Design and content validity verification of an instrument to evaluate access to hospital infrastructure in Colombia

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Abstract. The present study determined the content validity of an instrument to assess Colombian health institutions physical access. The questionnaire was designed by the authors of the study, based on the Colombian Technical Standard of Accessibility to the Physical Environment 6047 framework. The content validity was carried out by six experts. To the score the content validity, the researchers designed a qualification template, and calculated a content validity index dividing the relevance and pertinence score of each item/question by the number of experts who evaluated the question. Based on methodological recommendations from the literature, items with content validity index ≤ 0.78 were eliminated from the questionnaire or modified in their wording in accordance with the recommendations of the expert reviewers. The content validity index of the scale was found to be excellent (0.95). In total, 2 questions were eliminated due to their low relevance index (≤ 0.78). The final questionnaire has 69 questions.

1. Introduction
This study defines accessibility as a feature or condition that enables the use and enjoyment of the built environment. In Colombia, quality health care is considered to involve providing both individual and collective services in an accessible and equitable manner. To this end, the general social security system’s mandatory health care quality assurance system establishes the conditions that must be fulfilled by the nation’s health care centers. These conditions vary depending on the degree of complexity and technological sophistication of each specific institution, with three degrees of complexity specified – the third being the most exigent. The modern concept of infrastructure has also evolved, and presently incorporates an analysis of human behavior as a facet of the experience of spaces; in which places tend to result in more pleasant and attractive experiences [1-3].

The Colombian health care system currently evaluates hospitals and medical establishments for their compliance with the criteria of published quality standards, however little verification presently exists with respect to accessibility. Consequently, a need exists to design such an instrument based on the building code requirements established for the public-use structures in question. In order to help ensure
the development of a reliable body of knowledge on the subject, the content validity of the tool (in this case a questionnaire) must first be established to ensure that the instrument contains an appropriate sample of elements for the construct being studied. At the same time, the growth in biomedical technology development and in social networks in health opens possibilities for efficient and interdisciplinary work, and allows for innovative solutions to problems in this sector. The need to drive innovative development in health is clear and urgent, and these innovations must be implemented in a planned and coordinated manner by a group of professionals qualified in all stages of innovation management.

As well, basic methodologies for the evaluation of health infrastructure must be implemented to provide health decision-makers with the best possible scientific and technological evidence. By this means, improvements for patient access can be objectively justified. The current study, therefore, aims to apply a methodology that systematically determines whether the instrument created constitutes a representative sample of the domain of knowledge and / or skills that is intended to evaluate [4,5].

2. Method
The current study evaluated the content validity of an instrument to evaluate “Physical Access of Institutions of Health Services” (PAIHS) in Colombia, an instrument designed by the authors of this article. The study was undertaken in two stages. In the first, the PAIHS instrument and its instructions were designed and written, based on the “Colombian Technical Standard for Accessibility to the Physical Environment 6047” [6] During the second stage, content validity was verified by invited experts selected according to a specific profile in terms of their academic training and experience in the subject. The content validity (CV) was carried out by six experts: 3 civil engineers, one of them master in structural engineering; 2 architects, one of them master in accessibility for smart cities; and one architecture draftsman, lawyer with master on laws for urbanism. Before reviewing the PAIHS instrument, these experts signed a confidentiality agreement, in which they undertook to refrain from divulging any of the information involved.

In conducting their review, the experts evaluated the relevance, pertinence, and composition of each of the 71 questions in the PAIHS questionnaire. To record the responses, the researchers designed a template containing each of the items and questions from the questionnaire with a rating of either 0 (not pertinent or not relevant) or 1 (pertinent and relevant). This template included a space for the reviewers’ observations for each item (if they considered it necessary) with specific reference to the composition of the question. Completing this template yielded a relevance index (RI) and pertinence index (PI), as the sum of the results for each item/question divided by the total number of items of the instrument. These indices were calculated individually for each evaluator. The content validity index of each item/question (CVI-I) was then calculated by dividing its relevance and pertinence scores by the number of experts who had evaluated it. Finally, the content validity index of the scale or questionnaire (CVI-S) was obtained by summing its individual CVI-I results and dividing by the number of experts. According to Polit & Beck [6], for a scale to exhibit excellent content validity, its items must have a CVI-I of 0.78 or more, with a CVI-S of 0.90 or better. A CVI-S equal to or greater than 0.80 is considered acceptable. Based upon these methodological recommendations, any items with CVI-I ≤0.78 were identified for elimination from the questionnaire. Other questions were retained but rewritten in accordance with the experts’ recommendations.

2.1. Ethical aspects
The researchers submitted the project to the bioethics committee of the Universidad de Santander (UDES), Colombia, for review. As documented in zet No. 060-16, the plan was approved without restriction.
### 3. Results

The CVI-S determined by the five experts was 0.95, as detailed in Table 1. This score can be interpreted as an excellent content validity result according to Polit & Beck [7]. Moreover, all the individual CVI-I scores were above 0.78, as set forth in Table 2 and Table 3.

As can be seen in Table 1, respondents homogeneously reported high relevance rates, indicating the importance of each of the questions included in the questionnaire; in general, the IR was 0.96, which indicates that the questionnaire was considered by the experts to be suitable for its purpose.

**Table 1. Indices of relevance and pertinence by evaluator of PAIHS.**

| Evaluator | RI | PI | CVI-S |
|-----------|----|----|-------|
| Evaluator 1 | 0.98 | 0.93 | 0.96 |
| Evaluator 2 | 0.92 | 0.90 | 0.91 |
| Evaluator 3 | 0.94 | 0.90 | 0.92 |
| Evaluator 4 | 1.00 | 0.99 | 1.00 |
| Evaluator 5 | 0.95 | 0.96 | 0.96 |
| Total | 0.96 | 0.94 | 0.95* |

* Content validity index of scale (CVI-S); PI: Pertinence index; RI: Relevance index

Table 2 shows the RI and PI ratings for each evaluator separated into the instructions, notes, and observations sections of the instrument. The observation spaces were designed to allow users to identify the specific non-conforming areas of the clinic or hospital. These contributions are useful for the generation of improvement plans for the institution. Items A to J are open questions about the number of ramps, waiting rooms, reception areas, elevators, paths, corridors, and doors; to establish if all meet the requirements.

Table 3 illustrates the results for various additional questions organized by sections. The identification section can be seen to be the lowest-scoring section of the questionnaire, with a CVI-I of 0.80. On the other hand, the questions related to parking, reception, and orientation signage were the best rated, with a CVI-I of 1.

**Table 2. Content validity index by item (CVI-I) grouped by PAIHS section and by evaluator.**

| Questionnaire section | PI | RI | RI | RI | RI | RI | RI | RI | RI |
|-----------------------|----|----|----|----|----|----|----|----|----|
| Instructions sections I and III | 1.00 | 1.00 | 0.50 | 0.86 | 1.00 | 1.00 | 0.70 | 0.90 | 1.00 |
| Notes section I | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.97 |
| Observations sections II and III | 1.00 | 1.00 | 0.70 | 0.90 | 0.70 | 0.50 | 0.90 | 1.00 | 1.00 |
| Items A – J | 1.00 | 1.00 | 0.70 | 0.90 | 0.70 | 0.50 | 0.90 | 1.00 | 1.00 |

PI: Pertinence index; RI: Relevance index; CVI-I: Content validity index by item

**Table 3. CVI-I grouped by PAIHS section.**

| Questionnaire section | PI | RI | CVI-I |
|-----------------------|----|----|-------|
| I. Identification (8 questions) | 0.85 | 0.75 | 0.80 |
| II. Areas of admission to the health services institution | | | |
| Parking (7 questions) | 0.97 | 0.91 | 0.94 |
| Parking signage (2 questions) | 1.00 | 1.00 | 1.00 |
| III. Areas of attention, and vertical and horizontal user circulation | | | |
| Check-in counter (4 questions) | 1.00 | 1.00 | 1.00 |
| Ramps, stairs, and elevators (23 questions) | 0.97 | 0.96 | 0.96 |
| Walking paths (3 questions) | 1.00 | 1.00 | 1.00 |
| Internal corridors (3 questions) | 0.93 | 0.93 | 0.93 |
| Doors (5 questions) | 0.92 | 0.92 | 0.92 |
| IV. Hygiene areas (16 questions) | 0.99 | 0.96 | 0.98 |

PI: Pertinence index; RI: relevance index; CVI-I: Content validity index by item.
4. Discussion
To properly design an instrument, its psychometric properties of validity and reproducibility must be correctly established. Without these qualities, the instrument would be unable to measure objectively; thus, an instrument that is unreliable cannot be valid. Validity has been defined as an instrument’s ability to measure the construct it is designed to study, and includes content, construct, and criterion validity [8].

The present study determined the content validity of an instrument created to evaluate physical access to the infrastructure of the institutions that provide health services in Colombia. This content validity was taken to include all of the instrument’s elements: instructions, observation fields, etc., which were included in the investigation, with excellent results. The importance of determining the CV in the present study lies in the fact that, although the nature of the questions in the instrument might seem simply self-evident, a scientific basis is required to be sure of this supposition.

This process helps identify the elements that impede physical access to hospitals, clinics, and other health services; installations legally required to be accessible to the entire population. Among all public spaces, these are the most committed to the concept of design without barriers, given the importance of the services they provide to preserve the life and health of an individual. Barrier-free design goes beyond focusing on physical disability, and includes design for everyone in any physical state, age group, or even religious belief [9].

A study from Spain presents the results of an evaluation of hospital accessibility in the Basque Country, in a report that evaluated everything from movement within rooms to the various services that involve hospitalization, etc. The information was collected through photographs, plans, and from direct observation; with the results laid out in a sophisticated technical sheet based on international and state regulations. Another study, carried out in Brazil and published in 2017, evaluated the accessibility of 4 Sobral hospitals. The authors based this analysis on the Brazilian association of technical standards regulations using a checklist. This same instrument was also previously used to evaluate physical infrastructure accessibility in 12 basic health units in Ceará, Brazil [10-12].

Another 2017 study evaluated accessibility conditions in a hospital in Thailand, considering entry areas such as entrances and parking lots; circulation areas such as passages and elevators; and bathrooms, among others. The authors describe the construction of an instrument for this evaluation, which also takes into account a physical disability perspective. Another study conducted in California, in the United States, evaluated accessibility to primary care centers using an instrument with 55 items and based on the Americans with disabilities Act (ADA) guidelines. Using this instrument, the researchers evaluated the constructed area, with entryways, pathways, stairs, and ramps, among other architectural elements included in the analysis [13,14].

In this sense, studies are found in the literature that evaluate the physical access to, or architectural barriers of, health care service facilities, using two methodologies. Some research is carried out through surveys of users and health professionals based upon their perceptions; others involved on-site evaluation where architectural access is determined by observation. A common weakness, however, is that none of the aforementioned studies included an evaluation of the validity of the questionnaires or instruments used, and therefore the validity of their results remains to be established.

Growth in the use of patient-participation evidence in the design and planning of health institutions has driven improvements in the quality of the physical environment of these spaces. The patient-participation movement, as described by Cahill in 1998, is presented in the context of increased patient responsibility in the prevention, detection, and treatment of health problems. Nevertheless, the topic of hospital circulation areas remains largely neglected in the literature, despite being of central importance for the provision of medical services. In the study by Haddox, participants described encountering obstacles in the circulation areas such as passageways obstructed by medical equipment and cleaning supplies, among others. These impeded freedoms of movement, both while walking as well as when using wheelchairs [15,16].
5. Conclusions

The process of validating the content of research instruments through expert judgement is more efficient when researchers specify exactly what is required of those experts, and also by taking into account the work and time required of these professionals. The use of information and communication technologies (ICT) presents the advantage of connecting people across geographical space and reducing the inconvenience of time and distance.

The technique of using expert judgement used in this study must be handled carefully, being the only indicator of content validity. Currently, expert judgement is a generalized practice that requires that its results be interpreted and applied correctly and efficiently, and with methodological and statistical rigour, to ensure that the information acquired can be used to properly determine whether the test is indeed adequate for its designed purpose.

Evidence-based design is currently an urgent requirement for implementation in the Colombian hospital network. This implies joint work together with engineers, architects, health personnel, and patients. It has been shown that taking into account user experiences provides relevant information that will allow greater satisfaction when using medical centers, as well as shorter hospital stays.

Limitations: User perception must be included in the evaluation of access to hospital infrastructure. Research should take into account user experiences and expectations, to ensure their comfort, and guarantee their access to health services in an appropriate and timely manner.

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