)	22.4 (9.83)	< 0.01**

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Table 2. Univariable analysis (Chi Square test) of internet use behaviour in eHealth literacy. HAGO: Hospital Authority mobile application

Variable	Low eHEALS (< 26), (n = 204) n (%)	High eHEALS (≥ 26) (n = 156), n (%)	Overall (n = 360), n (%)	*p* value
Use of smart phone	193 (94.6)	155 (99.4)	348 (96.7)	0.01*
Use HAGO	83 (40.7)	116 (74.4)	199 (55.3)	< 0.01**
Computer with internet access	84 (41.2)	103 (66.0)	187 (51.9)	< 0.01**
Able to use computer	35 (17.2)	103 (66.0)	138 (38.3)	< 0.01**
Use of internet service	74 (36.3)	122 (78.2)	196 (54.4)	< 0.01**
Search health information online	47 (23.0)	127 (81.4)	174 (48.3)	< 0.01**
Search DM information online	51 (25.0)	119 (76.3)	170 (47.2)	< 0.01**

Table 3. Univariable analysis (Chi Square test and Mann Whitney U) of diabetic control in eHealth literacy. T2DM: Type 2 Diabetes Mellitus

Variable	Low eHEALS (< 26), (n = 204) n (%)	High eHEALS (≥ 26) (n = 156), n (%)	Overall (n = 360), n (%)	*p* value
Duration of T2DM				0.23
0 – 4	79 (38.7)	73 (46.8)	152 (42.2)	
5 – 9	64 (31.4)	47 (30.1)	111 (30.8)	
≥ 10	61 (29.9)	36 (23.1)	97 (26.9)	
HbA1c Control				0.35
< 7.0	121 (59.3)	97 (62.2)	218 (60.6)	
7.0 – 7.9	53 (26.0)	44 (28.2)	97 (26.9)	
> 8.0	30 (14.7)	15 (9.6)	45 (12.5)	
HbA1c Control, Median (IQR)	6.80 (0.8)	6.70 (0.9)	6.80 (0.8)	0.11
T2DM Complication				0.67
No	148 (72.5)	110 (70.5)	258 (71.7)	
Yes	56 (27.5)	46 (29.5)	102 (28.3)	

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Table 4. Multivariable analysis (Binary Logistic Regression) of associated factors of low eHealth literacy (* reference group)

Variables	Odds Ratio (95% Confidence Interval)	*p* value
Age		
< 65 years old *	2.25 (1.17 – 4.34)	0.02
≥ 65 years old		
Education Level		
Primary or Below *	0.42 (0.21 – 0.83)	0.01*
Secondary or Above		
Self-Perceived Health		
Poor or Average *	0.33 (0.17 – 0.66)	<0.01**
Good/ Very Good/ Excellent		
Search health information online		
No *	0.18 (0.07 – 0.44)	<0.01**
Yes		

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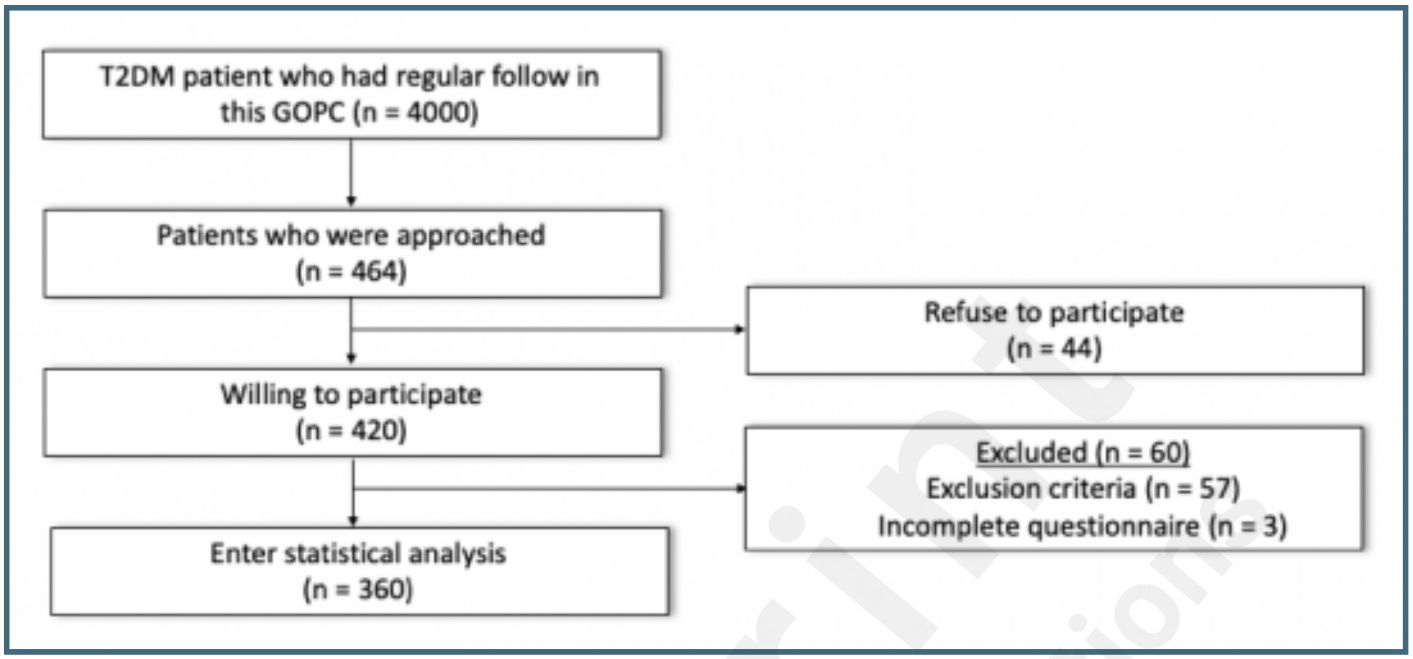
Supplementary Files

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Figures

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Flow chart of simple random sampling. T2DM: Type 2 Diabetes Mellitus.



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