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ORIGINALES

# A learning assessment instrument for the management of peripheral venous catheters: adaptation, extension and validation in Spanish

Un instrumento de evaluación del aprendizaje para el manejo de catéteres venosos periféricos: adaptación, extensión y validación en español

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## ABSTRACT:

Nursing practice should be based on available evidence-based practice because of its impact on patient safety in care. Its use should not only be encouraged in professionals but should begin in nursing education. The objective of this study is to translate, adapt, extend and validate a learning assessment instrument in relation to knowledge of peripheral venous catheter management. A two-stage process was followed: 1) translation, adaptation and extension of the instrument; and 2) psychometric testing. The study included 675 nursing students. Cronbach's alpha internal consistency coefficient was 0.703 and the intraclass correlation coefficient was 0.91. The instrument was fairly balanced in terms of difficulty: 46.6% easy items, 13.3% items of medium difficulty and 53.3% of high difficulty. In conclusion, it is a simple instrument to use and to score. The Spanish version has good psychometric properties and provides a valid and reliable instrument for the assessment of knowledge for the management of catheters.

**Keywords:** Back-Translation; Evidence-based guidelines; Instruments validation; Nursing; Peripheral Venous Catheter.

## RESUMEN:

La práctica de enfermería debe basarse en la práctica basada en la evidencia disponible debido a su impacto en la atención segura del paciente. Su uso no solo debe fomentarse en los profesionales, sino

que debe iniciarse en la formación en enfermería. El **objetivo** de este estudio se basa en traducir, adaptar y validar un instrumento de evaluación del conocimiento basado en la evidencia científica disponible en relación al manejo de los catéteres venosos periféricos. Se siguió un proceso en dos etapas: 1) traducción, adaptación y ampliación del instrumento; y 2) pruebas psicométricas. El estudio incluyó 675 estudiantes de enfermería. El coeficiente de consistencia interna alfa de Cronbach fue 0,703 y el coeficiente de correlación intraclase de 0.91. El instrumento se presentó bastante equilibrado en cuanto a dificultad: 46,6% de ítems fáciles, 13.3% de ítems de dificultad media y 53.3% de alta dificultad. En conclusión, es un instrumento simple de utilizar y de puntuar. La versión española tiene unas buenas propiedades psicométricas y proporciona un instrumento válido y fiable para la valoración de los conocimientos basados en la evidencia para un manejo óptimo de catéteres venosos periféricos en personas portadoras.

**Palabras clave:** Traducción inversa**;** Práctica Basada en la Evidencia; Validación de instrumentos; Enfermería; Catéter venoso periférico.

# INTRODUCTION

The implementation of Evidence-Based Practice (EBP) is necessary to guarantee patient safety in healthcare, and should therefore be integrated into the academic curricula of future healthcare professionals [(1)], and its use should be encouraged in nursing professionals [(2)]. Its development incorporates the best available evidence, clinical experience, user values and preferences into decision-making [(3)]. EBP as a working instrument enhances professional competencies and guarantees high-quality care [(4)]. On the other hand, patient safety involves a set of standards, procedures, instruments and methods based on scientific evidence aimed at preventing and reducing the risks associated with healthcare [(5)]. Nursing practice can lead to preventable adverse events, that is, actions or omissions that deviate from safe practice [(6)]. Thus, to ensure safe nursing practice in relation to the management of Peripheral Venous Catheters (PVCs), evidence-based guidelines on the prevention of intravascular catheter-related infections should be followed. These guidelines are issued by organizations such as the Center for Disease Control and Prevention (CDC) [(7)] and Infusion Therapy Standards of Practice [(8)].

PVCs have great clinical relevance due to their widespread use in hospitalized patients, estimated at over 70% [(9)]. Despite its great cilinical utility and countless advantages this procedure is associated with complications such as phlebitis [(10)] or more serious infections such as bloodstream infections [(11)]. In addition to other negative consequences such as increased economic costs, increased hospital stay and the discomfort it creates in people when complications appear [(12)]. The incidence of phlebitis and infectious complications related to PVCs can be reduced with appropriate interventions [(13)]. However, these should be based on available evidence to achieve a reduction of unnecessary practices, more cost-effective care and more satisfactory care for the patients [(4)].

The literature [(14–16)] shows that the knowledge of nurses and nursing students is limited in relation to the prevention of infections associated with the management of PVCs. This contrasts with the clinical relevance of procedures associated with PVCs (insertion and maintenance of venous catheters). Without a doubt, these are some of the most commonly used nursing procedures at hospital level, and are undoubtedly taught in all universities or nursing training centers. Therefore, more studies are needed to examine the subject in depth. Especially in the Spanish-speaking field, as there is no study that evaluates knowledge in students and only one in

professionals[17], but it does not mention the validation of the instrument. The practice of validating instruments used for learning assessment is infrequent. The main reasons could be the cost involved in the process and the permanent re-elaboration of these instruments. However, justification is based on the fact that a large-scale and high-impact instrument is presented, which assesses standardized, evidence-based knowledge, and that the technical conditions set out guarantee its rigor. Thus, the aim of this study was to translate, adapt, extend and validate an evidence-based practice learning assessment instrument in relation to knowledge of peripheral venous catheters.

# MATERIAL AND METHOD

The design was a cross-sectional study of cross-cultural adaptation, extension and validation of an instrument on knowledge of the management of peripheral venous catheters. It was presented in two stages: 1) translation, adaptation and extension of the instrument; and 2) psychometric analyses.

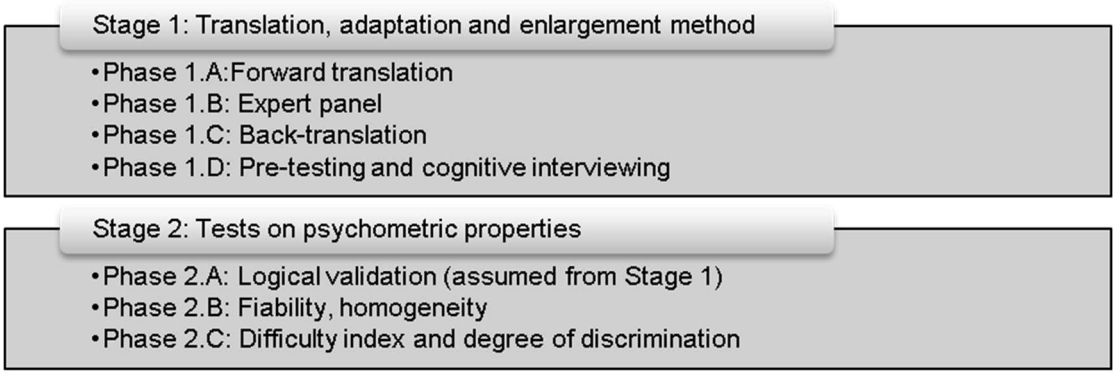
## Participants

Participants were nursing students from 3 faculties in Spain. Inclusion criteria were: 1) second, third and fourth-year nursing students, and 2) students who gave consent to participate. First-year students were excluded due to lack of knowledge of the subject matter and a possible low level of competence; and students who were absent during the survey period were also excluded. In Spain the nursing Degree is a four-year full-time programme.

## Procedure

Stage 1: Method of translation, adaptation and extension. A translation and subsequent adaptation was made of the instrument presented by Cicolini et al. [15] on the prevention of peripheral venous catheter-related infections based on that of Labeau, Vereecke, Vandijck, Claes, & Blot [14] on central venous catheters. This process followed the initial phases of the process of translation and adaptation of health instruments described by the World Health Organization (WHO) (https://www.who.int/substance_abuse/research_tools/translation/en/) and also followed the recommendations of Sousa & Rojjanasrirat [18] and Kalfoss [19] (Figure 1).

**Figure 1. Stages of the research**



- Phase 1.A: forward translation. In this phase, two bilingual translators participated independently, translating the initial document into Spanish. One of the translators was an expert in health terminology and the other in linguistics.
- Phase 1.B: expert panel. Three experts suggested by consensus that the instrument should be adapted and expanded to cover more dimensions of the management of PVCs. The experts had clinical experience and a PhD. The experts were asked to assess relevance, clarity and comprehension of the content.
- Phase 1.C: back-translation. Retranslation was carried out by the translators. The research team, which already included a methodologist and health experts, checked the original and the new version.
- Phase 1.D: pre-testing and cognitive interviewing, logical validation. The test was re-tested with two experts. A group debriefing was carried out, assessing each question and answer. To assess the equivalence of content, the scale proposed by Sousa & Rojjanasrirat (2011) was used: 1=not relevant; 2=unable to assess relevance; 3=relevant but in need of minor change; 4=very relevant. In addition, the Kappa index was used to assess agreement.

Subsequently, a pilot test was conducted with 20 students to check comprehension and time duration.

Stage 2: tests on psychometric properties. In this stage, the psychometric properties of the instrument were assessed: (1) Reliability, internal consistency reliability (or sensitivity and specificity) and (2) Homogeneity. In addition, as it is a learning tool, the following were also calculated: (3) Difficulty index and (4) Degree of discrimination. A sample of 675 participants was used.

Finally, IBM SPSS Statistics was used to perform the statistical analysis (version 22, Armonk, NY).

## Instrument

The original version was authorized and provided by its original authors via email. The initial translation of the instrument presented by Cicolini et al. [15] on the prevention of peripheral venous catheter-related infections was carried out, based on that of Labeau, Vereecke, Vandijck, Claes, & Blot [14]. Both for the format and for the formulation of the questions and the type of answer, the model proposed by the aforementioned authors was followed. The instrument has two different parts: one, general data such as sociodemographic data (age, sex), access route to university, possible experience in the health context and academic year; and two, the knowledge questions. This was renamed Evidence-Based Knowledge of Peripheral Venous Catheter Management (Table 1).

## Table 1. Questionnaire: Evidence-Based Knowledge of Peripheral Venous Catheter Management

**1. Sterile gloves must be used when placing catheters::**
- a. Peripherals
- b. Centrals*
- c. In all types of catheters
- d. I do not know

**2. It is recommended to perform an antiseptic hand wash before insertion of Peripheral Venous Catheters (PVCs)…**
- a. No, it's sufficient to wash hands with a non antimicrobial soap o with alcohol-based hand rubs *
- b. No, you do this only for invasive procedure
- c. Yes, always
- d. I do not know

**3. It is recommended to use an aseptic technique during connecting/disconnecting the infusive lines (i.e. no touch technique)…**
- a. Yes, always *
- b. No, it's sufficient to wash hands with an antimicrobial soap
- c. No, because it increases the risk of infection
- d. I do not know

**4. It is recommended to use steel needles (butterfly type) for the administration of drugs…**
- a. No, because they might cause tissue necrosis if extravasation occurs *
- b. Yes, if I have to inject drugs for a short time
- c. Yes, always
- d. I do not know

**5. It is recommended to change the dressing on the catheter insertion site…**
- a. On a daily basis
- b. Every 3 days
- c. When indicated (soiled, loosened,…) and at least every five, six or seven days**
- d. I do not know

**6. It is recommended to cover up the catheter insertion site with…**
- a. Polyurethane dressing (transparent, semipermeable)
- b. Gauze dressing
- c. Both are recommended because the type of dressing does not affect the risk for catheter related infections*
- d. I do not know

**7. It is recommended to disinfect the catheter insertion site with…**
- a. 0.5% Chlorhexidine gluconate solution *
- b. 0,2% tinture of iodine
- c. 10% alcohol
- d. I do not know

**8. It is recommended to apply an antibiotic ointment at the insertion site of a PVC…**
- a. Yes, because it decreases the risk for
- b. No, because it causes antibiotic resistance *
- c. No, because it does not decrease the risk for catheter related infections
- d. I do not know

**9. When lipid emulsions are administered through a PVC (peripheral parenteral nutrition), it is recommended to replace the administration set…**
- a. Within 24 hours *
- b. Every 72 hours
- c. Every 96 hours
- d. I do not know

**10. A Medium Venous Catheter (MVC) or Peripherally Inserted Central Catheter (PICC) should be substituted for the use of a PVC if intravenous (IV) therapies have a duration of more than:**
- a. 3 days
- b. 6 days*
- c. 10 days
- d. I do not know

**11. It is recommended to use a system for manipulation and IV access through PVCs:**
- a. With needle
- b. Without needle*
- c. Either way, both systems are valid.
- d. I do not know

**12. The site of choice for the placement of the PVC is...**
- a. Upper or lower extremity
- b. Upper extremity *
- c. lower extremity
- d. I do not know

**13. In the event of administering blood or blood products, the PVC set must be changed....**
- a. Within 24h of the start of the infusion*

b. Every 96h
c. Upon removal of the PVC
d. I do not know

**14. When signs of phlebitis (tenderness, warmth, erythema or palpable venous cord) or infection from the PVCs occur...**

a. The infusion must be halted and the equipment changed.
b. Antibiotics must be administered through the catheter itself.
c. The catheter must be removed*
d. I do not know

**15. It is recommended that the following PCV should be placed:**

a. Larger size
b. Smaller size*
c. Larger external diameter
d. I do not know

The question-answer model comprised one question and 4 answer options, with only one correct answer (score 1 point), 2 options for an incorrect or distractor answer (score 0 points), and a final "I don't know" (score 0 points). The maximum obtainable score was 15 points and the minimum score was zero. The random control formula was not applied, i.e. the possibility of answering a question incorrectly did not penalise the final grade obtained.

### Ethical aspects

This study was approved by the research commission of the Faculty of Nursing and Physiotherapy (University of Lleida). Authorization was obtained from the three university centers involved. Permission was also sought from the students to carry out the study. All data were treated confidentially and anonymously.

## RESULTS

### Results of Stage 1: translation, adaptation and extension

The results of stage 1 in the expert panel phase show that the experts rated 8 of the 10 questions of the initial instrument positively. Therefore, 2 questions were deleted, namely questions 1 and 10 of the initial instrument of the Cicolini et al. In relation to question 1 on routine catheter replacement it was found to be an unresolved issue in the literature (Webster, Osborne, Rickard, & Marsh), therefore, it should be removed. And in relation to question 10 it was suggested to ask about the management of lipid emulsions or blood products separately. Based on this review, the experts suggested expanding the questionnaire to other areas of interest on the management and care of PVCs to avoid infection in PVCs (Table 2). Literature was reviewed [7,8] and the instrument was expanded by consensus to 15 questions, with 8 from the initial document plus 7 new additions.

**Table 2. Explored areas in the instrument**

| Explored areas | Questions |
|---|---|
| Selection of Catheters and Sites | *4,6,10,12,14,15* |
| Hand Hygiene and Aseptic Technique | *1,2,3* |
| Skin Preparation | *7* |
| Catheter Site Dressing Regimens | *6,5,8* |
| Replacement of Administration Sets | *9,13* |
| Needleless Intravascular Catheter Systems | *11* |

Phase 1.D pre-testing and cognitive interviewing, the experts rated all questions with a score of 4 (very relevant) except question 9 which was rated with a score of 3 (relevant but in need of minor changes). Thus, an adaptation of the wording of question 9 was made for better comprehension. The inter-expert concordance analysis resulted in a Cohen's kappa index of 0.870. This rating according to Landis & Koch (1977) was almost perfect.

The pilot test involved 20 nursing students from the three courses involved (second, third and fourth), with an average age of 20.5 years. They completed the test in a mean time of 21.35 (SD: 2.39), range 18 to 26 minutes. They did not suggest any changes to the wording of the questions.

**Results of Stage 2: Tests on psychometric properties**

The socio-demographic data of the participants are presented in Table 3. The participants were 675 nursing students aged between 18 and 50 years, with a mean of 22.45 (SD=4.65), mostly female (74.07%) and with an access to university through secondary education (63.8%).

**Table 3. Socio-demographic data**

| Variables | | n | % |
|---|---|---|---|
| Sex | Woman | 500 | 74.07 |
| | Man | 175 | 25.93 |
| University access route | Secondary education | 430 | 63.80 |
| | Training course | 189 | 27.90 |
| | Other university studies | 36 | 5.34 |
| | Test over 25 or 45 years old | 20 | 2,96 |
| Nursing course | Second | 229 | 34 |
| | Third | 243 | 36 |
| | Fourth | 203 | 30 |

The results obtained show a very good assessment of concordance according to the Intraclass Correlation Coefficient (ICC) values of 0.91. Likewise, the instrument presents adequate reliability, understood in this case as internal consistency, with a total Cronbach's Alpha of 0.703. In Table 4, specifically in the column "total correlation

of corrected items", the contribution of the item to the scale can be seen. This is the corrected homogeneity index, despite not being close to 1, in no case was it less than 0.10; in which case its elimination would have been suggested. The contribution of the items was also verified through the Cronbach's Alpha method by eliminating each of the items. From this it was obtained that all the items contribute to the scale, since in none of the cases, it increased above 0.703 of the total Cronbach's Alpha (Table 4).

**Table 4: Instrument statistics by item**

| Question | Scale average if the element has been removed | Scale variance if the element has been suppressed | Total correlation of corrected items | Cronbach's Alpha if the item has been removed |
|---|---|---|---|---|
| Qn_01 | 13,9985 | 25,580 | ,411 | ,681 |
| Qn_02 | 14,3156 | 26,380 | ,307 | ,691 |
| Qn_03 | 13,8000 | 26,409 | ,293 | ,692 |
| Qn_04 | 14,1541 | 25,935 | ,346 | ,686 |
| Qn_05 | 13,8919 | 26,554 | ,229 | ,695 |
| Qn_06 | 14,4430 | 27,330 | ,145 | ,701 |
| Qn_07 | 13,8444 | 26,321 | ,293 | ,691 |
| Qn_08 | 14,2119 | 25,850 | ,378 | ,684 |
| Qn_09 | 14,1378 | 25,807 | ,369 | ,684 |
| Qn_10 | 14,3141 | 26,738 | ,222 | ,696 |
| Qn_11 | 14,1659 | 25,824 | ,371 | ,685 |
| Qn_12 | 13,7170 | 26,636 | ,292 | ,693 |
| Qn_13 | 14,0163 | 25,764 | ,372 | ,684 |
| Qn_14 | 13,7896 | 26,131 | ,363 | ,687 |
| Qn_15 | 14,1911 | 26,377 | ,261 | ,673 |

In addition, several appropriate verifications were made on the achievement tests or learning tools, including the difficulty index and the degree of discrimination of the items. Table 5 shows that the test is fairly balanced in terms of difficulty, with 46.6% easy items (0-0.44), 13.3% medium difficulty items (0.45-0.54) and 53.3% high difficulty items (0.55-1). As for the degree of discrimination, the formula of correct answers of the higher group minus correct answers of the lower group on the number of answers was used, in this case it was observed that the composition of the test was 73.3% of excellent items (< 0.39), 13.3% of good questions (0.38-0.28), item 10 regular (0.27-0.20) and item 6 poor (< 0.20), that is, it does not discriminate between students who have knowledge and those who do not.

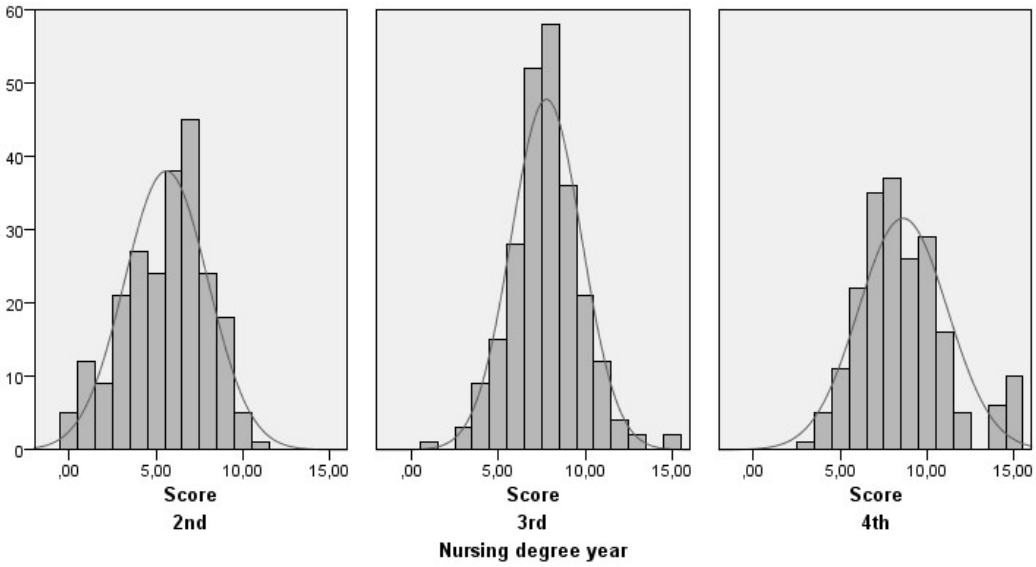
**Table 5: Difficulty and discrimination index**

| Question | Index of difficulty | Index of discrimination by year | | | Degree of discrimination | Not know the answer |
|---|---|---|---|---|---|---|
| | | 2 | 3 | 4 | | |
| Qn_01 | 0,45 | 0,66 | 0,46 | 0,19 | 0,62 | 13 |
| Qn_02 | 0,76 | 0,88 | 0,75 | 0,65 | 0,41 | 20 |
| Qn_03 | 0,25 | 0,38 | 0,16 | 0,21 | 0,40 | 45 |
| Qn_04 | 0,60 | 0,75 | 0,60 | 0,44 | 0,55 | 246 |
| Qn_05 | 0,34 | 0,44 | 0,28 | 0,30 | 0,39 | 28 |
| Qn_06 | 0,89 | 0,85 | 0,93 | 0,89 | 0,08 | 46 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Qn_07 | 0,29 | 0,38 | 0,21 | 0,29 | 0,37 | 65 |
| Qn_08 | 0,66 | 0,76 | 0,67 | 0,53 | 0,42 | 176 |
| Qn_09 | 0,59 | 0,72 | 0,49 | 0,55 | 0,58 | 178 |
| Qn_10 | 0,76 | 0,76 | 0,86 | 0,65 | 0,26 | 211 |
| Qn_11 | 0,61 | 0,77 | 0,50 | 0,57 | 0,59 | 201 |
| Qn_12 | 0,17 | 0,30 | 0,12 | 0,07 | 0,32 | 34 |
| Qn_13 | 0,47 | 0,65 | 0,41 | 0,33 | 0,60 | 201 |
| Qn_14 | 0,24 | 0,38 | 0,21 | 0,11 | 0,46 | 44 |
| Qn_15 | 0,64 | 0,72 | 0,57 | 0,63 | 0,39 | 123 |

Another element that has been incorporated, assessing a learning tool, has to do with the results obtained by year in the difficulty index (Table 5). The analysis of the items by year shows that in the majority of items (1, 2, 4, 8, 12, 13 and 14) the difficulty index falls progressively from the results of the students in the 2nd year to the 4th year, and if the results of the 2nd year are contrasted with the 4th year in all cases (except item 6, which is also the item with the worst discrimination index), it is true that there is a higher percentage of correct answers compared to the totality of the responding subjects. This is also confirmed in the histograms in figure 2, where it can be seen that the normal curve shifts to the right as the grade increases.

**Figure 2: Frequency of hits per course**




# DISCUSSION

The development of this instrument for evidence-based knowledge that nurses should apply to promote good management, and prevent complications in people with PVCs is of vital importance for the quality of care for people who need such a device, and for nursing education. Similar instruments are available in other languages [14,15,21] but not validated in Spanish. The Spanish language represents a significant population worldwide, especially on the American and European continent. According to the Cervantes Institute, Spanish is a language spoken by 580 million people. Therefore, this study fills a gap and has a clear educational, clinical and research utility.

This instrument has been extended from the original [14,15] from 10 to 15 questions, thus allowing a more global assessment of different areas (selection of catheters and

sites, hand hygiene and aseptic technique, skin preparation, catheter site dressing regimens, replacement of administration sets, needleless intravascular catheter systems) of PVCs management. Translation and validation in other languages will also contribute to research in this area.

It should also be noted that a rigorous and systematic process has been followed. Sometimes the direct translation of an instrument from one language to another is erroneous, although the process of cultural adaptation and psychometric validation is necessary to assess if the meaning and intention of the original is maintained [19].

In this research the participants were nursing students as in similar studies [16,21,22]. These studies show that students present basic global knowledge but in some areas or questions deficient. Therefore formative actions are essential to correct them, which must be guided by measurements through instruments that meet the necessary technical conditions of rigor. For nursing students it is essential to establish collaboration between training and clinical practice in order to effectively promote the development of EBP, both the combination of classrooms and clinical practice settings, and in clinical practice settings alone [23]. Without cooperation and shared commitment between academia and practice, EBP implementation will never occur in nursing students and their subsequent professional development [24].

Studies in nurses [15,17] also present poor knowledge in some areas of PVCs management. The application of this instrument by nursing or other health science professionals, in conjunction with specific interventions, can help correct practice errors that have a clear implication on patient and health care safety. The knowledge contained in this instrument is basic and essential for a good management of PVCs, both for healthcare workers who insert catheters and have responsibility for surveillance and maintenance, as well as for infection control experts [7]. Being evidence-based, it not only has a clear impact on quality of care and patient care, but also adds value to the work and contributions of nurses because of its scientific soundness [25].

Validation results show satisfactory psychometric properties for assessing infection prevention knowledge in PVCs. Internal consistency and reliability standards have been achieved. It is a simple instrument to use and to score. A systematic and rigorous process of translation, adaptation, extension and validation of the instrument has been followed.

Finally, although the availability of the scale in Spanish will facilitate the use of the scale in other countries and among Spanish-speaking populations, a pilot study of the instrument is deemed appropriate to guarantee its validity in a cultural context other than Spain in order to ensure comprehension. The implementation of the instrument in Spanish-speaking countries, and its translation and validation in other languages, will allow for a more global and shared vision that will help to improve knowledge about PVC, and therefore, the quality of care for people with PVC.

## Limitations

For the validation, only nursing students participated, which could be a limitation. However, understanding the instrument should not be a problem for a professional. The language used in the instrument was professional and scientific.

# CONCLUSIONS

The Spanish version has good psychometric properties and provides a valid and reliable instrument for the assessment of evidence-based knowledge to prevent infection in people with PVC, in addition to being an tool whose items show an appropriate level of discrimination and is balanced in terms of difficulty for the reference population (2nd, 3rd and 4th year nursing students).

### Considerations for practice

This instrument can be used for health students or professionals, nurses or doctors depending on the level of competence of each country. Moreover, it can be used to support the application of EBP at both academic and health care levels.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