



Questionnaire to evaluate the competency in evidence-based practice of registered nurses (EBP-COQ Prof®): development and psychometric validation

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ABSTRACT

Background: The availability of valid and reliable instruments, based on current competency frameworks, is essential to respond to the need for accurate measurement of the competency of registered nurses in evidence-based practice (EBP).

Aims: To develop and validate a questionnaire capable of measuring EBP competencies in registered nurses following the competency framework developed by Melynk et al.

Methods: The study was developed in two stages: 1) creation of the questionnaire based on an operational definition of the construct, its face and content validation by 10 experts, and cognitive piloting; 2) psychometric evaluation of the questionnaire by a cross-sectional, and multicenter study between February and November 2018. Analyses were conducted of the questionnaire's reliability and construct validity (exploratory [EFA] and confirmatory [CFA]) factor analyses).

Results: **First phase: The initial version of EBP-COQ Prof© contained 50 items grouped in four dimensions (attitudes, knowledge, skills, and utilization). After two expert validation rounds, a 35-item version was obtained with content validity index of 0.86. Second phase: The questionnaire was completed by 579 nurses;** EFA with PROMAX rotation revealed that the four-factor model had the best fit ($\chi^2 = 311.32$; $p=0.001$, root mean square error of approximation [RMSEA] = 0.000, 90 % confidence interval (CI)= 0.000 –0.010; comparative fit index [CFI]= 1), and it showed a good CFA fit index: **CFI = 0.932, and RMSEA= 0.093 (90% CI= 0.097–0.108).** Cronbach's α for each factor ranged from 0.817 (factor III) to 0.948 (factor II).

Linking evidence to action: EBP-COQ Prof© is a valid, reliable, and easily administered questionnaire that measures the self-perceived competency of registered nurses in EBP based on an updated and specific competency framework. It permits the independent evaluation of attitudes, knowledge, and skills related to EBP and of its utilization in hospital and primary care settings, allowing the monitoring of compliance with EBP.

Key words: Evidence-based practice; validation; competency; nurse; instrument development; questionnaire.

INTRODUCTION

The World Health Organization declared the promotion of evidence-based practice (EBP) to be a priority field of action to increase the contribution of nurses to the health of citizens (World Health Organization, 2017). Various studies have demonstrated that EBP implementation improves the health outcomes and safety of patients by increasing the quality of their care (Coster, Watkins, & Norman, 2018) (Melnyk, Gallagher-Ford, Troseth, & Wyngarden, 2014). However, there can often be a long delay between the generation and application of research results, and the adoption of EBP remains a challenge for the nursing profession. A systematic review of 37 studies (n=18,355 nurses) concluded that a large proportion of nurses are not prepared for EBP, regardless of their function, clinical setting, or country (Saunders & Vehviläinen-Julkunen, 2015). It has also been reported that nurses are generally familiar with the concept and have favorable attitudes towards EBP but around three-quarters of them want more knowledge and training on this approach (Melnyk, Fineout-Overholt, Gallagher-Ford, & Kaplan, 2012) and do not feel competent to apply EBP in their work (Melnyk et al., 2018).

Background

Over the past few years, interest has grown in the setting of professional standards for nursing, including the development of EBP-related competencies (American Nurses Association, 2015). In 2015, a competency framework based on European directive 2013/55/EU included the implementation of scientific findings in EBP as a central competency (European Federation of Nurses Associations, 2015). Various authors have reviewed the concept of EBP competency in nursing (Laibhen-Parkes, 2014) and developed different EBP competency frameworks for nurses (Leung, Trevena, & Waters, 2016; Melnyk, Gallagher-Ford, Long, & Fineout-Overholt, 2014) or health care professionals in general (Albarqouni et al., 2018). **Laibhen-Parkes (2014) reported that efforts had been made to describe EBP competencies but the concept of EBP competency had not been clearly defined. He proposed the following definition: “the ability to ask clinically relevant questions for the purposes of acquiring, appraising, applying, and assessing multiple sources of knowledge within the context of caring for a particular patient, group, or community”.** This is a very general definition, as pointed

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3 out by Leung et al., (2016), and does not cover all aspects of EBP, and it is less descriptive
4 and less specific than the frameworks that have been developed for EBP competencies.

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6 Leung (2016) and Alberqouni (2018) organized EBP competencies (knowledge and skills)
7 according to a 5-step model (*ask, acquire, appraise, apply, and assess*) (Straus et al.,
8 2019), mainly oriented towards the development of educational programs. Melnyk et
9 al. (Melnyk, Gallagher-Ford, Long, et al., 2014) proposed a set of practice competencies
10 for registered and advanced practice nurses that followed a 7-step model, with the
11 addition of “*cultivation of a spirit of clinical inquiry*” as step 0, and “*dissemination of*
12 *practice outcome*” as step 6 (Melnyk & Fineout-Overholt, 2015).

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19 Further research is needed to develop valid and reliable instruments for assessing these
20 competencies (Melnyk et al. 2014). Various instruments have been proposed to
21 evaluate EBP-related dimensions in nursing, including barriers, attitudes, values, beliefs,
22 knowledge, skills, and practice, either separately or in combination (Connor, Paul,
23 McCabe, & Ziniel, 2017; Leung, Trevena, & Waters, 2014; Oude Rengerink et al., 2013;
24 Shaneyfelt et al., 2006); however, most of them have important psychometric
25 weaknesses. A systematic review of 24 instruments (Leung et al., 2014) for measuring
26 evidence-based knowledge, skills, and/or attitudes in nursing practice found only one
27 with adequate validity, the Evidence-Based Practice Questionnaire (Upton & Upton,
28 2006), which measures knowledge, skills, and attitudes. Three new instruments have
29 been validated since then: the Quick-EBP-VIK for measuring nurses’ value,
30 implementation, and knowledge of EBP (Paul, Connor, McCabe, & Ziniel, 2016)(Connor,
31 L., Paul, F., McCabe, M., Ziniel, 2017); the Nurse Manager EBP Competency Scale
32 targeted specifically on nurse managers (Shuman, Ploutz-Snyder, & Titler, 2018); and
33 the Evidence-based Nursing Practices Assessment Tool (EBNPAT) (Leung, Trevena, &
34 Waters, 2018), which uses clinical scenarios to evaluate EBP competency but has only
35 demonstrated adequate content validity to date. However, these instruments gather
36 only partial information on EBP steps (Oude Rengerink et al., 2013) or do not use
37 updated EBP competency frameworks, and there remains a need for valid and reliable
38 instruments to precisely measure the EBP competencies of registered nurses.

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The objective of this study was to develop and validate a questionnaire to measure EBP
competencies in registered nurses, based on the competency framework developed by
Melnyk et al. (Melnyk, Gallagher-Ford, Long, et al., 2014).

METHODS

Study design

We developed and psychometrically validated the questionnaire in two stages, following the guidelines of the American Psychological Association (American Educational Research Association, American Psychological Association, & National Council on Measurement in Education, 2014). The global validation process of EBP-COQ Prof© is depicted in figure 1.

First phase, questionnaire creation

Operational definition of the construct and item creation

The design of the questionnaire was based on the definition of competency as “the capacity of nurses to integrate cognitive, affective, and psychomotor abilities in nursing care provision” (Miller, Hoggan, Pringle, & West, 1988). It encompasses a wide range of observable knowledge, skills, attitudes, and behavior patterns, which together constitute the capacity to provide a specific professional service (Neary, 2002). **We therefore consider that the development of competency in EBP requires nurses to advance their abilities in all domains of EBP competence required to implement the steps of the EBP process, i.e., knowledge, skills, attitudes/beliefs, and EBP implementation/behaviors (Saunders & Vehviläinen-Julkunen, 2018).**

For the first version, items were selected from questionnaires measuring similar constructs (Connor et al., 2017; Leung et al., 2014; Oude Rengerink et al., 2013; Ruzafa-Martinez, Lopez-Iborra, Moreno-Casbas, & Madrigal-Torres, 2013; Shaneyfelt et al., 2006), with the addition of new items on EBP attitudes, knowledge, skills, and utilization. Its design also took account of the framework of EBP competencies for practicing registered nurses proposed by Melnyk et al. (Melnyk, Gallagher-Ford, Long, et al., 2014). Accordingly, the research team used focus groups to develop a conceptual map in which each competency was associated with the most appropriate EBP step, assigning at least one questionnaire item to each competency (Table 1). Items were written in a manner that allowed responses on a 5-point Likert scale from 1 = completely disagree to 5= completely agree.

Face and content validation by experts

An expert group analyzed the dimensionality of the first version of the questionnaire and the adequacy of its items, using the Delphi consensus technique (Falzarano & Pinto Zipp, 2013). The group comprised ten nursing professionals with expertise in EBP, seven with > 10 years of experience in research and teaching and three with > 10 years of clinical experience. Each expert received the first version of the questionnaire by e-mail along with a description of its objectives and dimensions. The experts assessed the adequacy of items, their relevance in the assigned dimension, and their comprehensibility, responding on a 5-point Likert scale. They were also asked to propose improvements in the wording of items or other aspects when appropriate.

We conducted as many rounds as necessary until consensus was reached on all items. Items with a coefficient validity ratio (CVR) >0.70 were preserved in the final version of the instrument. We also calculated the content validity index (CVI) for the instrument as a whole, considering a value > 0.80 to be adequate (Almanasreh, Moles, & Chen, 2019). Finally, the INFLESZ v1 package was used to determine the Flesch-Szigriszt Index of readability (Barrio-Cantalejo et al., 2008).

Cognitive piloting

Cognitive piloting was conducted in 18 nurses with professional experience of 5-30 years working in hospital and primary care settings for the public health service in the region of Murcia (Spain); the aim was to assess the comprehensibility, acceptability, and completion time of the questionnaire.

Second phase, psychometric evaluation of the questionnaire

An observational, cross-sectional, and multicenter study was conducted between February and November 2018.

Participants

We selected a non-probabilistic sample of nursing professionals in the public health services of the autonomous communities of Andalusia and Murcia (Spain). The inclusion criterion was being actively working with a minimum experience of 1 year providing direct care to patients in hospital or primary care settings. Nurses who were managers

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3 or from central services were excluded. The recommended sample size for validation
4 studies is between 200 and 400 participants (Conway & Huffcutt, 2003).
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8 Variables and measurement instrument 9

10 A data-gathering notebook was used for anonymous and self-administered completion.
11 It included sections on: 1) Sociodemographic variables: age, sex; 2) Work variables:
12 professional experience, time in the current work unit, care setting (hospital/primary
13 care), unit, work shift, highest qualification, and hours of EBP training; 3) Version 3 of
14 the 35-item Evidence-Based Practice Evaluation Competency Questionnaire for
15 Professionals (EBP-COQ Prof©) (table 2); 4) Evidence-based practice questionnaire
16 (EBPQ-19) (De Pedro-Gomez Joan et al., 2009) validated in our setting (to analyze criteria
17 validity), containing 19 items grouped in three dimensions: attitudes, skills/knowledge,
18 and practice in EBP.
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29 Procedure

30 Questionnaires were delivered to the nursing managers of six health areas, containing
31 a total of 6 hospitals and 64 health centers, in the Autonomous Communities of Murcia
32 and Andalucía for distribution to the nurses in their areas. The professionals were
33 informed of the study objectives and invited to participate as volunteers. In order to
34 determine the time stability of the questionnaire (test-retest), it was administered twice
35 to 18 individuals with a between-test interval of 15 days. All questionnaires were
36 identified by codes alone to preserve the anonymity of participants.
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45 Data analysis

46 We first performed a descriptive analysis of item results, calculating means, standard
47 deviations [SDs], asymmetry, and kurtosis. Item discrimination was evaluated by
48 corrected item-total correlation (Carretero-Dios & Pérez, 2005). Exploratory factor
49 analysis (EFA) and confirmatory factor analysis (CFA) were then performed to analyze
50 the degree to which scale items conformed to the established construct (Elosua-Oliden,
51 2003), using a Structural Equation Model (SEM). In brief, the sample was randomly
52 divided into two subsamples; one was studied by EFA to identify the factorial structure
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3 underlying the items, using various models; the other was used to confirm this structure
4 using CFA, which imposes greater restrictions (Brown, 2006).
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8 For the EFA, factor extraction used the unweighted least squares (ULS) method with
9 PROMAX rotation (oblique rotation), determining the number of factors by the optimal
10 implementation of parallel analysis (Timmerman & Lorenzo-Seva, 2011). This analysis
11 was performed on a matrix of 290 participants (half of the sample) using the FACTOR
12 package (Lorenzo-Seva & Ferrando, 2006). For the CFA, we used the weighted least
13 squares means and variance adjusted (WLSMV) method, indicated for categorically
14 ordered data (Muthén & Muthén, 2010). This analysis was performed on a matrix of
15 289 participants (the other half of the sample) using Mplus 7 (Muthén & Muthén, 2010).
16 The fit of data to the models was assessed using χ^2/df , comparative fit index (CFI),
17 Tucker Lewis index (TLI), and root mean square error of approximation (RMSEA). The fit
18 was considered adequate with $\chi^2/df < 5$, CFI > 0.90, TLI > 0.90, and RMSEA < 0.08 (Kline,
19 2011)
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32 The selection of items was based on their descriptive statistics, their factorial load in
33 their dimension (Lloret-Segura, Ferreres-Traver, Hernández-Baeza, & Tomás-Marco,
34 2014), and confirmation that the content of the dimensions was represented by the final
35 items. Reliability was analyzed as internal consistency using Cronbach's alpha (α) for
36 each dimension of the scale, and the time stability of item scores was assessed with the
37 intraclass correlation coefficient (ICC), interpreted in accordance with Landis and Koch
38 (Landis & Koch, 1977). External validity was evaluated according to: a) Criterion validity
39 obtained from the correlations between the scores of each dimension in the EBP-COQ
40 Prof© and EBPQ-19 scales. b) Predictive validity, based on the hypothesis that
41 professionals with more EBP training would obtain higher scale dimension scores and
42 assessed using one-factor ANOVA with each scale dimension and the variable "hours of
43 training in EBP". SPSS 22.0, Mplus 7.0 (Muthén & Muthén, 2010), and FACTOR (Lorenzo-
44 Seva & Ferrando, 2006) packages were used for the statistical analyses.
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57 Ethical Considerations
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3 The study was approved by the Ethics Committee of the University of Murcia (registry
4 nº 1404).
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8 **RESULTS**

10 First phase

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12 The initial version of EBP-COQ Prof© (version 0) contained 50 items grouped in four
13 dimensions (attitudes, knowledge, skills, and utilization). **The experts achieved**
14 **consensus on all items after two validation rounds.** After the first expert validation
15 round, CVR results showed that 74 % (n=37) of items were acceptable, while items with
16 CVR ≤ 0.70 (n = 13) were eliminated. After considering the suggestions of experts, minor
17 modifications were made in 34 items, obtaining version 1. In the second expert
18 validation round, minor modifications were made to 21 of the items and 2 were
19 eliminated, resulting in a 35-item version 2 of the questionnaire. The I-CVI for version 2
20 was 0.86 (Figure 1).
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22 After cognitive piloting, four of the items were rewritten to improve their
23 comprehensibility. The time taken to complete the questionnaire was 8-11 min. **Version**
24 **3 of the questionnaire comprised 35 items that covered all of the competencies**
25 **proposed by** Melnyk et al. (Melnyk, Gallagher-Ford, Long, et al., 2014) (Table 1). The
26 Flesch-Szigriszt index was 55.18, indicating normal difficulty.
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40 Second phase

41 *Sample description*

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43 The questionnaire was completed by 579 nurses from the autonomous communities of
44 Andalusia (69.9 %, n = 405) and Murcia (28.5%, n = 165); 76 % (n = 440) were females;
45 the mean age was 43 years (SD = 9.2) and mean professional experience was 20 years
46 (SD = 9.7). The main nursing activity of 69.8 % of the nurses (n = 404) was in a hospital
47 setting.
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55 **Item analysis**

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57 Medium-high scores were obtained for all items and tended towards a normal
58 distribution (asymmetry and kurtosis values ranging from 1.5 to -1.5). Corrected item-
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total correlation was > 0.30 for all items except for nº 28, although the value was very close to 0.30 (Table 3).

Internal structure of the scale

The Kaiser-Meyer-Olkin (KMO) test of sampling adequacy was 0.89 and the Bartlett's statistic 6336.0 ($p < 0.001$). The EFA obtained the best fit for the four-factor model (Table 4). All items had factorial loads > 0.30 in the rotated matrix (Table 5). Factor I was formed by items 1-8, corresponding to attitudes towards EBP, factor II by items 9-19, corresponding to EBP knowledge, factor III by items 20-23, 27, and 28, corresponding to EBP skills, and factor IV by items 24-26 and 29-35, corresponding to EBP utilization.

The final model of 4 oblique factors with 35 items was then tested, obtaining CFA fit index values of $\chi^2 = 1935.92$ ($df = 554$; $p < 0.001$), $\chi^2/df = 3.49$, CFI = 0.932, TLI = 0.927, and RMSEA = 0.093 (90% CI = 0.097–0.108). Factorial loads ranged between 0.164 for item 28 and 0.94 for item 11, as shown in the path diagram (Figure 2). According to these results, the fit of data to the model can be considered adequate.

Reliability analysis

Internal consistency (Chronbach's α) for each scale dimension was 0.888 for factor I (attitude towards EBP), 0.948 for factor II (EBP knowledge), 0.817 for factor III (EBP skills), and 0.840 for factor IV (EBP utilization). ICCs showed high concordance between test and re-test scores: factor I (attitude towards EBP) = 0.840 ($p < 0.001$) 95% CI (0.574-0.940); factor II (EBP knowledge) = 0.966 ($p < 0.001$) 95% CI (0.908-0.987); factor III (EBP ability) = 0.815 ($p < 0.001$) 95% CI (0.505-0.931); and factor IV (EBP utilization) = 0.876 ($p < 0.001$) 95% CI (0.669-0.954).

Evidence of validity

Correlations obtained between EBP-COQ Prof© and EBPQ-19 dimensions were statistically significant ($p < 0.01$) with high coefficients ranging from 0.295 to 0.711, which were higher in the dimensions measuring the same content (Table 6). One-factor ANOVA revealed statistically significant differences in all EBP-COQ Prof© dimensions

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3 according to the hours of EBP training undergone by the professionals; the scores were
4 higher in those who had undergone > 40 h of training (Table 7).
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7 8 **DISCUSSION**

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11 EBP-COQ Prof© is an easily and rapidly administered 35-item questionnaire validated
12 for use in registered nurses. It evaluates the degree of self-perceived EBP competency
13 in relation to attitudes, knowledge, skills, and utilization. High mean scores (range 1-5)
14 signify a high level of competency in each dimension and globally.
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19 Construction of the questionnaire was based on a complete and exhaustive definition
20 of competency (Miller et al., 1988) and EBP steps (Melnyk & Fineout-Overholt, 2015).
21 Items were selected and redacted to closely reflect clinical realities in hospital and
22 primary care settings and to gather all operative manifestations in the EBP competency
23 framework for practicing registered nurses (Melnyk, Gallagher-Ford, Long, et al., 2014).
24 The distribution of the four dimensions of the competency construct follows the time
25 sequence of EBP. Thus, the attitude dimension shows a greater presence in step 0
26 (*cultivates a spirit of enquiry*), crucial to the beginning of the process. The knowledge
27 dimension is mainly grouped in steps 1-3 (*PICO question, search for evidence and critical*
28 *reading*) as in other instruments that specifically measure this dimension (Tilson et al.,
29 2011). Acquisition of these competencies is essential for the subsequent development
30 of relevant skills, cross-sectionally distributed throughout all EBP steps. Finally, the
31 utilization dimension mainly concentrates on steps related to EBP application and
32 evaluation.
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46 Confirmatory and exploratory factorial analyses demonstrated the adequate fit of the
47 four-factor model and confirmed the internal structure of the four dimensions of the
48 competency construct. Hence, this questionnaire combines in a single instrument the
49 dimensions of EBP attitudes, knowledge, skills, and also utilization, which is considered
50 especially important (Saunders & Vehviläinen-Julkunen, 2018) but is not usually
51 included in EBP measurement instruments (Leung et al., 2014).
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58 The questionnaire was found to have acceptable time stability and internal consistency,
59 with Cronbach's $\alpha > 0.8$ for all dimensions, considered adequate when the objective is
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3 diagnosis and classification (Carretero-Dios & Pérez, 2007). In contrast, the original
4 EBPQ (Upton, Upton, & Scurlock-Evans, 2014) and its Spanish adaptation (EBPQ-19)
5 (Sese-Abad et al., 2014) have demonstrated poor reliability in the attitude dimension.
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7 External evidence of validity was also obtained for the questionnaire, which showed
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9 significant correlations with EBPQ-19 dimensions and, as observed in other studies
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11 (Fernandez-Dominguez et al., 2017; Ramos-Morcillo, Fernandez-Salazar, Ruzafa-
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13 Martinez, & Del-Pino-Casado, 2015), a positive relationship between questionnaire
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15 scores and hours of EBP training.
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19 With respect to its dimensionality and implementation, it should be clarified that the
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21 attitude, knowledge, and skills dimensions represent potential rather than actual
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23 behaviors, given that the implementation of competencies depends on the
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25 circumstances and setting (Caprara & Cervone, 2003). However, inclusion of the
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27 utilization dimension means that EBP-COQ Prof© is also suitable for assessing real
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29 behaviors and can be useful to evaluate the influence of factors related to individuals or
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31 the practice setting on the EBP competency of nurses.
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33 The advantages of EBP-COQ Prof© over existing questionnaires include the
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35 improvement of methodological weaknesses related to an inadequate description of
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37 validation processes or of the metric properties or dimensions considered (Connor et
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39 al., 2017; Leung et al., 2014, 2018; Paul et al., 2016). In addition, the development of
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41 items was based on an updated EBP competency framework for nurses (Melnyk,
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43 Gallagher-Ford, Long, et al., 2014). The demonstrated comprehensibility, acceptability,
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45 and completion time of the questionnaire make it easy to apply for the evaluation of
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47 nurses' EBP competency, facilitating the study of associated individual and institutional
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49 factors. It can also be useful to evaluate the effect of EBP training programs and of
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51 organizational interventions designed to improve EBP competency.
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53 In addition, the 7-step theoretic framework used to develop EBP-COQ Prof© facilitates
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55 identification of the stage in which nurses perceive themselves as less competent. This
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57 allows interventions to be adapted to the competency level of specific populations and
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59 to be targeted where most needed.
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Limitations

The factorial load of item 28 *“In clinical decision-making I consider my professional experience”* was low in the CFA, possibly due to the insufficient development of EBP in the daily practice of nurses (Saunders, Gallagher-Ford, Kvist, & Vehviläinen-Julkunen, 2019). Nevertheless, this item was maintained so that one of the basic postulates of EBP was not missing (Sackett, Rosenberg, Gray, Haynes, & Richardson, 1996).

There is currently debate around the relationship of scores obtained using a self-perception questionnaire such as the EBP-COQ Prof© with the results of more objective instruments (Hagedorn Wonder et al., 2017; McCluskey & Lovarini, 2005; Snibsøer et al., 2018). Further research is warranted to compare the EBP-COQ Prof© with objective tests, to examine its performance in different clinical settings by professionals with different profiles, and to measure its sensitivity to changes after EBP interventions.

LINKING EVIDENCE TO ACTION

- It is especially important to precisely determine the utilization of EBP by nurses
- EBP-COQ Prof© is a valid and reliable questionnaire with a robust competency framework. It is useful to determine both potential and actual behaviors by assessing EBP utilization in a clinical setting as well as EBP-related attitudes, knowledge, and skills.
- EBP-COQ Prof© can also be useful to study individual factors related to the EBP competency of nurses and the influence of the practice setting.
- Further research is warranted to determine the functioning of the questionnaire in different clinical settings and with other professional profiles and to measure its sensitivity to change after EBP interventions.

CONCLUSIONS

The EBP-COQ Prof© was constructed under robust theoretical postulates and demonstrated adequate internal consistency and good reliability. It allows evaluation of

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3 the self-perceived competency of registered nurses in EBP and yields information
4 related to four dimensions: attitudes, knowledge, skills, and utilization.
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15 information contained therein.”
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Table 4. Goodness-of-fit indexes for the 1-factor, 2-factor, 3-factor, and 4-factor EFA models with PROMAX rotation of the EBP-COQ Prof©

Models	χ^2	df	P	RMSEA (90% CI)	TLI	CFI
1 factor	3012.8	560	<0.00	0.115 (0.101 – 0.123)	0.862	0.871
2 factors	1301.6	526	<0.00	0.072 (0.500 – 0.800)	0.946	0.952
3 factors	568.49	493	0.001	0.039 (0.010 – 0.050)	0.984	0.987
4 factors	311.32	461	0.001	0.000 (0.000 – 0.010)	1.000	1.000

χ^2 : Chi-square test; df: degrees of freedom; RMSEA: Root Mean Square Error of Approximation; CI: Confidence Interval; TLI: Tucker-Lewis index; CFI: Comparative Fit Index

For Peer Review

Table 6. Bivariate correlations between dimensions of EBP-COQ Prof© and EBPQ-19 (N=384)

EBP-COQ Prof©	EBPQ-19			
	Attitude	Knowledge and skills	Practice	Total
Attitude	0.491**	0.391**	0.314**	0.490**
Knowledge	0.346**	0.688**	0.507**	0.649**
Skills	0.318**	0.582**	0.470**	0.579**
Utilization	0.295**	0.411**	0.476**	0.505**
Total	0.449**	0.675**	0.568**	0.711**

** $p < 0.01$

For Peer Review

Table 7. Means and standard deviations of scores for each EBP-COQ Prof© dimension as a function of hours of EBP training (N=376)

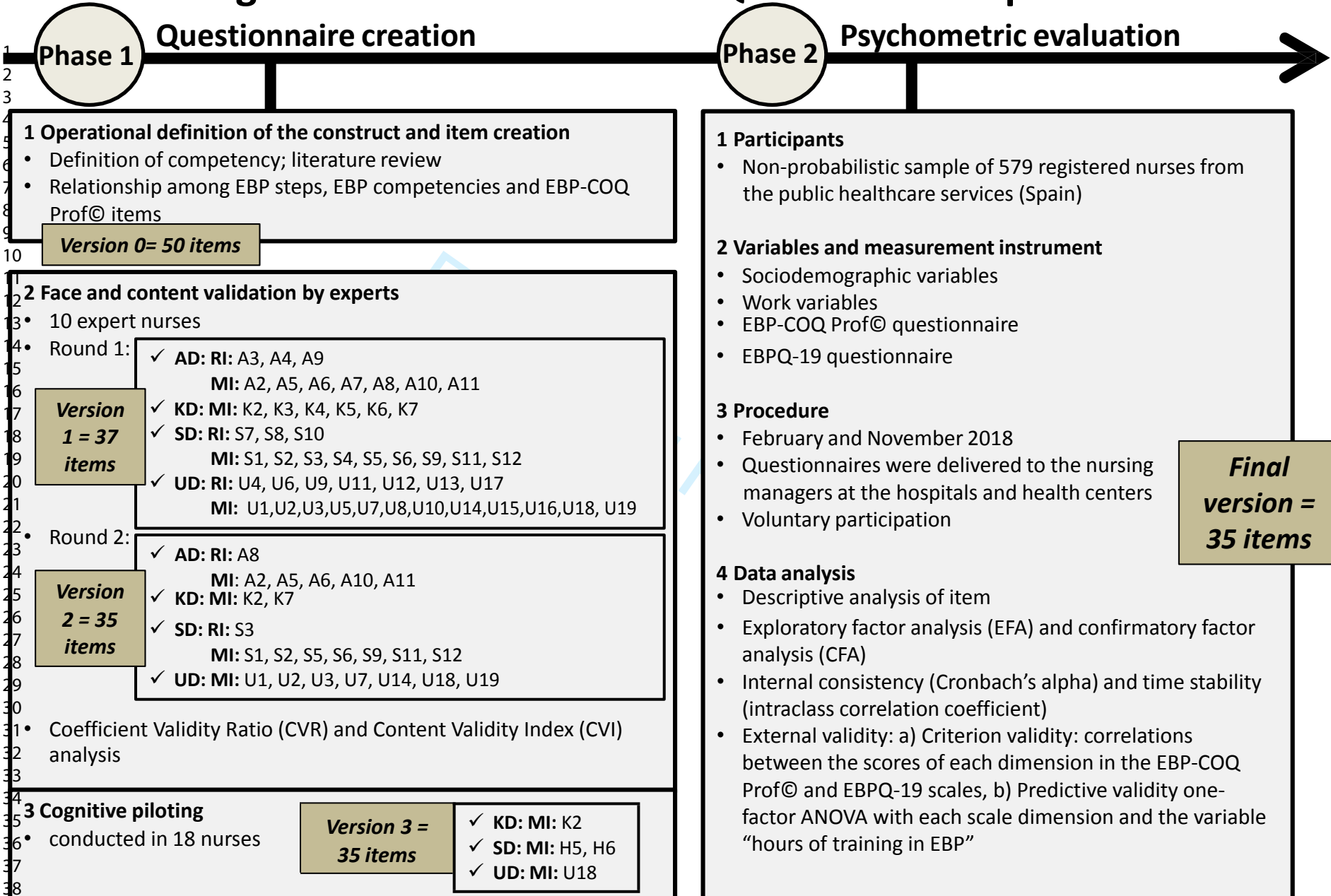
EBP-COQ PROF©	None ^a n=85		< 40 h ^b n=106		40-150 h ^c n=99		>150 h ^d n=86		p
	M	SD	M	SD	M	SD	M	SD	
Attitude	4.11 ^c	0.56	4.29	0.47	4.38	0.58	4.33	0.57	0.008
Knowledge	2.53 ^{bcd}	0.79	2.98 ^{acd}	0.74	3.41 ^{ab}	0.69	3.51 ^{ab}	0.78	<0.001
Skills	3.20 ^{cd}	0.67	3.40 ^{cd}	0.68	3.72 ^{ab}	0.61	3.85 ^{ab}	0.53	<0.001
Utilization	3.00 ^{cd}	0.65	3.19	0.60	3.29 ^a	0.59	3.34 ^a	0.65	0.002
TOTAL	3.21 ^{bcd}	0.49	3.47 ^{acd}	0.50	3.70 ^{ab}	0.49	3.76 ^{ab}	0.48	<0.001

M: mean; SD: Standard deviation

Footnote: ^{abcd} indicates the "hours of training" category with which there was a statistically significant difference ($p < 0.05$ in *post-hoc* analysis).

Figure 1: Process of EBP-COQ development

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Table 1: Relationship among EBP Steps, EBP competencies and EBP-COQ Prof© items

Steps	7 steps of EBP	EBP Competencies (Melnyk et al. 2014)	Items Questionnaire EBP-COQ Prof©
Step 0	Cultivate a spirit of inquiry along with an EBP culture and environment	Questions clinical practices for the purpose of improving the quality of care	<ul style="list-style-type: none"> The application of EBP improves patient care
		Describes clinical problems using internal evidence.* (internal evidence*=evidence generated internally within a clinical setting, such as patient assessment data, outcomes management, and quality improvement data)	<ul style="list-style-type: none"> EBP helps decision-making in clinical practice I feel able to analyze a clinical problem based on the assessment of the patient and/or the evaluation of his/her health outcomes
		Participates in strategies to sustain an evidence-based practice culture.	<ul style="list-style-type: none"> EBP increases the autonomy of the nursing profession EBP is one of my professional priorities right now I believe I should gain more training in EBP In my work center, I collaborate in making EBP part of the culture of my organization
Step 1	Ask the PICO(T) question	Participates in the formulation of clinical questions using PICOT* format. (*PICOT= Patient population; Intervention or area of interest; Comparison intervention or group; Outcome; Time).	<ul style="list-style-type: none"> I feel able to pose a clinical question to initiate a bibliographic search for scientific evidence I know how to formulate clinical questions structured according to the PICO question (patient, intervention, comparison and outcome)
Step 2	Search for the best evidence	Searches for external evidence* to answer focused clinical questions. (external evidence*=evidence generated from research)	<ul style="list-style-type: none"> I am grateful for the availability of scientific evidence that supports the care I practice I feel able to carry out structured bibliographic searches in the main databases I know the main webs with information that has already been critically evaluated (Cochrane, NICE, Guiasalud...)
Step 3	Critically appraise the evidence	Participates in critical appraisal of preappraised evidence (such as clinical practice guidelines, evidence-based policies and procedures, and evidence syntheses).	<ul style="list-style-type: none"> I know the meaning of the main measures of association and effect size (Student's t, chi-square, RR, OR, and NNT, etc.) I keep my clinical practice updated with information from clinical practice guidelines, systematic reviews, and other evidence
		Participates in the critical appraisal of published research studies to determine their strength and applicability to clinical practice	<ul style="list-style-type: none"> I feel able to evaluate the methodological quality of a scientific article I feel able to interpret the effect size and precision of the results of a scientific article I know the aspects that determine the quality of quantitative research I know the aspects that determine the quality of qualitative research
		Participates in the evaluation and synthesis of a body of evidence gathered to determine its strength and applicability to clinical practice.	<ul style="list-style-type: none"> I feel able to evaluate the applicability of the results of a scientific article in my work center I know the evidence level of the different designs of research studies I know the degrees of recommendation that endorse the introduction of health interventions.

Step 4	Integrate the evidence with clinical expertise and patient preferences to make the best clinical decision	Collects practice data (e.g., individual patient data, quality improvement data) systematically as internal evidence for clinical decision making in the care of individuals, groups, and populations.	<ul style="list-style-type: none"> I use validated instruments (questionnaires, tests, indexes, etc.) to evaluate the results of my clinical practice
		Integrates evidence gathered from external and internal sources in order to plan evidence-based practice changes.	<ul style="list-style-type: none"> I take account of the preferences of patients and/or family members in my clinical practice I take account of my professional experience in clinical decision-making I consult scientific evidence (clinical practice guidelines, systematic reviews, original studies, etc.) for my clinical practice In my work center, the decisions taken are based on scientific evidence rather than custom
		Implements practice changes based on evidence and clinical expertise and patient preferences to improve care processes and patient outcomes	<ul style="list-style-type: none"> I am grateful or would be grateful for the application of EBP in my work center I am willing to make a greater effort to apply EBP in my clinical practice I feel able to collaborate in (or lead) changes in clinical practice in my work center Interventions based on scientific evidence are performed in my work center The majority of evidence-based interventions in my work center are proposed by my health organization The majority of evidence-based interventions in my work center are proposed by nurses in the unit
Step 5	Evaluate the outcomes(s) of the EBP practice change	Evaluates outcomes of evidence-based decisions and practice changes for individuals, groups, and populations to determine best practices.	<ul style="list-style-type: none"> My institution regularly supplies the nurses with the results obtained by the unit I analyze with my colleagues the results obtained after evaluation of our care
Step 6	Disseminate the outcome(s)	Disseminates best practices supported by evidence to improve quality of care and patient outcomes.	<ul style="list-style-type: none"> I feel able to communicate to my colleagues the results obtained with my clinical practice

Table 2. Questionnaire to evaluate the competency in evidence-based practice of registered nurses (EBP-COQ Prof©)

		muy en desacuerdo strongly disagree	en desacuerdo disagree	ni de acuerdo ni en desacuerdo / neither agree nor disagree	De acuerdo agree	muy de acuerdo strongly agree
1	La PBE ayuda en la toma de decisiones en la práctica clínica / EBP helps decision-making in clinical practice	1	2	3	4	5
2	Me agrada disponer de evidencias científicas que sustenten los cuidados que practico / I am grateful for the availability of scientific evidence that supports the care I practice	1	2	3	4	5
3	La PBE aumenta la autonomía de la profesión enfermera / PBE increases the autonomy of the nursing profession	1	2	3	4	5
4	Me agrada o agradecería que en mi centro de trabajo se esté aplicando la PBE / I am grateful or would be grateful for the application of EBP in my work center	1	2	3	4	5
5	Ahora mismo la PBE es una de mis prioridades profesionales / EBP is one of my professional priorities right now	1	2	3	4	5
6	Con la aplicación de la PBE mejora la atención a los pacientes / The application of EBP improves patient care	1	2	3	4	5
7	Estoy dispuesta/o a realizar un mayor esfuerzo por aplicar la PBE en mi práctica clínica / I am willing to make a greater effort to apply EBP in my clinical practice	1	2	3	4	5
8	Creo que debería formarme más en PBE / I believe I should gain more training in EBP	1	2	3	4	5
9	Conozco cómo formular preguntas clínicas estructuradas según el formato PICO (paciente, intervención, comparación y resultado) / I know how to formulate clinical questions structured according to the PICO question (patient, intervention, comparison and outcome)	1	2	3	4	5
10	Conozco las principales web con información ya evaluada críticamente (Cochrane, NICE, Guíasalud...) / I know the main webs with information that has already been critically evaluated (Cochrane, NICE, Guíasalud...)	1	2	3	4	5
11	Conozco los aspectos que determinan la calidad de la investigación cuantitativa / I know the aspects that determine the quality of quantitative research	1	2	3	4	5

		muy en desacuerdo strongly disagree	en desacuerdo disagree	ni de acuerdo ni en desacuerdo / neither agree nor disagree	De acuerdo agree	muy de acuerdo strongly agree
12	Conozco los aspectos que determinan la calidad de la investigación cualitativa / I know the aspects that determine the quality of qualitative research	1	2	3	4	5
13	Conozco el nivel de evidencia de los diferentes diseños de estudios de investigación / I know the evidence level of the different designs of research studies	1	2	3	4	5
14	Conozco los grados de recomendación que avalan la implantación de intervenciones en salud / I know the degrees of recommendation that endorse the introduction of health interventions	1	2	3	4	5
15	Conozco el significado de las principales medidas de asociación y magnitud del efecto (t-Student, ji-cuadrado, RR, OR, NNT, etc.) / I know the meaning of the main measures of association and effect size (Student's t, chi-square, RR, OR, and NNT, etc.)	1	2	3	4	5
16	Me siento capaz de plantear una pregunta clínica para iniciar la búsqueda bibliográfica de evidencias científicas / I feel able to pose a clinical question to initiate a bibliographic search for scientific evidence.	1	2	3	4	5
17	Me siento capaz de realizar búsquedas bibliográficas de manera estructurada en las principales bases de datos / I feel able to carry out structured bibliographic searches in the main databases	1	2	3	4	5
18	Me siento capaz de evaluar la calidad metodológica de un artículo científico / I feel able to evaluate the methodological quality of a scientific article	1	2	3	4	5
19	Me siento capaz de interpretar la magnitud y precisión de los resultados de un artículo científico / I feel able to interpret the effect size and precision of the results of a scientific article	1	2	3	4	5
20	Me siento capaz de valorar la aplicabilidad de los resultados de un artículo científico en mi centro de trabajo / I feel able to evaluate the applicability of the results of a scientific article in my work center	1	2	3	4	5
21	Me siento capaz de analizar un problema clínico a partir de la valoración del paciente y/o de la evaluación de sus resultados en salud / I feel able to analyze a clinical problem based on the assessment of the patient and/or the evaluation of his/her health outcomes	1	2	3	4	5

22	Me siento capaz de comunicar a mis compañeros los resultados que obtengo con mi práctica clínica / I feel able to communicate to my colleagues the results obtained with my clinical practice	1	2	3	4	5
23	Me siento capaz de colaborar en (o liderar) cambios de la práctica clínica en mi centro de trabajo / I feel able to collaborate in (or lead) changes in clinical practice in my work center	1	2	3	4	5
24	En mi centro de trabajo se realizan intervenciones basadas en evidencias científicas / Interventions based on scientific evidence are performed in my work center	1	2	3	4	5
25	La mayoría de las intervenciones basadas en evidencias que se realizan en mi centro de trabajo son propuestas desde mi organización sanitaria / The majority of evidence-based interventions in my work center are proposed by my health organization	1	2	3	4	5
26	La mayoría de las intervenciones basadas en evidencias que se realizan en mi centro de trabajo son propuestas por las enfermeras de la unidad / The majority of evidence-based interventions in my work center are proposed by nurses in the unit.	1	2	3	4	5
27	Tengo en cuenta las preferencias de pacientes y/o familiares en mi práctica clínica / I take account of the preferences of patients and/or family members in my clinical practice	1	2	3	4	5
28	En la toma de decisiones clínicas tengo en cuenta mi experiencia profesional / I take account of my professional experience in clinical decision-making	1	2	3	4	5
29	Para mi práctica clínica consulto evidencias científicas (guías de práctica clínica, revisiones sistemáticas, estudios originales, etc.) / I consult scientific evidence (clinical practice guidelines, systematic reviews, original studies, etc.) for my clinical practice	1	2	3	4	5
30	Mi institución proporciona regularmente a las enfermeras los resultados obtenidos por la unidad / My institution regularly supplies the nurses with the results obtained by the unit.	1	2	3	4	5
31	Analizo con mis compañeras/os los resultados obtenidos tras la evaluación de los cuidados / I analyze with my colleagues the results obtained after evaluation of our care	1	2	3	4	5

		muy en desacuerdo strongly disagree	en desacuerdo disagree	ni de acuerdo ni en desacuerdo / neither agree nor disagree	De acuerdo agree	muy de acuerdo strongly agree
32	Utilizo herramientas validadas (cuestionarios, test, índices, etc) para evaluar los resultados de mi práctica clínica / I use validated instruments (questionnaires, tests, indexes, etc.) to evaluate the results of my clinical practice.	1	2	3	4	5
33	Mantengo actualizada mi práctica clínica con la información procedente de guías de práctica clínica, revisiones sistemáticas y otras evidencias / I keep my clinical practice updated with information from clinical practice guidelines, systematic reviews, and other evidence	1	2	3	4	5
34	En mi centro de trabajo se toman decisiones apoyadas en evidencias científicas y no tanto en la costumbre / In my work center, the decisions taken are based on scientific evidence rather than custom	1	2	3	4	5
35	En mi centro de trabajo colaboro para que la PBE sea parte de la cultura de mi organización / In my work center, I collaborate in making EBP part of the culture of my organization	1	2	3	4	5

*PBE: Práctica Basada en la Evidencia / EBP: Evidence-based Practice

Note 1: the reliability and validity processes are only applicable to the original in Spanish.

Note 2: for using the EBP-COQ Prof© authorized permission is required

Table 3. Descriptive statistics and corrected item-total correlation of EBP-COQ Prof©

Item	<i>M</i>	<i>SD</i>	Asymmetry	Kurtosis	Corrected item-total correlation
1. EBP helps decision-making in clinical practice	4.44	0.67	-1.21	1.98	0.68
2. I am grateful for the availability of scientific evidence that supports the care I practice	4.58	0.61	-1.41	2.23	0.68
3. EBP increases the autonomy of the nursing profession	4.43	0.71	-1.09	0.66	0.65
4. I am grateful or would be grateful for the application of EBP in my work center	4.49	0.64	-1.20	1.96	0.73
5. PBE is one of my professional priorities right now	3.64	0.85	-0.30	0.18	0.58
6. The application of EBP improves patient care	4.44	0.65	-1.00	1.30	0.73
7. I am willing to make a greater effort to apply EBP in my clinical practice	4.30	0.67	-0.75	0.89	0.68
8. I believe I should gain more training in EBP	4.44	0.69	-1.19	1.57	0.61
9. I know how to formulate clinical questions structured according to the PICO question (patient, intervention, comparison and outcome)	3.01	1.08	-0.04	-0.73	0.73
10. I know the main webs with information that has already been critically evaluated (Cochrane, NICE, Guiasalud...)	3.31	1.09	-0.29	-0.73	0.74
11. I know the aspects that determine the quality of quantitative research	3.07	1.06	-0.14	-0.67	0.83
12. I know the aspects that determine the quality of qualitative research	3.05	1.07	-0.10	-0.66	0.80
13. I know the evidence level of the different designs of research studies	3.05	1.07	-0.09	-0.68	0.79
14. I know the degrees of recommendation that endorse the introduction of health interventions.	3.15	1.05	-0.16	-0.65	0.72
15. I know the meaning of the main measures of association and effect size (Student's t, chi-square, RR, OR, and NNT, etc.)	2.76	1.09	0.17	-0.71	0.74
16. I feel able to pose a clinical question to initiate a bibliographic search for scientific evidence.	3.16	1.08	-0.25	-0.64	0.79
17. I feel able to carry out structured bibliographic searches in the main databases	3.25	1.06	-0.35	-0.53	0.79
18. I feel able to evaluate the methodological quality of a scientific article	2.81	1.02	0.02	-0.49	0.79

19. I feel able to interpret the effect size and precision of the results of a scientific article	2.78	0.98	0.08	-0.37	0.72
20. I feel able to evaluate the applicability of the results of a scientific article in my work center	3.06	1.00	-0.13	-0.54	0.67
21. I feel able to analyze a clinical problem based on the assessment of the patient and/or the evaluation of his/her health outcomes	3.34	0.98	-0.53	-0.27	0.75
22. I feel able to communicate to my colleagues the results obtained with my clinical practice	3.54	0.96	-0.68	0.05	0.78
23. I feel able to collaborate in (or lead) changes in clinical practice in my work center	3.41	1.00	-0.48	-0.19	0.66
24. Interventions based on scientific evidence are performed in my work center	3.33	0.91	-0.46	-0.01	0.56
25. The majority of evidence-based interventions in my work center are proposed by my health organization	3.14	0.91	-0.31	-0.10	0.45
26. The majority of evidence-based interventions in my work center are proposed by nurses in the unit.	2.96	0.91	-0.12	-0.18	0.38
27. I take account of the preferences of patients and/or family members in my clinical practice	3.88	0.84	-0.72	0.63	0.35
28. I take account of my professional experience in clinical decision-making	4.11	0.68	-0.79	1.89	0.26
29. I consult scientific evidence (clinical practice guidelines, systematic reviews, original studies, etc.) for my clinical practice	3.76	0.86	-0.68	0.73	0.44
30. My institution regularly supplies the nurses with the results obtained by the unit.	3.19	1.06	-0.29	-0.46	0.56
31. I analyze with my colleagues the results obtained after evaluation of our care	3.12	1.00	-0.20	-0.49	0.55
32. I use validated instruments (questionnaires, tests, indexes, etc.) to evaluate the results of my clinical practice.	3.23	1.12	-0.21	-0.78	0.55
33. I keep my clinical practice updated with information from clinical practice guidelines, systematic reviews, and other evidence	3.49	0.95	-0.47	0.04	0.59
34. In my work center, the decisions taken are based on scientific evidence rather than custom	3.24	0.92	-0.26	-0.18	0.67

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4 35. In my work center, I collaborate in making EBP part of the culture of my
5 organization

6 3.27 0.96 -0.31 -0.21 0.59

7 *M*: Mean; *SD*: Standard deviation
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For Peer Review

Table 5. Factorial loads of the four EFA models

	Model 1	Model 2		Model 3			Model 4			
	F1	F1	F2	F1	F2	F3	F1	F2	F3	F4
Item 1			0.676		0.786			0.773		
Item 2	0.339		0.669		0.702			0.694		
Item 3	0.371		0.601		0.612			0.608		
Item 4			0.711		0.779			0.759		
Item 5	0.449		0.573		0.545			0.538		
Item 6			0.796		0.830			0.804		
Item 7	0.378		0.678		0.702			0.667		
Item 8			0.595		0.634			0.606		
Item 9	0.701	0.707				0.731				0.737
Item 10	0.712	0.689				0.707				0.744
Item 11	0.708	0.791				0.887				1.000
Item 12	0.682	0.763				0.851				0.963
Item 13	0.725	0.766				0.807				0.829
Item 14	0.688	0.679				0.685				0.660
Item 15	0.638	0.757				0.775				0.732
Item 16	0.755	0.816				0.849				0.647
Item 17	0.737	0.859				0.879				0.727
Item 18	0.735	0.836				0.836				0.643
Item 19	0.699	0.782				0.763				0.548
Item 20	0.728	0.726				0.697		0.581		
Item 21	0.655	0.637				0.566		0.845		
Item 22	0.669	0.577				0.513		0.814		
Item 23	0.605	0.452				0.350		0.669		

Item 24	0.303		0.640	0.582	
Item 25			0.521	0.477	
Item 26			0.509	0.432	
Item 27	0.418				0.308
Item 28					0.370
Item 29	0.506	0.355	0.345	0.302	
Item 30	0.305		0.675	0.693	
Item 31	0.366		0.612	0.607	
Item 32	0.530	0.473	0.459	0.520	
Item 33	0.611	0.470	0.484	0.477	
Item 34	0.311		0.773	0.815	
Item 35	0.521	0.354	0.503	0.484	

Loadings lower than absolute 0.300 omitted

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Figure 2. Confirmatory Factor Analysis of the EBP-COQ Prof ©

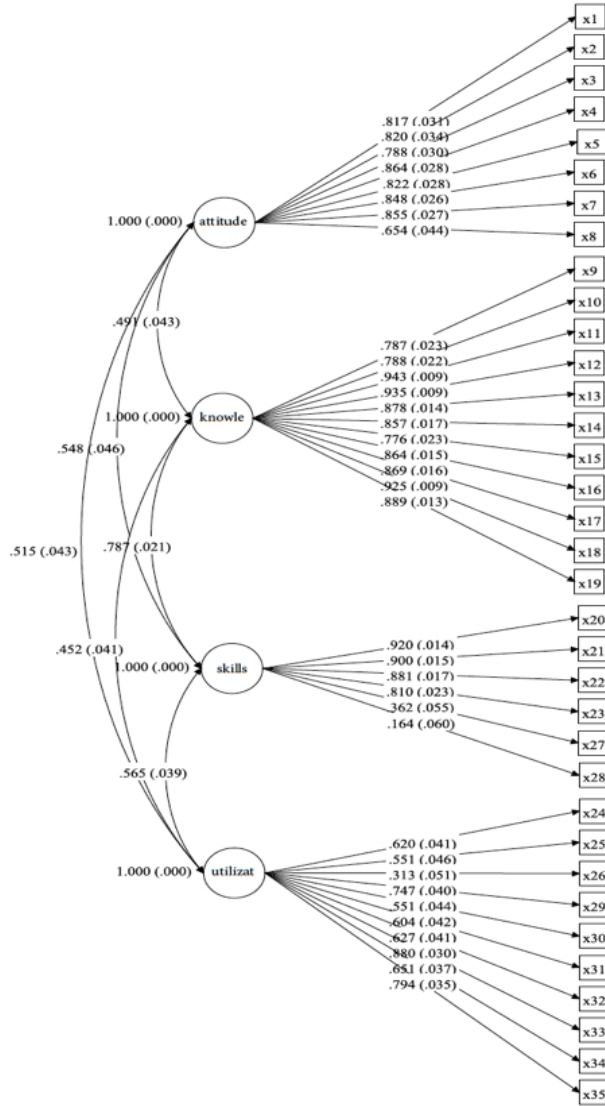


Figure 2. Confirmatory Factor Analysis of the EBP-COQ Prof (C)

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