Development and evaluation of pictograms to improve adherence to treatment in patients with type 2 diabetes mellitus and hypertension

Desarrollo y evaluación de pictogramas para mejorar la adhesión al tratamiento en pacientes con diabetes mellitus tipo 2 e hipertensión arterial

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◈ Abstract

The World Health Organization (who) states that diabetes mellitus type 2 (dmt2) and arterial hypertension (hypertension) represent pathologies of increasing incidence in ages ranging from young people to the elderly, causing death and reducing healthy years of life in these patients. Collaterally, those suffering from these diseases present psychological symptoms that interfere with how they cope with the diseases and have an unfavorable impact on adherence to their treatment.

This work aims to present the process carried out to develop and evaluate pictograms as motivational incentive images for patients with chronic degenerative diseases such as type 2 diabetes mellitus and arterial hypertension, which were used in a digital application. The process for developing and evaluating these pictograms was structured in three stages: 1) definition of the messages to be communicated; 2) design and development of pictogram proposals; and 3) evaluation and selection of the best proposals for communicating the message.

The results suggest that the developed process can effectively design and evaluate pictograms to communicate positive moods, thus contributing to a better mood of patients and improving their adherence to treatment.

Keywords: pictograms, diabetes mellitus type 2, arterial hypertension, design, assessment

◈ Resumen

La Organización Mundial de la Salud (oms) manifiesta que la diabetes mellitus tipo 2 (dmt2) y la hipertensión arterial (hta) representan patologías de creciente incidencia en edades que van desde los jóvenes hasta los adultos mayores, causando la muerte y disminuyendo años de vida saludables de estos pacientes. Colateralmente, quienes padecen estas enfermedades presentan síntomas a nivel psicológico que interfieren en la manera en la que afrontan las enfermedades y tienen una repercusión no favorable en la adhesión al tratamiento de las mismas.

El objetivo de este trabajo es presentar el proceso que se realizó para desarrollar y evaluar pictogramas como imágenes incentivantes motivacionales para pacientes con enfermedades crónico degenerativas como la diabetes mellitus tipo 2 y la hipertensión arterial, mismos que fueron utilizados dentro de una aplicación digital. El proceso para el desarrollo y evaluación de dichos pictogramas estuvo estructurado en tres etapas: 1) definición de los mensajes a comunicar; 2) diseño y desarrollo de propuestas de pictogramas; y 3) evaluación y selección de las mejores propuestas para la comunicación del mensaje.

Los resultados sugieren que el proceso desarrollado puede ser eficaz para el diseño y evaluación de pictogramas para comunicar estados de ánimo positivos y así contribuir a un mejor estado de ánimo de los pacientes y mejorar su adhesión al tratamiento.

***Palabras clave:** pictogramas, diabetes mellitus tipo 2, hipertensión arterial, diseño, evaluación*

◈ **Introduction**

The present research was part of a broader linkage project between researchers from the Centro Universitario de Ciencias de la Salud (cucs) and the Centro Universitario de Arte, Arquitectura y Diseño de la Universidad de Guadalajara (cuaad), with an industry in the pharmaceutical sector. The project included the development of a digital nutritional intelligence application for patients with type 2 diabetes mellitus (dmt2) and hypertension (hta). This article specifically reports the participation of the cuaad research team, which included the development of motivational images called "pictograms", intending to alleviate the emotional state presented by the patients, incorporating the aforementioned pictograms in the recipes of each patient's nutritional plan.

This work aims to present the process carried out to develop and evaluate pictograms as motivational incentive images for patients with chronic degenerative diseases such as type 2 diabetes mellitus and arterial hypertension. These images were used within a digital application as part of the follow-up of the medical treatment of palliative intervention in the psychological symptomatology of patients seeking better adherence to treatment. It is important to note that this work does not report the subsequent use of the pictograms and/or the development of the digital application.

a) Diabetes mellitus type 2 and arterial hypertension

The World Health Organization points out that type 2 diabetes mellitus and arterial hypertension represent pathologies of increasing incidence in the general population from the age of 18 onwards but that they are especially relevant in older adults, causing thousands of deaths each year and reducing the healthy life years of the people who suffer from them. Collaterally, these patients present symptoms at the psychological level that interfere with their ability to cope with the disease, to lead a healthy quality of life and better adherence to treatment.

In Mexico, the Federación Mexicana de Diabetes, A.C. specifies that of the citizens who presented dtm2 and hta as of the first half of 2017,

just over one-fifth are located in the considered productive age, while those diagnosed with obesity increase, for the same age group, to about half of the total.

The problem with these pathologies is that they can leave sufferers incapacitated or lead to other fatal diseases. The Ministry of Health (ssa) has set as one of its main challenges to address and reduce this type of chronic non-communicable conditions since 70% of the Mexican population has obesity, 30% hypertension and 9% diabetes, according to statistics from the federal agency itself. mtd2, as referred to by Noda, Pérez, Malaga and Aphang (2008), is a chronic metabolic disease associated with the development of irreversible, disabling and even fatal complications, with a significant impact on quality of life if inadequately treated. A basic condition for the quality of life of patients not to be affected in a complicated way is that the patient adheres to the treatment, which can only be achieved if the patient internalizes what it means to be a carrier of the disease and the potential complications to which he/she is exposed while understanding the rationality and risks of the treatment. To achieve all this requires the patient to have adequate knowledge about the disease.

A satisfactory state of health for these patients is a core element for the performance of any activity, so its loss also alters the daily functioning of those who face this situation, compromising their quality of life. From the point of view of Behavioral Medicine and Health Psychology, quality of life denotes how the individual responds to daily situations (Moreno and Ximénez, 1996). Health as a component of quality of life has become one of the variables that affects other components of patients' daily lives, such as work, autonomy, social relations, leisure, emotional state, etc., and therefore it is progressively occupying a central place, alerting us to the need to intensify strategies for the detection, control, treatment and prevention of arterial hypertension and diabetes in Mexico.

On the other hand, Almeida and Matos (2003) have observed that metabolic control and therapeutic adherence can be predicted through psychological variables, such as emotional and instrumental coping and medical social support. The aim is to use this knowledge to design and, if necessary, implement interventions that restore or improve the population's quality of life and therapeutic adherence to the aforementioned conditions. To test the efficacy of these interventions, adequate, sensitive, valid and reliable recording and observation systems are required from the point of view of the behavior of patients with these pathologies (Riveros, Cortazar-Palapa, Alcazar and Sánchez-Sosa, 2005).

Its diagnosis alone implies the loss of health status and the implementation of care and new routines to follow the health care team's instructions. In the case of patients with diabetes, higher levels of depression (up to six times higher than in the rest of the population), anxiety,

stress, hostility, low self-esteem, and feelings of hopelessness and handicap have been reported (Velasco and Sinibaldi, 2001). In the case of arterial hypertension, stress and anxiety is a dimension naturally associated with it because of the physiological reactions involved (Varela, 2010). Moreover, because of their symptomatology, patients with hypertension are more likely to develop an anxiety disorder compared to other chronic conditions.

Therefore, the literature exposes the importance of adherence to treatment in relation to patients' quality of life. That is why the development of this research focused on the emotional aspect, intending to contribute to the improvement of the patient's quality of life in relation to their nutritional treatment.

b) Motivation and positive reinforcers

The term motivation derives from the Latin *movere* (to move). The Royal Academy Dictionary defines it in its third meaning as "preparatory mental rehearsal of an action to encourage or be encouraged to perform it with interest and diligence" (2022, s. p.). The latter perfectly defines the concept that can be referred to in the educational context. Pintrich and Schunk (2006) define motivation as the process that directs us towards the objective or goal of an activity, that instigates and maintains it; while for Boza and Tozcano (2012) it is more a process than a product implies the existence of some goals, requires some activity (physical or mental), and is a determined and sustained activity.

A distinction is usually made between extrinsic and intrinsic motivation. Extrinsic motivation is that which leads to the performance of a task as a means to an end and, therefore, depends on external incentives. Extrinsic incentives provide satisfaction independent of the activity itself. In contrast, intrinsic motivation does not depend on external incentives inherent to the activity. Intrinsically motivated activities are interesting in themselves and do not need any reinforcement. These two types of motivation are not polar opposites and are linked to time and context (Pintrich and Schunk, 2006).

The present research focused on extrinsic motivation, which, as already mentioned, requires external incentives, in this case, called positive reinforcers, which, according to the behaviorist approach, occur through instrumental conditioning, where feedback is produced following the reinforced response. In this case, the positive reinforcer, according to Rojas (2001), is a stimulus whose presence makes a behavior stronger.

Today, there is evidence of the development and use of digital applications that seek to function as reinforcers to improve mental health (Rodríguez-Riesco & Senín-Calderón, 2022) and improve adherence to clinical treatments (Porras-Leiva, Richmond-Solera, García-Calvo &

Jensen, 2016). It highlights that digital applications often use pictograms to act as reinforcers and as an effective resource for transmitting messages.

c) Pictograms

Since a core ingredient of the deterioration of these patients in their human behavior is psychological, the treatment of the areas affected by the disease process should allow the patient to restore and/or improve their therapeutic adherence, emotional well-being and quality of life. In this sense, the present research proposes using motivational incentive images or pictograms. Prado and Avila (2010) point out that pictograms primarily describe actions and functions through images of familiar objects, which do not require special learning to understand the message. The primary interest in generating them was to serve as positive reinforcers in the daily life of the patients.

These pictograms are designed considering the following recommendations to make them legible and understandable, according to Prado and Avila (2010):

a) Design several symbols for the message.

b) The design of the pictogram must present a defined limit and the closing of the form.

c) The pictogram must take up the aspects of the balance of the form.

d) Include enough detail in the pictogram (and no more) to make it recognizable.

e) Use some type of border.

f) When there is doubt about the user's understanding, labels and figures should be used.

g) Consider sight distance and illumination.

h) Test the effectiveness using perceptual experimentation.

◈ Methodology

The process for the development and evaluation of pictograms was a cross-sectional study structured in the following stages: 1) definition of the messages to be communicated; 2) design and development of pictogram proposals; and 3) evaluation and selection of the best proposals for the communication of the message.

Stage 1. Definition of the messages to be communicated

For the design and development of pictograms, clearly defining the messages to be communicated is of fundamental importance. The process of defining the messages began at a stage before this study as part of the activities of the research team at cucs. At that stage, two scales were used to assess the emotional state of patients with dtm2 and hta. The scales used were: 1) the Hostility subscale of the adult dsm-5 personality inventory (pid-5) by Krueger, Derringer, Markon, Watson and Skodol (2013); and 2) the Perceived Stress Scale (pss) by Remor (2006).

The Hostility subscale of the adult dsm-5 (pid-5) personality inventory contains descriptions, symptoms and other criteria for diagnosing mental disorders and consists of 10 items. The results are coded under three levels: a) low level of hostility, b) moderate level of hostility and c) high level of hostility. The Perceived Stress Scale was designed to measure the degree to which life situations are rated as stressful. The Spanish version of the pss consists of 14 items. The results are coded under four levels: a) no perceived stress, b) very low level of perceived stress, c) moderate level of perceived stress and d) high level of perceived stress.

Based on the combination of the Hostility and Stress Scale categories, a first description of mood types was generated. For example, a combination of low hostility and no stress resulted in a "controlled cheerful" mood. Then, since the aim was to improve the patients' emotional states, creating an antonym was proposed to generate a positive reinforcer. Thus, except for the controlled cheerful state, an antonym was created for each of the 12 mood states created from the combination of the two scales. Table 1 shows the values of hostility and stress, the description of the result of their combination and the antonym for each of these states. From this stage, it was decided that the messages to be communicated should be associated with the positive reinforcers.

Table 1. Description of mood states and their positive reinforcers.

Hostility	Strees	Description	Antonyms for positive reinforces
1. Low	No	Cheerful controlled	Cheerful controlled
2. Low	Under	Cheerful insecure	Cheerful sure
3. Low	Medium	Nervous cheerful	Cheerful serene-tranquil
4. Low	High	Uncontrolled Cheerful	Cheerful controlled
5. Media	No	Half angry controlled	Controlled satisfied medium
6. Media	Under	Half angry insecure	Satisfied medium safe
7. Media	Medium	Nervous half-angry	Half-satisfied safe-quiet
8. Media	High	Half angry, out of control	Controlled satisfied medium
9. High	No	Controlled anger	Satisfied controlled
10. High	Under	Angry insecure	Satisfied for sure
11. High	Medium	Angry nervous	Satisfied, confident, calm
12. High	High	Angry out of control	Satisfied controlled

Source: Own elaboration.

Once the positive reinforcers were available, the CUAAD research team prepared a pencil and paper survey, which was structured about the 12 possible combination categories of the Hostility and Stress Scales. The objective of the survey was to identify actions associated with each of the positive reinforcers, which would be the basis for the design and development of the pictograms in the subsequent stage.

The sample of participants in the survey consisted of 25 people, men and women, whose ages ranged from 28 to 63 years. The non-probabilistic snowball sampling technique was used. The inclusion criterion was anyone with a diagnosis of type 2 diabetes mellitus and/or arterial hypertension issued by a health professional who was willing to collaborate in the present investigation and who responded fully to the application of the instrument (survey). Table 2 shows the incomplete sentences used in the survey.

Table 2. Phrases to identify actions associated with positive reinforcers

When you finish reading the sentence, write down the first action that comes to your mind
1. When I feel Cheerfully controlled, I...
2. When I feel Cheerful for sure, I...
3. When I feel Cheerful, serene-tranquil, I...
4. When I feel Cheerfully controlled, I...
5. When I feel half satisfied and controlled, I...
6. When I feel halfway satisfied, for sure, I...
7. When I feel half-satisfied, safe-quiet, I...
8. When I feel half satisfied and controlled, I...
9. When I feel Satisfied and controlled, I...
10. When I feel satisfied for sure, I...
11. When I feel Satisfied, safe calm, I...
12. When I feel Satisfied and controlled, I...

Source: Own elaboration.

Stage 2. Design and development of pictogram proposals.

After identifying the actions associated with the positive reinforcers, we developed the design of proposals for the pictograms. At this stage, three graphic design students were invited to generate three proposals for each of the actions to be represented. Each student developed proposals for four of the actions. In total, 36 proposals were designed, which are described and presented in Table 3 in the following stage.

The proposals for the pictograms were developed following the guidelines of Prado and Avila (2010) and with the following technical specifications: Pantone 7683CP blue color (according to NOM-026-STPS-2008); Arial Black font: from 40pts to 80pts depending on the phrase; square shape (according to NOM-026-STPS-2008).

Stage 3. Evaluation and selection of pictograms for message communication.

A pencil and paper survey was conducted to evaluate the pictograms developed in stage 2. The sample consisted of 105 people of both sexes, aged between 20 and 85 years. The non-probabilistic snowball sampling technique was used. Any subject with a diagnosis of type 2

diabetes mellitus and/or arterial hypertension issued by a health professional who was willing to collaborate in the investigation and who completed the survey was included.
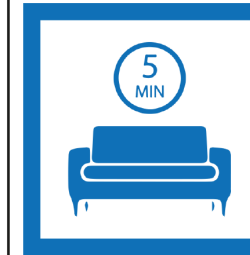
As part of the procedure, participants were asked to fill in demographic data for the description of the population; then they were shown the 12 actions associated with mood states according to the antonyms obtained in the previous stages and the images associated with those actions previously designed in the form of pictograms. They were asked to choose the pictogram that best represented the described action.
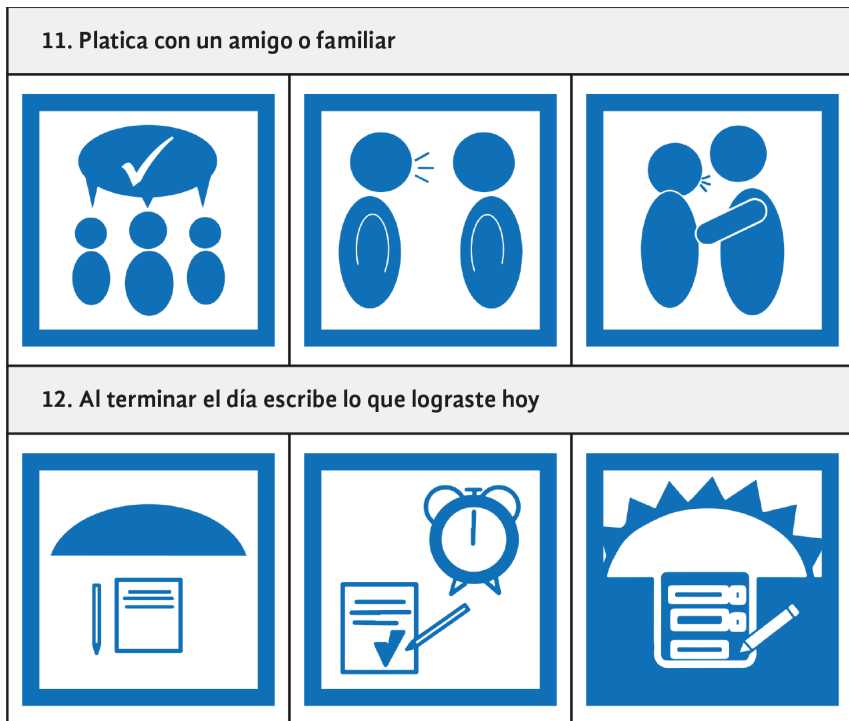
Table 3 shows part of the instrument used and the 36 images associated with the 12 actions identified with the positive reinforcers.

Table 3. Pictograms designed around positive reinforcers

Instructions:
Look carefully at each of the images and MARK WITH AN **X** the action you think is most closely associated with the described action.

1. Live with family or Friends

2. Read a good book

3. Watch a movie while relaxing on the couch

4. Exercise and enjoy it

5. Strive for what you do

6. Eating whatever your doctor suggests is nutritious

7. Take a 5-minute break

8. Meditate in your bed relaxed for 5 minutes

9. At the end of each meal, give yourself a smile

10. Listen to music

11. Platica con un amigo o familiar

12. Al terminar el día escribe lo que lograste hoy

Source: Own elaboration.

It is important to note that, during all stages of this project, ethical considerations were made based on the Regulations of the General Health Law on Health Research (1987), Title Two, Chapter I, Article 17, under which the present research is considered to be of minimal risk. The identity of each participant was kept strictly confidential. In addition, verbal consent was requested to apply the instrument (survey).

◈ Results

The results obtained in stage 2, that is, in the application of the surveys of the association of phrases according to the category of the Hostility Subscale of the adult DSM-5 personality inventory (PID-5) and the Perceived Stress Scale (PSS) are as follows:

Twenty-five subjects participated, of whom 72% were female and 28% male, with ages ranging from 28 to 63 years. The total population had a bachelor's degree education, all diagnosed with type 2 diabetes mellitus and/or arterial hypertension.

Table 4 describes the actions that had a greater association with positive reinforcers linked to mood states, processed in the Atlas Ti program, for qualitative analysis.

Table 4. Positive reinforcers and their associated actions

Antonyms for positive reinforcers	Actions associated with moods according to antonyms
1. Cheerfully controlled	Living with others (family-friends)
2. Cheerfully sure	Read a good book
3. Cheerfully serene-tranquil	Watch a movie while relaxing on the couch
4. Cheerfully controlled	Do any exercise and enjoy it
5. Controlled satisfied médium	Strive for what you do
6. Satisfied medium safe	Eating whatever your doctor suggests is nutritious.
7. Half-satisfied safe-quiet	Take a 5-minute break
8. Controlled satisfied médium	Meditate in your bed relaxed for 5 minutes
9. Satisfied controlled	At the end of each meal, give yourself a smile
10. Satisfied for sure	Listen to music
11. Satisfied, confident, calm	Talk to a friend or family member
12. Satisfied controlled	At the end of the day, write down what you achieved today

Source: Own elaboration.

The descriptions of the referred actions were the ones that gave the guideline for elaborating the motivational incentive images or pictograms.

The results of stage 3 were obtained by implementing the SPSS 23.0 computer statistical processor. A total of 105 surveys were administered, 66 of which were answered by female participants (63%), while 39 were answered by male participants (37%). The ages of the participants ranged from 20 to 85 years, with a mean of 44 years. Three segments were grouped according to Papalia, Wendkos and Duskin (2010), concerning the stage of development, as described below: in Early Adulthood (20 to 40 years), 35% of the study population was concentrated, in Middle Adulthood (40 to 65 years) 55%, that is, half of the surveyed population, and in Late Adulthood (65 years and older) only 10% of the participants.

The educational level of the population was distributed as follows: elementary school (9%), secondary school (13%), technical level (6%), high school (11%), college (46%) and postgraduate (15%). Of the participants, 45% reported having a diagnosis of MTD2, 37% of HT and 18% of both.

Table 5 below shows each positive reinforcer, the action associated by the participants, the pictogram chosen by the highest number of respondents and the percentage received of the three proposed motivational incentive images called "pictograms".

Table 5. Results for the **selected** pictogram

Positive reinforcers	Actions associated with moods	Pictogram elected	Percentage assigned by respondents
1. Cheerfully controlled	Living with others (family-friends)		37%
2. Cheerfully sure	Read a good book		54%
3. Cheerfully serene-tranquil	Watch a movie while relaxing on the couch		55%
4. Cheerfully controlled	Do any exercise and enjoy it		65%
5. Controlled satisfied medium	Strive for what you do		49%
6. Satisfied medium safe	Eating whatever your doctor suggests is nutritious		69%

7. Half-satisfied safe-quiet	Take a 5-minute break		47%
8. Controlled satisfied medium	Meditate in your bed relaxed for 5 minutes		77%
9. Satisfied controlled	At the end of each meal, give yourself a smile		44%
10. Satisfied for sure	Listen to music		57%
11. Satisfied, confident, calm	Talk to a friend or family member		45%
12. Satisfied controlled	At the end of the day, write down what you achieved today		50%

Source: Own elaboration.

Based on these images, a new evaluation and redesign of the pictograms was suggested before they were implemented in the corresponding *app* and used to benefit adherence to the treatment of patients with the chronic conditions in question. Similarly, the following suggestions were made for the use of the incentive images:

1. It is suggested that the **location of the information** be at the TOP LEFT, since it has been proven that when reading a text on a full page or on a computer screen, it is easier to locate

the information (Grahame, Laberge and Scialfa, 2004; Woodson and Conover, 1973; in Prado and Avila, 2010).

2. It is suggested that the orientation of the information be horizontal, since it is recognized much faster than information placed vertically, according to Prado and Avila (2010).

3. It is suggested that the motivational incentive image that starts the recipe on MONDAY be the one that contains the PHRASE. For example: "Listen to music" would go with the image and subsequently, the other days would only present the image without the label.

◈ Conclusions

This work aimed to present the process carried out to develop and evaluate pictograms as motivational incentive images for patients with chronic degenerative diseases, such as type 2 diabetes mellitus and arterial hypertension, which could be used as part of a digital application. Therefore, the work shows the different stages that were followed to achieve this, from the generation of the messages to the development of the pictograms and their evaluation.

In general, it can be concluded that implementing such pictograms with actions at the psychological level in medical interventions can effectively improve patients' mood and, therefore, their treatment. However, it is also recognized that the pictogram proposals are susceptible to improvement, which would be achieved with an iterative process over the evaluation and redesign stages.

On the other hand, it should be clarified that the design of the pictograms, their shape and, above all, their color, do not cause any confusion in the visual perception and positive reinforcing function in patients if they are presented in black and white, on a computer screen or on printed paper, since the reinforcement of the behavior is found in the image that represents the action (Prado and Avila, 2010).

Regarding the possibility of adherence to treatment and metabolic control, as mentioned by Almeida and Matos (2003), it can be predicted that, through emotional support using certain instruments, these patients contribute to a better state of their mental health. In this case, the design of motivational images can contribute to the improvement in their daily life and to the consistency in the intake of the medications for their treatment.

However, it is important that further research is conducted to corroborate both the positive results of this intervention with patients with the aforementioned symptomatologies, as well as the actions suggested in

each of the pictograms while identifying the significance in the quality of life of people and their treatment adherence.

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