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Original Article

A Physician's Perspective on the Incorporation of Pictograms as a Supplement to Medical Instructions in Chile: A Pilot Study

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HIGHLIGHTS

- This study aims to construct pictograms as a complement to medical indications.
- The instructions considered most relevant describe mainly pharmacological treatment.
- Most of the instructions-pictograms were judged essential and useful by the experts.
- We aim to design new pictograms to complement the medical instructions of this study.

GRAPHICAL ABSTRACT

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ABSTRACT

Introduction and objectives: Current models of health care are progressively migrating to more participatory models, where for treatment to achieve results that last over time, there must be effective communication between the patient, his or her caregivers, and health professionals. Although the use of pictograms in the context of medical instructions has been widely studied, in our country, there are no studies about their usefulness, or which set of symbols should be used by the systems. This work aims to present the first step towards the development of platforms that automatically suggest pictograms to supplement medical instructions for primary care settings in Chile.
Materials and methods: In this pilot study, we collected and analyzed the physicians' opinions on the selection of medical instructions that later will automatically be supplemented by the software that is under construction. We designed an expert validation survey using a set of 66 medical instructions with pictograms. This survey provided three rating options for each medical instruction: Not necessary (supplementing the instruction with a pictogram does not carry any value), Useful (supplementing the instruction with a pictogram may help patients to understand and remember the instruction), and Essential (supplementing the instruction with a pictogram is essential). Seventy-one physicians responded to the survey.
Results: 22 out of 66 medical instructions were considered "essential" by >=51% of the experts, and 12 of the 66 were considered to be "useful but not essential" by >=51% of the experts.

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Conclusion: Results of our survey validate the potential use of pictograms as a complement to better comprehension of medical instructions in our country.

1. Introduction

As a result of advances in medicine and public health, healthcare information systems are in a state of permanent reform and renewal [1]. Current healthcare models are migrating to a more participatory approach that not only considers the patients as protagonists of their treatment but also their environment to achieve results that prevail over time [2]. Therefore, health professionals need to develop effective communication strategies to promote self-care and healthy lifestyles in patients and their caregivers. An effective communication process between health professionals and patients will result in the understanding and successful application of the post-treatment medical instructions.[1] The actual communication of discharge instructions is impacted by factors that can negatively influence the understanding and retention of the information given, which is a prerequisite for treatment adherence [3,4]. By definition, understanding is the cognitive process by which the receiver creates a mental image of the transmitted message, based on data provided by a transmitter. For the receiver, making sense of the transmitted message not only depends on the concept but also perception, attention, and memory [5]. Often clinical personnel give medical instructions to the patient in haste and using complex medical language [6–8]. Studies of patients' understanding of medical instructions show that patient self-reported understanding is higher than their actual understanding [3,9]. The literature states that a person immediately forgets between 40% and 80% of the information given, and up to 50% of the recalled information may not be correct [10,11]. These findings reveal the risk to patients' treatment adherence and the possibility of risky behaviors caused by not understanding the information provided [12]. The consequences range from an increase in health expenditure, caused by multiple consultations, impoverishment of health status, or re-hospitalizations, to the death of the patient. In 2009, Engel et al. [13] studied the understanding of discharge instructions by patients attending two different hospital emergency rooms in Michigan, USA. They interviewed 140 randomly selected adult patients' who were in the discharge process. Patients were asked to rate their level of understanding in each of the domains covered by an emergency discharge sheet; scores ranged from 1 (poor) to 5 (excellent). The consulted domains were: (1) diagnosis and cause, (2) emergency room treatment (tests and treatments), (3) post-care instruction (medications, follow-up care, and follow-up), and (4) directions to return. The information provided by the physician on the discharge sheet was then used to contrast the level of understanding stated by the patients. Results showed that 78% of the patients showed poor comprehension in at least one of the consulting domains with the post-care instructions domain, causing the most significant difficulty. Another finding of this study is that most of the patients who had difficulty understanding one or more domains (measured objectively by the panel of experts) stated they had no difficulty understanding the discharge instructions during the interview. In 2012, the same authors performed a study to find out which of the post-care domains were least understood by patients [14]. They interviewed 159 patients in 5 domains: (1) diagnosis, (2) prescribed medications, (3) home care, (4) follow-up visits, and (5) symptoms necessitating a return visit to the emergency service. The results stated that 80% of the patients had deficits in understanding instructions in the domain of home care and 79% in the domain of reasons for returning to the emergency room. The domains with the fewest comprehension deficits were medical follow-up (39%), medications (22%), and diagnosis (14%). Hill et al. [15] obtained similar results in a study conducted in the Cardiovascular Unit of the University of Utah Hospital in the context of the development of the Glyph system[2] [16]. The authors recruited 50 patients who were asked to read and review their medical instructions for up to 15 min and then answer questions about their discharge sheet. The results indicated that 83% of the recruited patients did not remember general care instructions, and 78% of the patients did not understand instructions related to physical activity. To reduce the communication gap between professionals and patients, researchers have proposed the incorporation of pictograms as a way to supplement written medical instructions to support treatment understanding and adherence [17–19]. Pictograms are figurative drawings used to communicate information that requires rapid interpretation, such as an event, risk, or activity [20]. The spectrum of beneficiaries of this type of informative element is broad, given that the use of pictograms also facilitates understanding for non-native speakers or people with a limited linguistic ability (low literacy levels), with cognitive or neurodevelopmental disabilities, and with reading problems, such as the elderly [21–23]. Although there are many benefits of using pictograms, their incorporation as an enhancement to any medical instruction requires systematic evaluation of their validity and reliability in conveying the intended message. The literature suggests that to associate pictograms with medical instructions, researchers should follow a series of steps that may need of expert consensus. The main steps of the process are: i) select a set of medical instructions that will have an impact on the patient when supplemented with pictograms, ii) design or adapt pictograms to include cultural factors, iii) validate pictograms to ensure reliable delivery of the message, iv) validate the automatic association between medical instruction and pictograms and v) measure the effects of the intervention on patients. [24–26]. Although there are studies on the use of pictograms in the context of medical instructions, to our knowledge, there are not studies in our country about their usefulness or which set of pictograms should be used. This work is an initial step towards the development of platforms that automatically suggest pictograms as a supplement for medical instructions. In this pilot study, we collect the experts' opinions on the selection of medical instructions that later will be complemented with pictograms by the platform. We based the selection criteria on the usefulness of the instruction- pictogram pair. The results will assist us in obtaining a set of medical instructions that we could use in the stages of adaptation/design of pictograms and their subsequent validation by patients. We also aim to know the expert's opinion on the usefulness of having pictograms to supplement a set of medical instructions to help patient understanding.

[1] When we refer to medical instructions in this article, we mean instructions for post-treatment care given to the patient at the end of a clinic visit or hospital discharge process.

[2] Glyph system that automatically supplements discharge summaries for patients with Cardiovascular disease with pictograms [21].

2. Materials and methods

2.1. Datasets

We used two sets of data. The first set includes 26,514 medical instructions extracted in a previous study from an anonymized database of electronic clinical files [27]. The second corresponds to a set of 540 pictograms created by the authors of the Glyph System [16]. Since the collection of pictograms comes from the USA, it was necessary to adapt some of them due to cultural and language differences. The set of pictograms we obtained only has images; it does not contain labels or a predefined classification.

2.2. The medical instructions selection process

For this pilot study, we decided to select a set of medical instructions that are commonly used by physicians in general practice. To reduce our initial set of medical instructions to a more manageable size in a survey, we designed together with the experts, a dictionary of words related to instructions about medications, follow up, reasons to go to the emergency room, patient habits, weight control, hydration, physical activity/rest, nutrition, and procedures. We filtered the 26,514 instructions to obtain a set of instructions containing a word in the dictionary. The resulting set had a total of 1616 medical instructions. We finally filtered the instructions set once more to remove infrequent, repeated instructions, and those that do not have pictograms available to represent them.

We implemented Levenshtein distance to determine the frequency of the instruction. Levenshtein distance is a string distance metric that measures the difference between two strings as the minimum number of single-character edits, e.g., insertions, deletions, or substitutions, required to change one word into the other. The smaller the distance, the more similar the strings are.

Let's define $x = x_1, x_2, \ldots, x_m$ and $y = y_1, y_2, \ldots, y_n$ as two strings; $D(i, j)$ as the distance between $x[1:i]$ and $y[1:j]$, and δ as is the indicator function equal to 0 when $X_i = y_j$ and equal to 1 otherwise. Then Levenshtein distance would be defined by Equation (1) [28]:

$$D(i,j) = \begin{cases} D(i-1, j-1), & x_i = y_j \\ \min \begin{cases} D(i-1,j)+1 \\ D(i,j-1)+1 \\ D(i-1,j-1)+\delta(x_i, y_j) \end{cases}, & x_i \neq y_j \end{cases} \quad (1)$$

Once each instruction obtained a similarity score, we ranked them to select the most frequent ones. We eliminated from the set those instructions that did not have a pictogram representation available. As a result, we selected 66 different medical instructions that were later reviewed by an expert panel of clinicians who group them into eight categories: 4 instructions in the category "rest"[3]; 14 in "nutrition"; 4 in "hydration"; 14 in "medication"; 6 in "physical activity"; 5 in "medical monitoring or procedure"; 4 in "symptoms management" and 15 in "general care measures." Medical instructions related to pain or ache control are included in the category "symptoms management." For this preliminary study, we have not considered chronic or retained pain in the "symptoms management category."

2.3. Grouping pictograms with medical instructions

With the idea of providing a representation of what an instruction associated with pictograms would look like, we associated a set of pictograms manually with the 66 instructions selected in the previous stage. Fig. 1 shows examples of pictograms associated with medical instructions: salt-free diet and medication before breakfast.

Fig. 1. Example of medical instruction-pictogram mapping. A low salt diet, B take this drug before breakfast/in fasting.

2.4. Design of expert judgment matrix to evaluate medical instruction to pictogram mapping

We designed an expert judgment matrix in the form of a survey to evaluate the value of supplementing medical instructions with pictograms. Each of the questions of the survey presented an instruction with a possible pictogram representation and three options to be selected by the participants:

Not required: the instruction is less frequent or easily understood and should therefore not be supplemented by a pictogram.

Useful (but not essential): the instruction is frequent but may not be included in the study without affecting the results.

Essential: the instruction is frequent and essential and should, therefore, be included in the study and supplemented with a pictogram.

At the end of the survey, we provided an open section to collect suggestions, comments, or opinions from participants to improve the instructions, pictogram design or to add medical instructions not covered in the study.

2.5. Expert judgment matrix application

This pilot study has an observational, exploratory, and cross-sectional design in the sense that the survey was applied at one point in time[4]; the survey was anonymous, and we did not collect demographic information [29]. Our population corresponds to 2,200 physician's members of the Colegio Médico Regional Concepción (CMRC) in the city of Concepción, Chile.

Before initiating the study, approval was obtained from the Scientific Ethical Committee of the School of Medicine at the University of Concepción (CEI-42-17).

[3] Lack of physical activity or exercise according to a temporal medical instruction as a treatment or after a medical procedure. For example: Bed rest.

[4] In this case, a survey was designed and applied in a specific time to the population under analysis.

Table 1
Internal consistency (Alpha Cronbach).

	Estimated	L.L.*	U.L.*
Cronbach's Alpha	0.97	0.95	0.98

* L.L. stands forlowe limit, U.L. stands forupper limit.

Table 2
Total average percentages per voting preference, N=4686 answers.

	Not necessary	Useful, but not essential	Essential
Total answers	773	1903	2010
% Mean	16.50 ± 2.38	40.61 ± 2.43	42.89 ± 4,20
% Standard deviation	9.65	9.89	17.09

2.6. Data analysis

We analyzed the survey responses using descriptive statistics, mainly calculating relative and absolute frequencies for each item. We measured the usefulness of including a particular instruction in the study to be later supplemented by a pictogram by the relative frequency of the three responses. We analyzed the internal consistency of the instrument by calculating the Cronbach's Alpha coefficient [30] to verify if the answers per instruction-pictogram are consistent across the sample.

3. Results

We sent the invitation to participate in the study, informed consent, and the link to the online validation matrix by email through CMR's communications unit. We obtained for this pilot study a non-probabilistic sample of 78 physician volunteers between the ages of 25 and 73, working in public and private healthcare centers. We excluded from the analysis seven surveys containing missing answers. Table 1 shows the result of the internal consistency analysis of our survey. We obtained a high internal consistency measured by Cronbach's Alpha = 0.97, CI = [0.95, 0.98]; this means that the instrument is appropriate for measuring the usefulness of incorporating instructions to be supplemented with pictograms. We obtained 71 valid surveys with 66 questions and a total of 4,686 valid answers (773 in the Not Necessary category, 1903 Useful, But Not Necessary, 2010 Essential). Table 2 shows the results of a global analysis of the survey. We observe that 42.9% of the instruction was considered to be "Essential" by the participants, 40.6% to be "Useful but not essential," and 16.5% to be "not necessary."

Table 3 presents the average percentages by preference voting. For the "Essential" category, the sets representing instructions such as Rest, Symptom Management, and Medication obtained the highest voting percentage. In the category "Useful but not essential," we observe that the highest rates are for instructions related to Hydration, General Measurements, Physical Activity, Food, and Control or medical procedure.

Table 4 presents an individual analysis per instruction; we included those sets receiving 51% of the votes in the "Essential" and "Useful, but not essential" categories. These results show that 22 of the 66 sets (approx. 33%) were considered "Essential" by >=51% of the experts, while 11 of the 66 sets (approx. 17%) fell into the "useful but not essential" category, based on views of >=51% of the experts.

Table 5 shows the top 3 instructions that in the voting process obtained percentages equal to or greater than 51% for the "essential" and "useful, but not essential" categories, respectively.

Besides, in the "suggestions" section of the survey, some possibilities for improvement were presented, for example: modifying the design of some pictograms, adding instructions, and having some medical considerations in the interpretation and design of pictograms. The following are suggestions we consider to be significant:

Additions:

- Expansion of the number of instructions for feeding regimes, for example, liquid regime, avoid irritants, among others.
- Handwashing before touching children/babies.
- An instruction to apply local heat or cold.
- Glycemic control schedules for people with diabetes.

Modifications

- In case of mild symptoms, go to your primary care center emergency unit, and in case of severe/risk symptoms, go to the Hospital Emergency Room.
- Include the patient in pictograms related to taking medication at certain times.

4. Discussion and perspectives

This study is the first step towards a project to build a platform to suggest pictograms as a supplement to medical instructions automatically. In Chile, there are no previous studies that support the use of pictograms in the context of medical instructions. Hence, as the first step in this research, we decided to request physicians' opinions to select a limited set of instructions to be included in the next steps of the study.

Based on the results we obtained in this pilot study, the instrument designed to measure the usefulness of incorporating a particular instruction to be later supplemented with pictograms has a high internal consistency. The instructions considered to be the most relevant by the experts are those describing the pharmacological treatment, followed by the ones on symptom management and rest. The sets deemed by the experts as "essential" correspond to those related to the immediate treatment of the patient. On the other hand, the sets qualified as "useful, but not essential," mostly correspond to instructions for physical activity, hydration, general measures, nutrition, and medical control or procedure. Results indicate that experts believe that the instructions for general patient care are less complicated to understand and remember than instructions about medications. However, it is essential to remember that international studies showed that patients often have problems to remember instructions related to home care, general measures, and medical check-ups.

Therefore, it is essential to consider for future research to perform this study with a population of patients. A survey applied to patients will allow us to contrast results with the work presented in this article in order to validate a limited but representative set of medical instructions to be supplemented by pictograms, especially those related to the long-term management of a disease or for the prevention of other medical conditions.

In general terms, most of the instruction-pictogram sets were considered essential and useful based on views of >=51% of the experts. There were some sets voted as unnecessary but did not represent 51% of the experts. Results suggest that the participating physicians endorse the incorporation of pictograms as a supplement to the written medical instructions. At the end of the survey, we obtained a set of 34 medical instructions validated for the experts that we will include in future steps of this research.

Among the limitations of this study, we can mention the limited number of symptom management instructions included due to the low number of these instructions present in the database used for extraction. Thus we need to acquire a more in-depth and extensive collection of medical instructions through interviews, focus

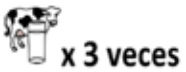
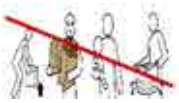
Table 3
Answers per individual medical instruction category and voting preference according to expert judgment matrix.

Medical instruction category	Survey items	Total answers	Not necessary		Useful, but not essential		Essential	
			N**	%	N**	%	N**	%
Hydration	4	284	51	18	124*	43.7*	109	38.4
Rest	4	284	42	14.8	121	42.6	121*	42.6*
General measures	15	1065	212	19.9	437*	41*	416	39.1
Symptom management	4	284	43	15.1	107	37.7	134*	47.2*
Physical activity	6	426	94	22.1	216*	50.7*	116	27.2
Medication	14	994	138	13.9	306	30.8	550*	55.3*
Feeding instructions	14	994	132	13.3	444*	44.7*	418	42
Medical procedure	5	355	61	17.2	148*	41.7*	146	41.1

Table 4
Accepted instruction-pictogram sets with a percentage equal or greater than 51% of the experts by category.

Medical instruction category	Accepted sets %>=51	
	Essential	Useful, but not essential
Hydration	0	1
Rest	1	1
General measures	3	2
Physical activity	1	4
Medication	11	0
Feeding instructions	5	4
Symptom management	1	0
Total	22	12
%	33.3	16.7

Table 5
Pictograms with the highest acceptance (voting) percentage as essential or useful.

Category	Medical instruction	Pictogram
Useful, but not essential	No levantarse rápido/de forma brusca (59,2%) (Do not get out of bed quickly)	
	Andar en bicicleta (59,2%) (Ride a bike)	
	Tomar leche 3 veces al día (59,2%) (Drink a glass of milk three times a day)	
Essential	No fumar (78,9%) (Do not smoke)	
	Si siente dolor en el pecho llamar a la ambulancia (76,1%) (If you have chest pain, call an ambulance)	
	No realizar esfuerzos/no cargar peso (69,0%) (Do not lift heavy things)	

groups, or other procedures to complement existing information. For different categories of instructions, an adequate quantity was obtained, with "pharmacological treatment managements" being the predominant category.

Given the importance of the thoroughness with which patients must follow the medical treatment, the use of pictograms is a potentially powerful tool that allows clinical language to be brought closer to patients and thus minimize the problems described above. An improvement in the understanding and retention of medical instructions gives patients more tools to empower themselves in self-care, symptom management, and adherence to treatment so that they can progressively improve their health state and make better use of health services.

Based on the results of this study, our future research will aim to design or adapt existent pictograms to supplement the set of medical instructions obtained in this pilot study. The final step and purpose of this project will be to validate in a real setting with patients, whether pictograms are indeed a contribution to patient understanding and retention of medical instructions. As future work, we will consider designing new pictograms or adapting glyph pictograms to validate them with people with cognitive impairment conditions in a controlled environment.

5. Conclusions

This article shows the results of a pilot study that is meant to know physician's opinions on a limited set of instructions to be included in a more extensive study that aimed to build a platform to suggest pictograms as a supplement to medical instructions automatically. Results show that in general, the participant's physicians found that most of the instruction- pictogram pairs were essential and useful based on views of >=51% of the experts. These results give us some valuable evidence that using pictograms as a tool for health care professionals could be feasible in our national context.

Human and animal rights

The authors declare that the work described has been carried out in accordance with the Declaration of Helsinki of the World Medical Association revised in 2013 for experiments involving humans as well as in accordance with the EU Directive 2010/63/EU for animal experiments.

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Author contributions

All authors attest that they meet the current International Committee of Medical Journal Editors (ICMJE) criteria for Authorship.

R.F., L.O., C.T., Q.Z., and C.V. conceived the presented idea and designed the experiments. R.F., C.T., C.V., L.O., C.F., P.S. performed the experiments, applied the survey and analyzed the results. All authors participated in the writing process discussed the results and contributed to the final manuscript.

Declaration of competing interest

The authors declare that they have no known competing financial or personal relationships that could be viewed as influencing the work reported in this paper.

Data availability

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

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