

Original Research Article

Assessment of a patient-centered pictogram to pharmacist-led tele-counselling in Type 2 diabetes mellitus management: A cross-sectional study in Indonesia

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Abstract

Purpose: To develop, validate, and evaluate Indonesian-specific pictograms intended to support pharmacist-led tele-counselling for patients with T2DM.

Methods: A quantitative cross-sectional study with a test–retest design was conducted over six months at a tertiary hospital outpatient clinic in Surabaya, Indonesia. Adults aged 35–65 years with T2DM, who were literate and without visual impairment, were recruited using accidental sampling. A questionnaire containing 38 pictograms addressing medication instructions, insulin timing, injection, storage, lifestyle, and diet was developed based on international guidelines and the literature. The questionnaire was reviewed by three pharmacists and one endocrinologist. Comprehension was assessed twice, with a four-month interval. Pictograms achieving comprehension rates of at least 66.7 % (ISO 9186) were accepted. Chi-square tests examined differences within pictogram sets, and Wilcoxon signed-rank tests assessed test–retest reliability.

Results: Fifty-five patients completed both rounds of assessment. Most participants were female (63.6 %), aged 56–65 years (56.4 %) and had at least a senior high school education (78.2 %). Many pictograms demonstrated high comprehension, often exceeding 90 % for medication timing and insulin instructions. Lifestyle pictograms also performed well, with comprehension rates of at least 78 %. Seventeen pictograms met all criteria and demonstrated stability over time ($p > 0.05$). Indonesia-specific pictograms for T2DM are highly comprehensible and reliable.

Conclusion: The selected pictograms support pharmacist-led tele-counselling, enhance digital communication, and address health literacy barriers.

Keywords: Diabetes Mellitus, Health care, Pictogram, Digital health

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INTRODUCTION

The escalating prevalence of diabetes mellitus (DM) represents a pressing global health crisis. The International Diabetes Federation (IDF) reports that 537 million people are affected,

projected to reach 643 million by 2030. Low health literacy drives this surge, exacerbated by inadequate lifestyle knowledge and medication non-adherence, which compromise blood glucose and HbA1c control [1,2]. Pharmacists are uniquely positioned to enhance literacy

through targeted education, particularly using mobile communication technology, which is a commonly accepted mode of communication in developing countries, including Indonesia. Remote pharmacy services, such as tele-counselling (remote counselling via video calls, WhatsApp, telephone, or text), can be an effective way to accelerate access and communication between pharmacists and patients. Despite its convenience, tele-counselling may carry significant risks, including the potential for misleading information and false interpretation of medication instructions. Therefore, a pictogram – a standardised graphic image with concise text – can enhance comprehension, safety, and adherence. Pictograms are useful to improve DM literacy, especially among low-literacy patients [3]. Studies in India, Sri Lanka, and Thailand confirm that culturally adapted pictograms boost comprehension during pharmacist counselling [2,4,5]. From the patient's perspective, pictograms are easy to understand and remember [6,7].

Pharmacists commonly use pictograms for patient education. With the advent of mobile technology, pictograms can be used to improve digital tele-counselling, assisting pharmacists to explain diseases and medicines. [9]. Unfortunately, pictogram-based tele-counselling [5] remains underexplored in Indonesia. Therefore, this study addresses the gap by developing, validating and measuring the reliability of Indonesia-specific pictograms (with text) for T2DM patients.

METHODS

Study design, setting, and participants

A quantitative, cross-sectional study employing a test–retest design was conducted over six months, from April to July, at the outpatient clinic of a tertiary hospital in Surabaya, Indonesia. Ethical approval was obtained from the institutional Human Research Ethics Committee prior to study initiation.

Eligible participants were adults aged 35 – 65 years diagnosed with type 2 diabetes mellitus (T2DM). Inclusion criteria were: (a) no visual impairment, (b) ability to read and write, and (c) provision of informed consent. Individuals who submitted incomplete responses were excluded. Participants were recruited using an accidental sampling method. The study was conducted in accordance with the *Strengthening the Reporting of Observational Studies in Epidemiology* (STROBE) guidelines.

Sample size

The minimum sample size was calculated to be 55 subjects using Eq 1 [10]:

$$n = \frac{Z^2 P(1-P)}{e^2} \dots\dots\dots (1)$$

where $Z = 1.96$ (for a 95 % confidence level), P represents the expected proportion, and $e = 0.05$ is the margin of error.

Assessment development, validity, and reliability of pictograms

A questionnaire comprising 38 pictograms was developed based on two primary sources: ISO 9186 standards and WHO medication pictogram guidelines. The pictogram set was reviewed by an expert panel comprising three pharmacists and one endocrinologist to assess content validity, accuracy, and cultural suitability. Revisions were incorporated according to expert feedback.

The final pictogram set was organised into three thematic sections: Medication use instructions (16 pictograms); Insulin timing, injection sites, and storage (16 pictograms); and Lifestyle and dietary guidance (6 pictograms). Validity and reliability were assessed through a two-stage user-testing process. In the first stage, the questionnaire was distributed to eligible participants. Four months later, the same group was invited to complete the questionnaire again to assess test–retest reliability. Comprehension rate (Cr) was calculated using Eq 2.

$$Cr = (Pn/Pt)100 \dots\dots\dots (2)$$

Where Pn is the number of participants who correctly interpreted the pictogram, while Pt is the total number of participants

According to ISO 9186 criteria, pictograms with a comprehension rate greater than 66.7 % were considered acceptable.

Data analysis

Descriptive statistics were used to analyse respondent characteristics and comprehension results. Chi-square test was performed to examine associations between categorical variables and frequency of pictogram selection. Wilcoxon signed-rank test was used to determine test–retest reliability of paired pictogram comprehension scores. All analyses were conducted using IBM SPSS Statistics version 26

(IBM Corp., Armonk, NY, USA), and $p < 0.05$ was considered statistically significant.

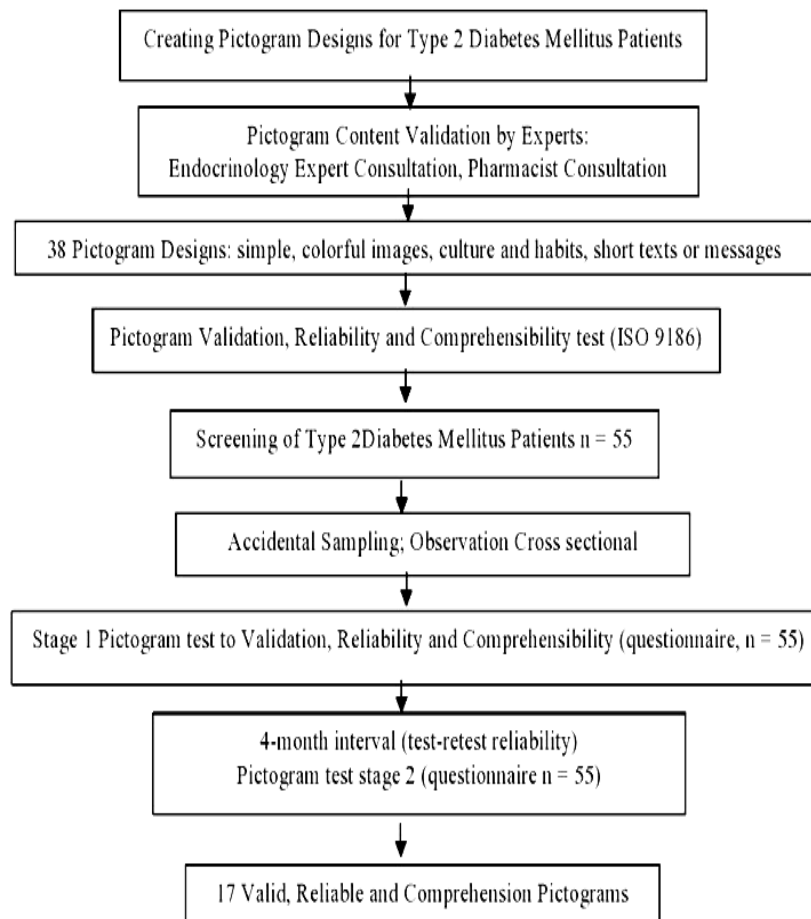


Figure 1: Pictogram validation steps for type 2 diabetes mellitus patients

Table 1: Demographic characteristics of participants based on the results of the pictogram validation questionnaire for type 2 DM patients

RESULTS

Participant characteristics

A total of 55 patients with type 2 diabetes mellitus completed the study and were included in the analysis (Table 1). Most participants were female (63.6 %), and more than half were aged 56–65 years (56.4 %). The majority had completed senior high school (78.2 %), while 18.2 % had higher education, and none had only elementary schooling. Most respondents had lived with diabetes for 1 – 5 years (65.5 %), with smaller proportions reporting 6 – 10 years (18.2 %), 11 – 15 years (5.5 %), and more than 15 years (10.9 %). The demographic characteristics of the participants are presented in Table 1.

Variable	Number of participants = n (%)
Gender	
Male	20 (36.4)
Female	35 (63.6)
Age (Year)	
35 – 45	6 (10.9)
46 – 55	18 (32.7)
56 – 65	31 (56.4)
Level of education	
Elementary School	0 (0)
Junior High School	2 (3.6)
Senior High School	43 (78.2)
Higher Education	10 (18.2)
Duration of suffering from diabetes (years)	
1 – 5	36 (65.5)
6 – 10	10 (18.2)
11 – 15	3 (5.5)
>15	6 (10.9)

Pictogram comprehension in Test 1 and Test 2

All 38 pictograms were evaluated in two rounds of testing (Table 2). Across the three sections (medication use instructions, insulin timing/injection/storage, and lifestyle/dietary guidance), several pictograms consistently achieved high comprehension rates exceeding the ISO 9186 threshold of 66.7 % in both tests.

In Section 1, pictograms illustrating taking medicines before meals (Pictogram 3), during meals (Pictogram 5), and after meals (Pictogram 8) showed high comprehension in both Test 1 and Test 2, with over 90 % of participants selecting these options correctly. Pictograms indicating morning, noon, and nighttime medicine intake (e.g., Pictograms 9, 11, and 14) also demonstrated acceptable comprehension, although some alternative designs in the same category received lower proportions of votes.

In Section 2, pictograms related to insulin pen storage before and after use (Pictograms 18 and 19), insulin injection sites (Pictogram 21), and injection timing (e.g., Pictograms 23, 26, 27, 29, and 31) reached high comprehension rates, often above 90 % in one or both test rounds. Similarly, Section 3 pictograms describing exercise or physical activity (Pictogram 33), recommended foods (Pictogram 35), and foods to avoid (Pictogram 37) were well understood by participants, with comprehension rates generally ≥ 78 % and some reaching 100 % in Test 1. Chi-square analysis showed statistically significant differences in the distribution of responses within each pictogram set ($p < 0.05$), indicating a clear preference for specific pictogram designs in most categories. The results of the pictogram comprehension in test 1 and test 2 are presented in Table 2.

Test–retest reliability

Test–retest reliability between Test 1 and Test 2 was evaluated for each pictogram using the Wilcoxon signed-rank test (Table 2). For the majority of pictograms selected as final designs, p -values were greater than 0.05, indicating no significant difference between Test 1 and Test 2 scores and suggesting stable comprehension over time. Pictograms for taking medicines before meals (Pictogram 3), during meals (Pictogram 5), after meals (Pictogram 8), morning/noon dosing (Pictograms 9 and 11), and

insulin-related instructions (Pictograms 18, 21, 23, 26, 27, 29, and 31) showed acceptable test–retest reliability.

Final selection of pictograms

Based on comprehension rate (≥ 66.7 %), statistical significance within each pictogram group, and test–retest reliability, 17 pictograms were selected as the final set for pharmacist-led tele-counselling (Table 3). These included seven pictograms for medication use instructions (Pictograms 3, 5, 8, 9, 11, and 14), eight pictograms for insulin timing, injection site, and storage (Pictograms 18, 19, 21, 23, 26, 27, 29, and 31), and three pictograms for lifestyle and dietary guidance (Pictograms 33, 35, and 37). Each selected pictogram corresponded to a key message in type 2 diabetes management, such as timing of oral medicines, insulin storage before and after use, injection timing relative to meals, physical activity recommendations, and healthy versus unhealthy foods. The results of the pictograms selected are presented in Table 3.

DISCUSSION

A set of Indonesia-specific pictograms was developed and validated to support pharmacist-led tele-counselling in the management of type 2 diabetes mellitus (T2DM). Most pictograms demonstrated high comprehension and acceptable test–retest reliability among outpatients. These findings suggest that carefully designed, culturally adapted visual aids can effectively communicate essential information regarding medication use, insulin administration, and lifestyle modification to this population [11,12].

Most pictograms met or exceeded the ISO 9186 comprehension threshold of 66.7 %, with many achieving comprehension rates above 90 % in both test rounds. This was particularly evident for pictograms related to the timing of oral medication and insulin-related instructions [8,13]. Patients accurately interpreted these visual cues during remote counselling sessions. Another significant finding is the stability of comprehension over time, as indicated by non-significant test–retest differences for most selected pictograms [7].

Table 2: Comprehension rate and significance of differences among pictograms

Type of Pictogram	TEST 1 Comprehension rate n (%)	Significance ^a	TEST 2 Comprehension rate n (%)	Significance ^a	Test-retest reliability between Test 1 and Test 2 ^b
Section One					
Medication use instruction					
<i>Taking medicine before meals</i>					
Pictogram 1	0 (0.0)	0.000	3 (54.5)	0.000	0.739
Pictogram 2	4 (7.3)		1 (1.8)		
Pictogram 3	51 (92.7)		51 (92.7)		
<i>Taking medicine during meals</i>					
Pictogram 4	1 (1.8)	0.000	2 (3.6)	0.000	0.564
Pictogram 5	54 (98.2)		53 (96.4)		
<i>Taking medicine after meals</i>					
Pictogram 6	1 (1.8)	0.000	2 (3.6)	0.000	0.630
Pictogram 7	3 (5.5)		3 (5.4)		
Pictogram 8	51 (92.7)		50 (91.0)		
<i>Taking medicines in the morning</i>					
Pictogram 9	39 (70.9)	0.003	38 (69.1)	0.0036	0.808
Pictogram 10	16 (29.1)		17 (30.9)		
<i>Taking medicines at noon</i>					
Pictogram 11	39 (70.9)	0.000	37 (67.3)	0.000	0.480
Pictogram 12	15 (27.3)		16 (29.1)		
Pictogram 13	1 (1.8)		2 (3.6)		
<i>Taking medicines at night before bedtime</i>					
Pictogram 14	37 (67.3)	0.000	22 (40.0)	0.000	0.674
Pictogram 15	12 (21.8)		19 (34.5)		
Pictogram 16	6 (10.9)		14 (24.5)		
Section Two					
Insulin timing, injection sites and storage					
<i>Insulin pen storage after use</i>					
Pictogram 17	18 (32.7)	0.0014	17 (30.9)	0.006	0.715
Pictogram 18	37 (67.3)		38 (69.1)		
<i>Insulin pen storage before use</i>					
Pictogram 19	55 (100)	0.000	53 (96.4)	0.000	0.157
Pictogram 20	0 (0)		2 (3.6)		
<i>Insulin injection site</i>					
Pictogram 21	52 (94.6)	0.000	53 (96.4)	0.000	0.655
Pictogram 22	3 (54.5)		2 (3.6)		
<i>Injected the night before bedtime</i>					
Pictogram 23	52 (94.5)	0.000	50 (76.4)	0.000	0.480
Pictogram 24	3 (5.5)		5 (23.6)		
<i>Injected before breakfast</i>					
Pictogram 25	0 (0)	0.000	3 (5.5)	0.000	0.830
Pictogram 26	55 (100)		52 (94.5)		
<i>Injected after dinner</i>					
Pictogram 27	53 (96.4)	0.000	51 (92.7)	0.000	0.414
Pictogram 28	2 (3.6)		4 (7.3)		
<i>Injected before lunch</i>					
Pictogram 29	55 (100)	0.000	55 (100)	0.000	0.564
Pictogram 30	0 (0)		0 (0)		
<i>Injected before dinner</i>					
Pictogram 31	53 (93.4)	0.000	55 (100)	0.000	0.414
Pictogram 32	2 (3,6)		0 (0)		
Section Three					
Lifestyle and dietary guidance					
<i>Exercise or physical activity</i>					
Pictogram 33	52 (94.5)	0.000	52 (94.5)	0.000	1.000
Pictogram 34	3 (5.5)		3 (5.5)		
<i>Diet plan</i>					
Pictogram 35	55 (100)	0.000	53 (93.4)	0.000	0.157
Pictogram 36	0 (0)		2 (3.6)		
<i>Poor lifestyle</i>					
Pictogram 37	43 (78.2)	0.000	48 (87.3)	0.000	0.285
Pictogram 38	11 (21.8)		7 (12.7)		

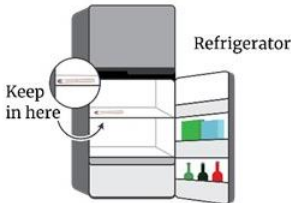
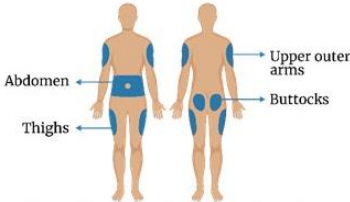
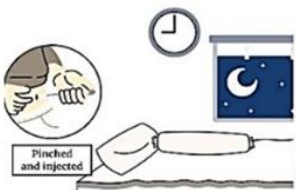
^a $p < 0.05$; ^b $p > 0.05$

Table 3a: Selected pictogram based on comprehension rate

No	Selected pictogram	Visual of pictogram	Description
1	Pict. 3	 Taking medicine 5 - 15 minutes before meals	Taking medicines before meals
2	Pict. 5	 Eating two spoons of meal before taking medicine, then continuing to have meals	Taking medicines during meals
3	Pict. 8	 Eating some meals first, then 1 hour later taking medicine	Taking medicines after meals
4	Pict. 9	 Taking medicine in the morning	Taking medicines in the morning
5	Pict. 11	 Taking medicine at noon	Taking medicines at noon
6	Pict. 14	 Taking medicine at night	Taking medicines at night
7	Pict. 18	 Store insulin pen after usage in room temperature around 15 - 30 °C	Insulin pen storage after use

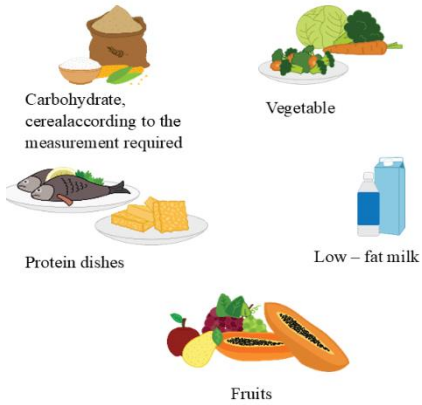
a = Chi - square test; b = Wilcoxon sign rank test

Table 3b: Selected pictogram based on comprehension rate

No	Selected pictogram	Visual of pictogram	Description
8	Pict. 19	 Refrigerator Keep in here Store insulin pen in the chiller (not in freezer) around 2 - 8 °C before usage	Insulin pen storage before use
9	Pict. 21	 Abdomen Thighs Upper outer arms Buttocks Insulin injection sites located in subcutaneous area in upper outer arms, thighs, buttocks, and abdomen.	Area of insulin pen injection
10	Pict. 23	 Pinched and injected Insulin injection at night	Insulin pen injection time at night
11	Pict. 26	 Insulin injection in the morning, before breakfast	Insulin pen injection time before breakfast
12	Pict. 27	 Insulin injection at night, after dinner	Insulin pen injection after dinner
13	Pict. 29	 Insulin injection before lunch	Insulin pen injection time before lunch

a = Chi - square test; *b* = Wilcoxon sign rank test

Table 3c: Selected pictogram based on comprehension rate *Contd*

No	Selected pictogram	Visual of pictogram	Description
14	Pict. 31		Insulin pen injection time before dinner
15	Pict. 33		Physical activity: Walking for 30 minutes, 3 times a week
16	Pict. 35		Recommended foods
17	Pict. 37		Foods to avoid

a = Chi - square test; b = Wilcoxon sign rank test

The Wilcoxon signed-rank test demonstrated that comprehension of key pictograms, including those related to medication timing, insulin storage, injection sites, and lifestyle advice, remained consistent over a four-month interval. This supports their reliability for repeated use in long-term telecounseling. Temporal stability is crucial in chronic disease management [14], where consistent message reinforcement is necessary.

The final set of 17 pictograms covers medication instructions, insulin timing and administration, and lifestyle and dietary guidance. High comprehension rates for lifestyle pictograms, such as those depicting physical activity, recommended foods, and foods to avoid, indicate that complex behavioural advice can be effectively communicated visually. These results support the integration of pictograms into pharmacist-led education for patients with diverse health literacy levels [15–17]. The present findings align with previous research

from India, Sri Lanka, and Thailand, which demonstrates that culturally adapted pictograms enhance patient comprehension and promote safer medication use compared to text-only instructions [2,4,5]. Consistent with these studies, the current research shows that pictograms are particularly effective for conveying temporal and procedural information, such as dosing relative to meals and insulin injection schedules. In this study, pictograms for “before meals,” “during meals,” and “after meals” dosing, as well as those for insulin timing and storage, achieved very high comprehension rates, reflecting patterns observed in other Asian contexts [2,4].

This study extends prior research in several important ways. While many existing studies have evaluated pictograms primarily in face-to-face or clinic-based counselling as adjuncts to verbal explanations, the present study was explicitly designed for tele-counselling [3,8]. The

First, although telepharmacy and mobile health services are rapidly expanding in low- and middle-income countries, few studies have focused on pictogram tools specifically designed for tele-counselling contexts [21]. Previous pictogram studies seldom considered how images would be shared, viewed, and interpreted during remote consultations, where physical demonstration and non-verbal clarification are limited. By focusing on pharmacist-led telecounselling in Indonesia and designing pictograms suitable for mobile communication, such as images sent via WhatsApp or embedded in telehealth platforms, this study directly addresses this gap [22,23].

Second, few regional studies integrate ISO-based criteria, expert review, patient testing, and reliability assessment within a single process. The present study employed ISO 9186 comprehension standards, expert panels, test-retest methods, and statistical analyses (chi-square and Wilcoxon signed-rank) to select the final pictograms. This systematic approach enhances rigour compared to studies that rely solely on cross-sectional comprehension testing [22]. The development of Indonesia-specific pictograms that meet international standards, demonstrate temporal stability, and are intended for tele-counselling addresses a critical gap in T2DM self-management within digital pharmacy settings [16]. These pictograms serve as a resource for clinicians and provide a model for standardising visual communication in chronic disease care [20].

pictograms were developed for transmission and interpretation via digital platforms, including messaging applications and video or telephone consultations [6]. Additionally, whereas earlier research often focused on single domains, such as oral medication instructions or lifestyle guidance, this study developed and tested an integrated set that encompassed oral medication instructions, insulin-related messages, and lifestyle guidance, specifically tailored to T2DM [18,19].

Test-retest reliability over four months was also examined, an aspect of pictogram research that is seldom addressed. The results indicate that pictograms can be used repeatedly in ongoing diabetes care without a loss of clarity. This study addresses two significant gaps at the intersection of health literacy, digital health, and pharmaceutical care [20].

In clinical practice, the validated pictogram set offers pharmacists a practical, standardised tool to improve the clarity and safety of tele-counselling, especially when working with patients with limited literacy or when non-verbal cues are limited by remote communication [23]. Incorporating these pictograms into mobile health applications, electronic reminders, and telepharmacy workflows may reduce misinterpretation of instructions, support adherence, and potentially improve glycaemic outcomes [3,9,11]. At the system level, the development approach described here can inform national or institutional initiatives to standardise visual aids in chronic disease. For research purposes, this study provides data on the psychometric performance of pictograms developed for diabetes tele-counselling and presents a framework that can be adapted to other diseases. Future research should assess the effects of pictograms on behavioural and clinical outcomes and evaluate their use in real-time telecounselling. Additional studies may investigate patient preferences and design features to enhance subgroup effectiveness [20,21].

Limitations of this study

The sample was drawn from a single tertiary hospital outpatient clinic in Surabaya using accidental sampling, which may restrict generalisability to other regions, primary care settings, or rural populations. Participants generally had higher educational attainment, potentially limiting the representation of individuals with very low literacy. The study evaluated comprehension and reliability but did

not directly measure behavioural or clinical outcomes. Therefore, improved understanding cannot be assumed to result in better adherence or glycaemic control [9,10]. The four-month test–retest interval may have allowed for knowledge changes or recall effects, although most pictograms showed stable performance. Additionally, the evaluation was conducted using a structured questionnaire rather than during live telecounselling sessions, which may not capture all nuances of real-world application. Despite these limitations, this study provides a robust foundation for the use of culturally adapted pictograms to support pharmacist-led telecounselling in T2DM. The pictogram set offers a practical tool that can be implemented and further evaluated in both clinical and digital health practice [5,6,23].

CONCLUSION

This study has developed and validated culturally adapted pictograms to support pharmacist-led tele-counselling for T2DM in Indonesia. Most pictograms met ISO 9186 comprehension standards and demonstrated acceptable test–retest reliability, particularly for oral medication timing, insulin use, and lifestyle recommendations. The findings suggest that standardised pictograms can effectively convey essential self-management messages and may help address health literacy barriers in remote diabetes care. The resulting set of 17 pictograms offers a practical tool for telepharmacy workflows and mobile health platforms. Future studies should examine the effects of pictogram use on adherence, self-care behaviours, and glycaemic outcomes, and evaluate its implementation in real-world telecounselling settings.

DECLARATIONS

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Ethical Approval

This study received ethical approval from the Ethics Committee of Haji Hospital in Surabaya, East Java, Indonesia, with approval number: 445/66/committee.ethics/2023.

Use of Artificial intelligence/Large language models

The authors confirm that AI-based tools were used solely for language editing and manuscript polishing purposes (e.g., grammar, phrasing, and clarity). No AI tools were used to generate content, interpret data, or influence study design, results, or conclusions. All intellectual contributions, study analyses, and interpretations reported in the manuscript are the original work of the authors.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Conflict of interest

No conflict of interest is associated with this work.

Contribution of authors

We declare that this work was done by the author(s) named in this article, and all liabilities pertaining to claims relating to the content of this article will be borne by the authors. The authors declare that this work was done by the authors named in this article and all liabilities pertaining to claims relating to the content of this article will be borne by the authors.

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