

RESEARCH

Open Access



# Impact of advanced practice nurses in hospital units on compliance with clinical practice guidelines: a quasi-experimental study

Sandra Pol-Castañeda<sup>1,2</sup>, Miguel Angel Rodriguez-Calero<sup>2,3\*</sup>, Carlos Javier Villafáfila-Gomila<sup>3</sup>, Ian Blanco-Mavillard<sup>2,4</sup>, Concepción Zaforteza-Lallemand<sup>2,5</sup>, Francisco Ferrer-Cruz<sup>5</sup> and Joan Ernest De Pedro-Gómez<sup>2,6</sup>

## Abstract

**Background:** Incorporating the best available evidence into clinical practice is a determining challenge for health-care professionals and organisations. The role of advanced practice nurses is viewed as a facilitator to adapt guideline recommendations to suit specific contexts and to overcome barriers to implementation. In this study, we evaluate the impact of advanced practice nurses on clinical indicators of hospitalised patients and on adherence to recommendations derived from two clinical practice guidelines (pressure ulcer prevention and treatment and vascular access device management).

**Methods:** Quasi-experimental study in five intervention (IU) and five control (CU) hospital units at three hospitals in Spain (period 2018–19). Five advanced practice nurses were incorporated into IU, with the intention that would produce attitudinal changes and enhance the skills and knowledge of the nursing team regarding 18 clinical practice recommendations. In this study, 41 indicators were evaluated through direct observation of all patients admitted, at monthly intervals for 1 year. Outcomes were assessed by means of a descriptive, multi-line regression and association analysis.

**Results:** The study population was composed of 3742 inpatients admitted for pressure ulcer assessment and 2631 fitted with vascular access devices. By the end of the study period, all variables had improved in the IU, where average compliance with recommendations was statistically significantly higher (pressure ulcer guidance  $7.9 \pm 1.9$  vs  $6.0 \pm 1.7$ . OR 1.86, 95% CI 1.67–2.05; vascular access devices guidance  $5.4 \pm 1.4$  vs  $4.4 \pm 1.6$ . OR 1.06, 95% CI 0.95–1.17). The prevalence of pressure lesions and catheter-related adverse events decreased statistically significantly in the IU compared to the CU. The prevalence of pressure ulcers decreases (5.7% in IU vs 8.7% in CU  $p < 0.005$ ) as well as the prevalence of adverse events related to the catheter (14% in IU vs 21.6% in CU  $p < 0.005$ ). The unnecessary catheters decreased in IU 10.9% VS CU 15.8% ( $p < 0.005$ ).

**Conclusions:** The incorporation of an advanced practice nurse statistically significantly improves clinical indicators related to the prevention and treatment of pressure ulcers and to the management of vascular access devices.

**Trial registration:** [SRCTN18259923](https://www.clinicaltrials.gov/ct2/show/study?term=SRCTN18259923) retrospectively registered on 11/02/2022.

\*Correspondence: [mianrodriguez@ibsalut.es](mailto:mianrodriguez@ibsalut.es)

<sup>3</sup> Balearic Islands Health Services, 07003 Palma, Balearic Islands, Spain  
Full list of author information is available at the end of the article



**Keywords:** Evidence-based practice, Advanced practice nursing, Nurses, Practice guideline, Pressure ulcer, Vascular access devices, Implementation science

## Background

Incorporating the best available evidence into nurses' clinical practice continues to be a challenge for healthcare professionals and organisations. Shortcomings in this respect result in inconsistencies between the recommendations made in clinical practice guidelines (CPGs) and the reality of the care offered [1, 2]. Over the last 30 years, studies of this situation have identified various contributory factors, some corresponding to the organisational culture (such as lack of team support, inadequate resources, poor leadership, insufficient communication with other disciplines), while others concern the nurses' own characteristics (competence, attitudes, perceptions, skills, motivation, resistance to change, etc.) or are intrinsic to the evidence itself [3–6]. The joint impact of these factors can produce considerable variability in clinical practice, as decision-making is often based purely on the experience and judgment of the healthcare personnel concerned [7–9].

Previous efforts to create CPGs to enhance and standardise professional practice have mostly failed because they were not accompanied by concrete implementation plans or were not based on solid theories and robust methods. These deficiencies provoked delays in implementation and consolidated suboptimal healthcare and variability in clinical practice [10–16].

In this context, various research studies and models of the implementation of research findings recommend the use of CPGs as a means of enhancing health care and outcomes [17–19]. In Spain, the incorporation of Advanced Practice Nurses (APNs) into the health system is viewed as a useful response to the need to improve the application of CPGs. The use of different nursing leadership roles with the ability to influence their environment is a highly studied strategy [3, 18, 20–22], but in addition, the close and daily contact of the APNs with the nursing team, maintaining their own patient care activity as a benchmark in care, places them in an optimal position, making it possible to adapt the CPGs recommendations to suit specific circumstances and to overcome barriers to implementation [23]. APNs provide support in problem-solving, via individual and collective actions, and usually receive valuable support from the health system [20, 24].

Previous studies have explored the role of APNs as agents of change and as facilitators of the implementation of evidence [13, 24–26]. We propose that this role

be formally incorporated into hospitalisation units, under the denomination of Advanced Practice Hospitalisation Nurses (APHNs). The integrated Promoting Action on Research Implementation in Health Services framework [27, 28] was used as a guide to identifying the necessary elements to design and execute the implementation study, where the APHN functioned as the main active element that embodied the role of facilitator. The Theory of Planned Behaviour [29] was used to understand the determinants of the registered nurses' clinical behavior change process, thus guiding the APHN' training and helping them to identify possible implementation strategies. Taken in combination, these theoretical approaches provide a sound framework for establishing facilitation as a crucial forerunner of effective implementation [25, 26, 30]. The previously-published protocol for the present study described the interventions carried out, with respect to each of the variables considered [31], taking due account of the context and the organisational climate in which improvements were sought [32, 33] and the consequent improvements in clinical outcomes [34].

Although nurses constitute the most numerous element of human capital in the health system, relatively little research attention has focused on the roles they play and the value added to clinical outcomes [35]. In the present study, our aim is to determine the added value provided by APHNs. In this respect, few indicators have been published to help establish the quality of care [36], and so our analysis is based on indicators extracted from two CPGs published by the Spanish National Health System. These guidelines refer to the treatment and prevention of pressure ulcers and the management of vascular access devices [37, 38]. In most adult hospitalisation units, both pressure ulcers and vascular access are important aspects of primary and transversal nursing care and are closely related to the quality of the process and to the resulting morbidity and mortality [39, 40].

This study considers, for the first time with respect to the Spanish Health Service, the value of incorporating APHNs into hospital units as a facilitation strategy to improve the implementation of research-based evidence, and responds to the request from the international arena to countries that are recently embraced advanced practice roles, as is the case of Spain, to share evidence of their own experiences to ensure a sustainable transition [41].

## Methods

### Aim

The main objective of this study is to determine the impact of the incorporation of APHNs on the clinical indicators of hospitalised patients and on the level of adherence of the nursing team to the recommendations derived from two CPGs, and thus the implementation of research-based evidence.

### Design

In this quasi-experimental study, the clinical indicators derived from two CPGs currently in use in the Balearic Islands Health System were evaluated by monthly on-site audits [37, 38].

This study is part of a mixed method project developed to explore the outcomes obtained when APHNs are incorporated into conventional hospital units. The protocol for this project has been published previously [31]. In the present paper, we report the findings of the first phase of the study, in which clinical indicators were monitored and a quantitative methodology was applied (trial registry ISRCTN18259923; Registration date 11/02/2022).

The study was carried out at three public hospitals (a university hospital and two general hospitals) in the Balearic Islands (Spain). For the purposes of this analysis, ten medical and surgical units were selected, with 5 units as the intervention group, and the remaining five as the control.

Before selecting these units, the organisational climate was characterised, using the validated Practice Environment Scale-Nursing Work Index questionnaire [42]. This instrument measures the degree to which a certain environment is favourable for the development of a recommended nursing practice. At each participating hospital, intervention and control units with a similar patient profile and comparable total Practice Environment Scale-Nursing Work Index score ( $\pm 5\%$ ) were selected (see Additional file 1).

The intervention consisted of the incorporation of an APHN within each unit involved, to participate in activities appropriate to the context in question, with specific interest in providing support to health teams, motivating attitudinal change regarding skills, abilities and knowledge and seeking to ensure the implementation of CPGs recommendations and the avoidance of low-value practices. Among other actions, the APHNs extended awareness of the project, assisted in the implementation of the CPGs, worked with the team to establish objectives, provided training for the health team, contributed to the planning of changes in routines, materials, techniques, etc., evaluated the results obtained, provided periodic feedback to the health team, adjusted the interventions as necessary, and offered support and mentoring.

The APHNs were selected from the registered nurses deployed within the intervention units at the start of the study. This selection was based on each individual's leadership qualities and on the score obtained in the Advanced Practice Nursing Competency Assessment Instrument [43]. A second nurse from the team (the 'support RN') was also selected to stand in for the primary APHN if necessary. All involved – APHNs, support RNs and ward supervisors – took part in an ad hoc training programme to develop the competencies associated with advanced practice and with the CPGs being evaluated. Further details of this programme are available in the research protocol [31]. These personnel were also instructed in the required methods of data collection and recording. Monthly meetings were held to monitor the intervention, in which the APHN and other team members participated, and individual contacts were also available if needed.

In the units forming the control group, no type of intervention was carried out, although the personnel did receive general information about the project before it started, through the unit supervisors. Nevertheless, these units were given the normal CPGs, as recommended by the health system.

### Sample/participants

The sample was composed of all adult patients hospitalised in the intervention and control units on the specific days in which audits were carried out, 1 day per month for each CPG. Patients in terminal care were excluded.

To calculate the minimum sample size, a pressure ulcer incidence of 8.6% and a catheter-associated adverse event incidence of 41% were assumed. These values were obtained from observational studies carried out locally [44, 45], in which the interventions performed reduced the incidence of these events by 10%. To detect this difference between the two proportions as statistically significant, accepting an alpha risk of 0.05 and a beta risk of 0.2 in a bilateral test, we calculated that a minimum sample size of 476 patients would be needed for the pressure ulcers guideline (238 in each group) and 722 for the vascular access guideline (361 in each group). These values were obtained using the ARCSIN approximation. A 12-month follow-up period was established for each unit to ensure the necessary sample size was obtained and to detect any seasonal variations.

### Data collection

In both control and intervention groups, sociodemographic variables (age, sex, date, unit of admission) were recorded, as well as process and outcome variables derived from the two CPGs (see Additional file 2). In the case of the pressure ulcer assessment, after collecting the

sociodemographic variables, the APHN evaluated the patient's risk of developing a pressure ulcer according to the Braden scale and evaluated the presence of pressure ulcers. A patient at risk of pressure ulcer was defined as a Braden score of <17 points in patients younger than 75 years or <19 points in patients older than 75 years. A patient at risk or currently presenting pressure ulcers was considered a "candidate for extended care" and only then, the rest of the variables were collected (see Additional file 2). The variables considered as potential effect modifiers were the time in which the audit was carried out ("time of the audit", measured in months) and unit of admission (APHN vs control). In the case of pressure ulcer guideline, the variable "risk of pressure ulcer" was also included.

Data collection began simultaneously with the onset of APHN activity in the unit (baseline), by direct observation of hospitalised patients on a predefined day, at one-month intervals, for 12 months. Independent audits were conducted to assess issues related to the prevention and care of pressure ulcers, on the one hand, and the insertion and maintenance of peripheral vascular catheters, on the other. The data collection period was from April 2018 to September 2019.

The audits were carried out by registered nurses specifically trained for this task to ensure data homogeneity. The data were stored in an anonymised database for later analysis.

### Data analysis

A descriptive analysis was made of all the study variables in order to define the characteristics of the study group, using frequencies and percentages for the qualitative variables and means and standard deviations for the quantitative ones. The Kolmogorov-Smirnov test was used for the analysis of normality. The findings for each process and outcome variable were evaluated by comparing each month of the study, together with the data accumulated by the end of the study period. For the variables regarding adherence to the CPG recommendations, the differences between the baseline and the last month of the study were evaluated, comparing the degree of compliance between groups, and the changes observed within each group. To evaluate inter-group differences, Student's t-test was used for the quantitative variables and the chi-square test or Fisher's exact test for the qualitative ones.

Linear regression analyses were performed on the numerical variables to analyse the effect of each factor on compliance with the CPG recommendations (outcome measures for these analyses were "Overall adherence to PU recommendations" and "Overall adherence to vascular access care recommendations", see Additional file 2). A value of  $p < 0.05$  was assumed to indicate statistical

significance. IBM-SPSS v.26 statistical software was used for all these analyses.

### Validity and reliability/rigour

The study variables were measured by direct observation, by nurses specifically trained to ensure the homogeneity of the data obtained. The questionnaires used in selecting the units (Practice Environment Scale-Nursing Work Index) and nurses (Advanced Practice Nursing Competency Assessment Instrument) included in the study were validated in Spanish and adapted to the context. The Cronbach's  $\alpha$  values of these instruments, in the validated version, were 0.91 and 0.96, respectively.

## Results

### Participants

In total, 6373 audits were carried out. In the case of pressure ulcer audits, 3742 patients were included, of whom 1797 were in the intervention group and 1945 in the control group. By sex, 2094 patients were male and 1648 were female. The mean (SD) age of the sample was 68.2 years  $\pm$  16.6. Regarding the patients included in the audit of vascular access devices, the study sample was 2631 patients, 1290 in the intervention group and 1341 in the control group, of whom 1493 were male and 1138 were female. The mean (SD) age of the sample was 70.7  $\pm$  16.3 years. No differences were observed in the distribution by sex between the study groups (Table 1).

### Indicators derived from the clinical practice guidelines for pressure ulcers

An additional file shows the monthly evolution of the variables observed for these CPG, for both groups (see Additional file 3).

The number of patients at risk or with pressure ulcers present, and therefore candidates to receive care based on CPG recommendations, ranged between 30 and 40% of all patients audited each month (a total of 1329 patients, 567 in the intervention group and 762 in the

**Table 1** Demographic characteristics of participants

Patients included in pressure ulcers assessment		
	Intervention group	Control group
Admission unit, n (%)	1797 (48.02%)	1945 (51.98%)
Male Gender, n (%)	984 (54.76%)	1110 (57.07%)
Age, mean (SD) (years)	67.3 $\pm$ 16.2	69 $\pm$ 16.9
Patients included in vascular access devices assessment		
	Intervention	Control
Admission unit, n (%)	1290 (49.03%)	1341 (50.96%)
Male Gender, n (%)	736 (57.05%)	757 (56.45%)
Age, mean (SD) (years)	69.2 $\pm$ 16.5	72.2 $\pm$ 15.9

control group). Table 2 shows the percentage of compliance with these recommendations in each unit at the beginning and the end of the intervention period. Figure 1 shows the evolution of adherence to the eleven process indicators measured monthly.

Table 3 shows the results of the linear regression model created to determine the influence of the intervention on adherence to the CPG recommendations for the prevention and care of pressure ulcers among patients who were candidates for extended care (n=1329). As observed, adherence to the CPG recommendations arise more likely to happen if the patient is admitted to an APHN unit as intervention time progresses. The

patient’s risk of pressure ulcer does not affect adherence to recommendations.

**Indicators derived from the clinical practice guidelines for vascular access devices**

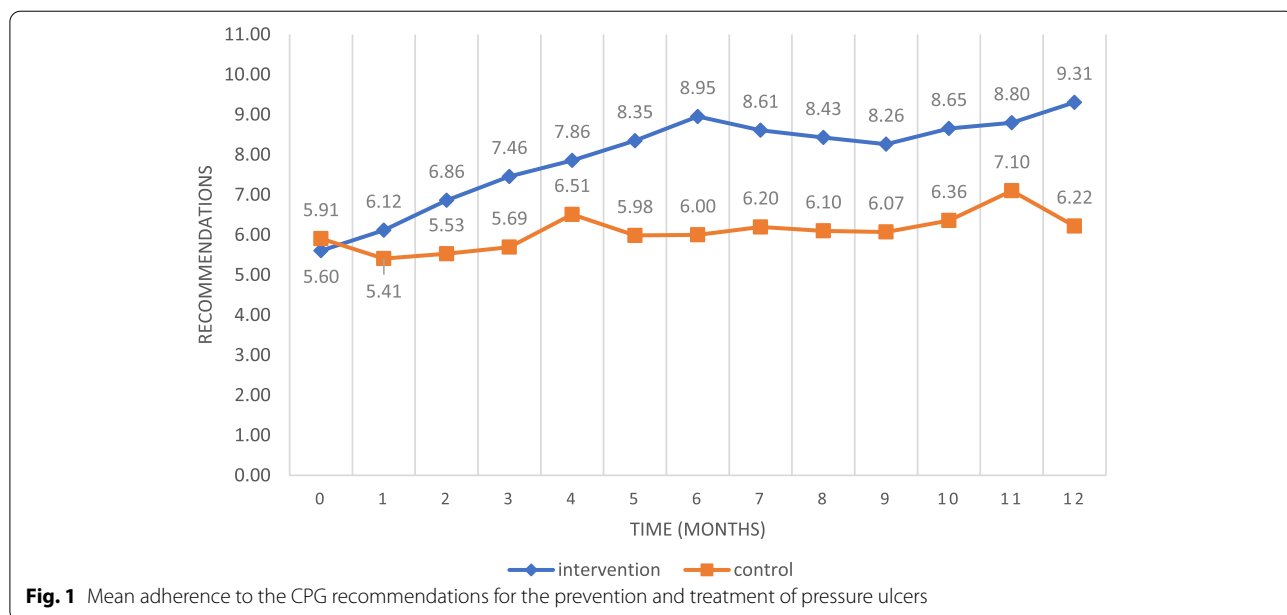
An additional file shows the monthly evolution of the variables observed in each of the study groups (see Additional file 4).

Table 4 shows the percentage of compliance with the CPG recommendations for vascular access in each unit, before and after the intervention. The evolution of adherence to the seven process indicators, measured monthly, is shown in Fig. 2.

**Table 2** Compliance with the CPG recommendations for the prevention and treatment of pressure ulcers

	Baseline (pre-intervention)			12 months (post-intervention)			Within-group pre-post difference	
	APHN	Control	p value	APHN	Control	p value	APHN (p value)	Control (p value)
PU risk assessment among candidates for extended care	65%	60%	0.633	94%	62%	<.001	29 pp. (0.000)	1 pp. (0.878)
PU risk reassessment	12%	13%	0.816	83%	16%	<.001	72 pp. (0.000)	3 pp. (0.644)
Daily assessment of skin condition	7%	2%	0.322	69%	22%	<.001	62 pp. (0.000)	20 pp. (0.001)
Barrier / moisturiser cream or oil	72%	70%	0.807	89%	47%	<.001	17 pp. (0.064)	−23 pp. (0.018)
Daily record of skin condition	0%	43%	0.000	97%	36%	<.001	97 pp. (0.000)	−7 pp. (0.455)
Postural changes scheduled	67%	55%	0.205	92%	67%	0.007	24 pp. (0.009)	13 pp. (0.181)
Pressure modification/Pressure relief support (PMS/PRS)	93%	87%	0.504	92%	89%	1.000	−1 pp. (1.000)	2 pp. (0.714)
Nutritional assessment	21%	30%	0.304	33%	16%	0.060	12 pp. (0.214)	−14 pp. (0.089)
Full record of PU characteristics	84%	83%	0.927	100%	95%	0.275	16 pp. (0.014)	12 pp. (0.057)
PU treatment schedule	81%	87%	0.469	94%	93%	1.000	13 pp. (0.101)	6 pp. (0.308)
Patients’ and families’ understanding of condition	58%	60%	0.824	86%	78%	0.343	28 pp. (0.006)	18 pp. (0.045)

PU: Pressure ulcer; APHN Advanced practice hospitalization nurse; pp. Percentage point



**Fig. 1** Mean adherence to the CPG recommendations for the prevention and treatment of pressure ulcers

**Table 3** Variables that influence overall adherence to pressure ulcers recommendations

N = 1329	Simple linear regression				Multiple linear regression			
	B	95% CI		p value	B	95% CI		p value
Unit (APHN / control)	1.833	1.635	2.031	0.000	1.865	1.677	2.053	<.001
Time (months)	0.151	0.123	0.179	0.000	0.156	0.131	0.181	<.001
Risk of PU <sup>†</sup>	-0.072	-0.307	0.164	0.551	0.094	-0.106	0.295	0.357

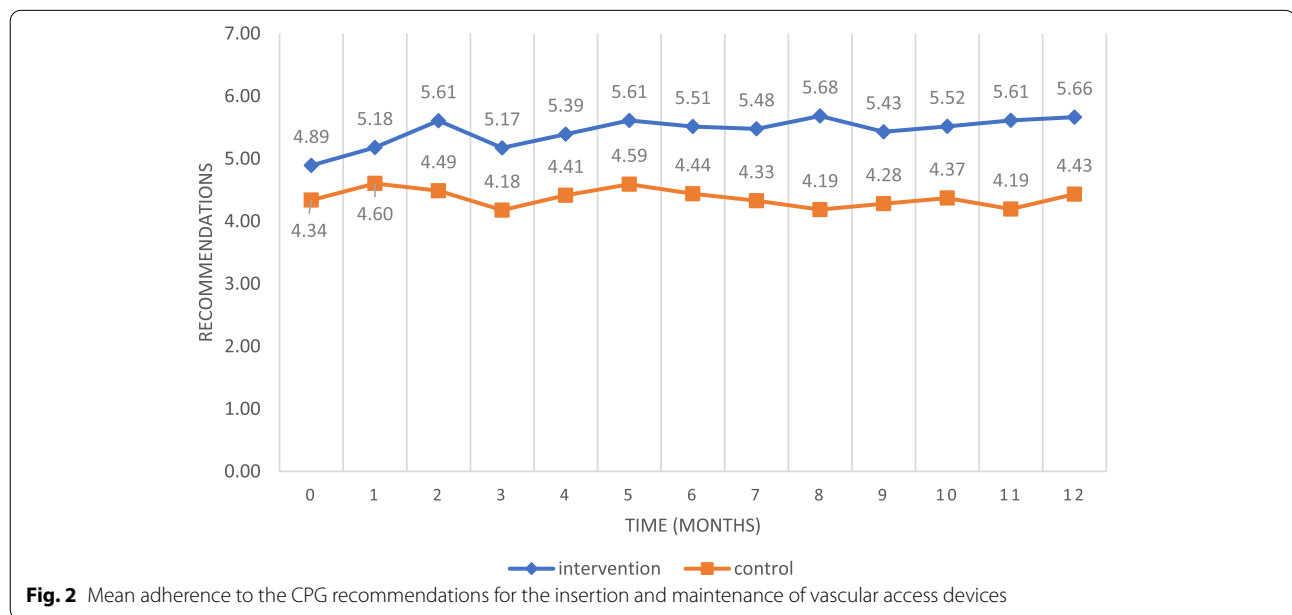
PU: pressure ulcer; APHN Advanced practice hospitalisation nurse; CI Confidence interval

<sup>†</sup> Patient at risk of developing a pressure ulcer was defined as one presenting a Braden score < 17 points in patients younger than 75 years or < 19 points in patients older than 75 years

**Table 4** Compliance with the recommendations for the care of peripheral catheters

	Baseline (pre-intervention)			12 months (post-intervention)			Within-group pre-post difference	
	APHN	Control	p value	APHN	Control	p value	APHN (p value)	Control (p value)
Catheters inserted in the correct location	84%	78%	0.279	78%	73%	0.363	-6pp (0.266)	-6pp (0.372)
Catheters inserted, with the orifice visible	67%	58%	0.193	90%	71%	<.001	23pp (0.000)	13pp (0.066)
Catheters in use	85%	92%	0.120	89%	83%	0.227	4pp (0.416)	-9pp (0.055)
Duration of insertion	66%	53%	0.078	60%	47%	0.067	-5pp (0.435)	-6pp(0.420)
Type of attachment	67%	57%	0.146	88%	69%	<.001	21pp (0.000)	13pp (0.066)
Condition of the dressing	60%	59%	0.875	75%	67%	0.222	15pp (0.019)	9pp (0.219)
Catheter record	61%	37%	0.001	85%	33%	<.001	24pp (0.000)	-4pp (0.535)

APHN: Advanced practice hospitalisation nurse, pp. Percentage point



**Fig. 2** Mean adherence to the CPG recommendations for the insertion and maintenance of vascular access devices

Table 5 shows the results of the linear regression model created to determine the influence of the intervention on adherence to CPG recommendations for the insertion and care of vascular access devices. Again, the CPG recommendations are more likely to be followed if the patient is admitted to an APHN unit as intervention time progresses.

**Discussion**

To our knowledge, the present study is the first that has been conducted to measure the impact produced on indicators of clinical results by the presence of an APHN in the hospital unit when these indicators depend directly on the nursing care provided. The study results revealed a

**Table 5** Variables that influence overall adherence to vascular access recommendations

N = 2631	Simple linear regression				Multiple linear regression			
	B	95% CI		p value	B	95% CI		p value
Unit (APHN / Control)	1.068	0.955	1.180	0.000	1.066	0.953	1.178	<.001
Time (months)	0.016	0.000	0.032	0,048	0.014	−0.001	0.029	0.077

APHN: Advanced practice hospitalisation nurse; CI Confidence interval

significant improvement in most of the clinical indicators derived from both the CPGs of pressure ulcer prevention and treatment and vascular access (catheterisation) care and maintenance (Tables 2 and 4), especially those related to the nursing care process. Higher adherence to evidence-based recommendations is observed in those units led by APHNs.

The findings we report are in line with those obtained in previous studies regarding the positive influence of APNs on clinical outcomes [46]. Many of these earlier studies compared the results of patients seen by APNs with those supervised by other healthcare providers, concluding that the outcomes for the former were equally good or even better [46–48]. The incorporation of APNs into multidisciplinary teams not only improves health system results but also reduces costs [49]. However, it is sometimes difficult to measure the specific effect of an APN's contribution, precisely because this professional forms part of a multidisciplinary team [50]. Our study addresses this very question, by measuring clinical indicators that depend directly on the nursing input, thus reflecting the individual's contribution and impact on patient care.

Analysis of the process indicators and of the linear regression suggests that the improvement in adherence to CPGs recommendations is produced by the direct intervention of the APHNs. The magnitude of this improvement increased as the intervention time progressed, and the curve never completely flattened during the intervention. Therefore, the long-term impact of the intervention remains to be determined.

In the specific case of the pressure ulcer guideline, adherence to the CPG recommendations and the improvements observed were independent of the patient's level of risk. This observation corroborates previous studies according to which awareness of CPGs is not sufficient to ensure compliance. Instead, a broad range of factors that may produce behavioural change must be taken into account [29, 51, 52].

Prior research has shown that the contribution made by APNs improves pressure ulcer care and decreases its prevalence [53]. In our case, the pre-post analysis of the process and outcome indicators of pressure ulcers showed that almost all aspects of nursing care related to

the treatment and prevention of these injuries in patients at risk were significantly improved in the intervention group, compared to the control group. Among the patients in the intervention group, almost 91% received a risk assessment on admission to hospital (an increase of 22 percentage points over the previous situation), which contrasts with the 62% measured in the control group (an 11 percentage points improvement). In the intervention group, moreover, we also observed a 30 percentage points increase in risk reassessment when this was indicated, an effect that was not observed in the control group. The adherence to the different variables at the beginning of the study was heterogeneous, some of them showing initial high compliance (ie. use of pressure modification/pressure relief support surfaces, record of PU characteristics or treatment schedule) possibly due to environmental or organisational characteristics that influence clinical staff to be more sensitive to certain aspects of care [54].

With respect to the impact of APHN intervention on compliance with the CPG recommendations for the use and maintenance of vascular access devices, we observed a reduction in catheter-related adverse events in both study groups, but they were statistically significantly less prevalent in the intervention group (9%) than in the control group (20%). This question is of great importance to patients' health, as reducing adverse events is directly associated with preventing bacteremia. Moreover, it considerably cuts health care costs [55, 56].

In our study, statistically significant improvements were obtained in the care and maintenance of catheters, in the variables concerning visual inspection of the insertion orifice, in the type of catheter attachment employed and in the records kept of catheter characteristics. The duration of catheter use tended to be greater in the intervention group. This might be explained by the closer monitoring performed of the device status, which helped achieve lower rates of adverse events, despite the prolonged insertion of the catheters [57].

There were no statistically significant improvements in all the other indicators considered. The variable "location of the catheter" was less influenced by the intervention, probably due to the complexity of measuring the long-term suitability of a given location. In addition, many patients are admitted with the catheter already in place, it

having been inserted during previous attention, in emergency department or any different unit. This situation may influence the assessment of the catheter suitability, as it may vary from when the catheter was originally inserted until the time at which the audit is performed.

Another notable result obtained is the increased number of nursing records kept related to the two processes under study. Although these figures increased overall, the increase was sharper in the intervention unit. Clinical documentation is an essential part of nursing care [58], by facilitating access to valid patient data and enabling healthcare providers to make a timely evaluation and deliver appropriate follow-up [59].

Although the contribution made by APNs has been studied in various settings, ranging from primary to specialised care, using indicators that directly reflect APN care [46, 48, 49, 60] the role and importance of these professionals in the Spanish health system have yet to be fully determined. Thus, while some institutions have incorporated nurses with advanced skills, especially in the care of patients with chronic diseases [50, 60], their status is neither well known nor formally regulated [61]. Our study shows that the incorporation of APNs enhances clinical outcomes, and therefore it would be useful to conduct cost-effectiveness studies in this field, as has been proposed elsewhere [47, 49, 50, 62]. In our view, the improved quality of care and the cost reductions facilitated by the introduction of APNs into hospital units are undeniable and should be acknowledged by policymakers when the opportunity arises to incorporate these new roles into the health system [62].

Working to improve healthcare practices is a complex, multifaceted task, and therefore any improvement strategy proposed should be carefully piloted before implementation [1]. The present study represents an initial step towards understanding this process within a still incipient context in the field of advanced healthcare practice [41]. APNs must function within the framework of models of proven efficiency. In line with previous research, our study highlights the role of APNs as agents of change, stimulating evidence-based practices, and facilitating the implementation of the CPG recommendations in hospitals' nursing teams [9, 24–26, 63].

### Limitations

This study is subject to certain limitations, especially the fact that the indicators were not monitored continuously, but were evaluated on predetermined, non-randomised days. Moreover, while the study variables were evaluated by direct observation of the care performed by the unit nurses, slight improvements were also observed in the control units, a phenomenon which could be explained by the Hawthorne effect, since it

is difficult to maintain usual work behaviour when the teams are aware that they are being studied [64]. Furthermore, as similar units from the same hospital were selected for study, there is the possibility that some of the dynamics established in an intervention unit may have influenced the actions of those working in the control unit. Finally, there may have been some interchange of nurses between the intervention and control units, which would also have affected the behaviour patterns observed.

### Conclusions

The incorporation of Advanced Practice Hospitalisation Nurses (APHNs) into hospital units significantly improves clinical indicators related to the prevention and treatment of pressure ulcers and the insertion and maintenance of peripheral catheters. Overall, these effects are reflected as a decrease in the number of adverse events experienced. Our study describes the specific contributions made by APNs in terms of the health indicators considered. Our focus on two CPGs illustrates the potential benefits of incorporating APNs into hospital units, in terms of the implementation of evidence and fostering adherence to the CPGs among other members of the nursing team. The results we present highlight the need to consider modifying certain professional roles, adapting them to new models of proven efficacy.

### Abbreviations

CPG: Clinical Practice Guideline; APN: Advanced Practice Nurse; APHN: Advanced Practice Hospitalization Nurse.

### Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12912-022-01110-x>.

**Additional file 1.**

**Additional file 2.**

**Additional file 3.**

**Additional file 4.**

### Acknowledgements

We thank the nursing teams that agreed to participate in the project and especially the nurses who developed the role of advanced practice nurse for their effort and dedication.

### Conflict of interest

The authors declare no conflicts of interests.

### Authors' contributions

JDPG designed the initial proposal of the study. SPC and MARC were responsible for the research team coordination. All authors contributed to the intervention control and follow-up. SPC compiled the data for analysis. SPC and MARC were responsible for data analysis and synthesis. All authors



contributed significantly to the text writing and approved the final version of the manuscript.

### Funding

This study was funded by the Nursing College of the Balearic Islands (PI2127/2019). The founder did not take part in any stage of the study and did not influence in any manner the study results and interpretation of the findings.

### Availability of data and materials

The datasets generated and/or analysed during the current study are not publicly available due to privacy and confidentiality reasons, but are available from the corresponding author on reasonable request.

### Declarations

#### Ethics approval and consent to participate

The study was approved by the Research Ethics Committee of the Balearic Islands (No. IB3662/18PI) on 27 June 2018 (committee No. 06/18). Before completing the questionnaires and recording the necessary clinical parameters, informed consent was obtained from all nurses involved in the study. Due to the characteristics of the study, it was impractical to collect individual informed consent from all patients in each clinical audit, as it was a long period of time. The intervention was carried out on clinical nurses to improve the quality of health care, so the risk to patients was null. The data collection process was coded to ensure the anonymity of those taking part. For all these reasons, the need for informed consent approval from patients was waived. All the information requested by the patient during the clinical audit was provided. If the patient refused to give data during the audit, the patient would not be part of the study. The processing, communication, and transfer of the personal data belonging to all participants were carried out in compliance with the Declaration of Helsinki and the provisions of national legislation concerning clinical research (Spanish Organic Law 3/2018). The confidentiality of the data and the anonymity and privacy of patients and nurses were preserved at all times.

#### Consent for publication

Not applicable.

#### Competing interests

The authors declare that they have no competing interests.

#### Author details

<sup>1</sup>Hospital Son Llàtzer, 07198 Palma, Balearic Islands, Spain. <sup>2</sup>Care, Chronicity and Health Evidences (CuRES) Research Group, Health Research Institute of the Balearic Islands (IdISBa), 07010 Palma, Balearic Islands, Spain. <sup>3</sup>Balearic Islands Health Services, 07003 Palma, Balearic Islands, Spain. <sup>4</sup>Hospital Manacor, 07500 Manacor, Balearic Islands, Spain. <sup>5</sup>Hospital Comarcal d'Inca, 07300 Inca, Balearic Islands, Spain. <sup>6</sup>Department of Nursing and Physiotherapy, University of the Balearic Islands, 07122 Palma, Balearic Islands, Spain.

Received: 22 July 2022 Accepted: 15 November 2022

Published online: 29 November 2022

### References

- Melnyk BM, Fineout-Overholt E. Evidence-based practice in nursing & healthcare: a guide to best practice. In Sigma Theta Tau International (Ed.), *Implementing the Evidence-Based Practice (EBP) Competencies in Healthcare* (Fourth ed., p. 782). Indianapolis, 2019.
- Greenhalgh T, Howick J, Maskrey N. Evidence based medicine: a movement in crisis? *BMJ* 2014;348:g3725. <https://doi.org/10.1136/bmj.g3725>.
- Jun J, Kovner CT, Stimpfel AW. Barriers and facilitators of nurses' use of clinical practice guidelines: an integrative review. *Int J Nurs Stud*. 2016;60:54–68.
- van Rosmalen BV, Alldinger I, Cieslak KP, Wennink R, Clarke M, Ali UA, et al. Worldwide trends in volume and quality of published protocols of randomized controlled trials. *PLoS One*. 2017;12(3).
- Williams B, Perillo S, Brown T. What are the factors of organisational culture in health care settings that act as barriers to the implementation of evidence-based practice? A scoping review *Nurse Educ Today*. 2015;35(2):e34–41.
- Sadeghi-Bazargani H, Tabrizi JS, Azami-Aghdash S. Barriers to evidence-based medicine: a systematic review. *J Eval Clin Pract*. 2014;20(6):793–802.
- Corallo AN, Croxford R, Goodman DC, Bryan EL, Srivastava D, Stukel TA. A systematic review of medical practice variation in OECD countries. *Health Policy (New York)*. 2014;114:5–14.
- Westert GP, Groenewoud S, Wennberg JE, Gerard C, Dasilva P, Atsma F, et al. Medical practice variation: public reporting a first necessary step to spark change. *Int J Qual Heal Care*. 2018;30(9):731–5.
- Gabbay J, Le May A. Mindlines: making sense of evidence in practice. *Br J Gen Pract*. 2016;66(649):402–3.
- Grandes G, Sanchez A, Cortada JM, Pombo H, Martinez C, Balagué L, et al. Collaborative modeling of an implementation strategy: a case study to integrate health promotion in primary and community care. *BMC Res Notes*. 2017;10(1):1–12.
- Jin Y-H, Tan L-M, Khan KS, Deng T, Huang C, Han F, et al. Determinants of successful guideline implementation: a national cross-sectional survey. *BMC Med Inform Decis Mak*. 2021;21(1):19.
- Kirk MA, Kelley C, Yankey N, Birken SA, Abadie B, Damschroder L. A systematic review of the use of the consolidated framework for implementation research. *Implement Sci*. 2015;11(1):72.
- Melnyk BM, Fineout-Overholt E, Giggelman M, Choy K. A Test of the ARCC® Model Improves Implementation of Evidence-Based Practice, Healthcare Culture, and Patient Outcomes. *Worldviews Evidence-Based Nurs*. 2017;14(1):5–9.
- Birken SA, Powell BJ, Presseau J, Kirk MA, Lorencatto F, Gould NJ, et al. Combined use of the Consolidated Framework for Implementation Research (CFIR) and the Theoretical Domains Framework (TDF): a systematic review. *Implement Sci*. 2017;12(1):2.
- Moullin JC, Dickson KS, Stadnick NA, Albers B, Nilsen P, Broder-Fingert S, et al. Ten recommendations for using implementation frameworks in research and practice. *Implement Sci Commun*. 2020;1(1):1–12.
- Graham ID, Kothari A, McCutcheon C, Alvarez G, Banner D, Botti M, et al. Moving knowledge into action for more effective practice, programmes and policy: protocol for a research programme on integrated knowledge translation. *Implement Sci*. 2018;13(1).
- Straus SE, Tetroe J, Graham ID. Knowledge translation in health care: moving from evidence to practice: John Wiley & Sons; 2013.
- McArthur C, Bai Y, Hewston P, Giangregorio L, Straus S, Papaioannou A. Barriers and facilitators to implementing evidence-based guidelines in long-term care: a qualitative evidence synthesis. *Implement Sci*. 9 de diciembre de. 2021;16(1):70.
- Mackey A, Bassendowski S. The History of Evidence-Based Practice in Nursing Education and Practice. *J Prof Nurs*. 1 de enero de. 2017;33(1):51–5.
- Dogherty EJ, Harrison M, Graham I, Keeping-Burke L. Examining the use of facilitation within guideline dissemination and implementation studies in nursing. *Int J Evid Based Healthc junio de*. 2014;12(2):105–27.
- Melnyk BM, Gallagher-Ford L, Fineout-Overholt E, Sigma Theta Tau International. *Implementing the evidence-based practice (EBP) competencies in healthcare: a practical guide to improving quality, safety, and outcomes*. 2016.
- Kitson AL, Harvey G, Gifford W, Hunter SC, Kelly J, Cummings GG, et al. How nursing leaders promote evidence-based practice implementation at point-of-care: a four-country exploratory study. *J Adv Nurs* 24 de febrero de. 2021;77(5):2447–57.
- Sevilla Guerra S, Zabalegui A, Comellas Oliva M, Estrem Cuesta M, Martín-Baranera M, Ferrús Estopà L. Advanced practice nurses: Analysis of their role from a multicentre cross-sectional study. *Int Nurs Rev*. 2022;69(1):30–37. <https://doi.org/10.1111/inr.12706>.
- McDonnell A, Goodwin E, Kennedy F, Hawley K, Gerrish K, Smith C. An evaluation of the implementation of advanced nurse practitioner (ANP) roles in an acute hospital setting. *J Adv Nurs* abril de. 2015;71(4):789–99.
- Harvey G, Gifford W, Cummings G, Kelly J, Kislov R, Kitson A, et al. Mobilising evidence to improve nursing practice: A qualitative study of leadership roles and processes in four countries. *Int J Nurs Stud*. 1 de febrero de. 2019;90:21–30.
- Seers K, Rycroft-Malone J, Cox K, Crichton N, Edwards RT, Eldh AC, et al. Facilitating implementation of research evidence (FIRE): an international cluster randomised controlled trial to evaluate two models of facilitation

- informed by the promoting action on research implementation in health services (PARIHS) framework. *Implement Sci.* 2018;13(1):137.
27. Kitson AL, Rycroft-Malone J, Harvey G, McCormack B, Seers K, Titchen A. Evaluating the successful implementation of evidence into practice using the PARIHS framework: theoretical and practical challenges. *Implement Sci.* 7 de enero de. 2008;3(1):1.
  28. Harvey G, Kitson A. PARIHS revisited: from heuristic to integrated framework for the successful implementation of knowledge into practice. *Implement Sci.* 2016;11(1).
  29. Ajzen I. The theory of planned behavior. *Organ Behav Hum Decis Process* diciembre de. 1991;50(2):179–211.
  30. Ajzen I, Madden TJ. Prediction of goal-directed behavior: Attitudes, intentions, and perceived behavioral control. *J Exp Soc Psychol.* 1 de septiembre de. 1986;22(5):453–74.
  31. Pol-Castañeda S, Rodríguez-Calero MÁ, Zaforteza-Lallemand C, Villafafila-Gomila CJ, Blanco-Mavillard I, Ferrer-Cruz F, et al. Moving evidence into practice by advanced practice nurses in hospitalization wards. Protocol for a multicentre quasi-experimental study in three hospitals in Spain. *Int J Environ Res Public Health.* 2020;17(10):1–14.
  32. McCormack B, Kitson A, Harvey G, Rycroft-Malone J, Titchen A, Seers K. Getting evidence into practice: the meaning of «context». *J Adv Nurs.* abril de. 2002;38(1):94–104.
  33. Rycroft-Malone J, Kitson A, Harvey G, McCormack B, Rycroft-Malone J, Kitson A, et al. Ingredients for change: revisiting a conceptual framework. *Qual Saf Health Care junio de.* 2002;11(2):174–80.
  34. Cho E, Chin DL, Kim S, Hong O. The relationships of nurse staffing level and work environment with patient adverse events. *J Nurs Scholarsh.* 2016;48(1):74–82.
  35. Welton JM, Harper EM. Measuring nursing care value. *Nurs Econ.* 2016;34(1):14.
  36. Oner B, Zengul FD, Oner N, Ivankova NV, Karadag A, Patrician PA. Nursing-sensitive indicators for nursing care: A systematic review (1997–2017). *Nurs Open.* 2021;8(3):1005–1022. <https://doi.org/10.1002/nop2.654>.
  37. Registered Nurses' Association of Ontario. Assessment and device selection for vascular access (Rev. Ed.). 2008. [https://mao.ca/sites/mao-ca/files/Assessment\\_and\\_Device\\_Selection\\_for\\_Vascular\\_Access.pdf](https://mao.ca/sites/mao-ca/files/Assessment_and_Device_Selection_for_Vascular_Access.pdf).
  38. Servicio de Salud de las Islas Baleares (IB-Salut). Prevención y tratamiento de las úlceras por presión. Palma (Spain). 2018.
  39. Pancorbo-Hidalgo PL, García-Fernández FP, Torra Bou J-E, Verdú Soriano J, Javier Soldevilla-Agreda J. Pressure ulcers epidemiology in Spain in 2013: results from the 4th National Prevalence Survey. *Originales.* 2014;162.
  40. Whalen M, Maliszewski B, Sheinfeld R, Gardner H, Baptiste D. Outcomes of an innovative evidence-based practice project: building a difficult-access team in the emergency department. *J Emerg Nurs.* 2018;44(5):478–82.
  41. Schober M. Development of advanced practice nursing (APN): the international context. *Enfermería Clínica (English Ed).* 1 de marzo de. 2019;29(2):63–6.
  42. De Pedro-Gómez J, Morales-Asencio JM, Sesé-Abad A, Bannasar-Veny M, Pericas-Beltran J, Miguélez-Chamorro A. Psychometric testing of the Spanish version of the practice environment scale of the nursing work index in a primary healthcare context. *J Adv Nurs.* 2012;68(1):212–21.
  43. Sastre-Fullana P, Morales-Asencio JM, Sesé-Abad A, Bannasar-Veny M, Fernández-Domínguez JC, De Pedro-Gómez J. Advanced practice nursing competency assessment instrument (APNCAI): clinimetric validation. *BMJ Open.* 2017;7(2):e013659.
  44. Blanco-Mavillard I, Rodríguez-Calero MÁ, de Pedro-Gómez J, Parra-García G, Fernández-Fernández I, Castro-Sánchez E. Incidence of peripheral intravenous catheter failure among inpatients: variability between microbiological data and clinical signs and symptoms. *Antimicrob Resist Infect Control.* 2019;8(1):124.
  45. Tomàs-Vidal AM, Hernández-Yeste MS, García-Raya MD, Marín-Fernández R, Cardona-Roselló J. Prevalencia de úlceras por presión en la Comunidad Autónoma de las Islas Baleares. *Enferm Clin.* 2011;21(4):202–9.
  46. Kilpatrick K, Reid K, Carter N, Donald F, Bryant-Lukosius D, Martin-Misener R, et al. A systematic review of the cost-effectiveness of clinical nurse specialists and nurse practitioners in inpatient roles. *Nurs Leadersh.* 2015;28(3):56–76.
  47. Kilpatrick K, Kaasalainen S, Donald F, Reid K, Carter N, Bryant-Lukosius D, et al. The effectiveness and cost-effectiveness of clinical nurse specialists in outpatient roles: a systematic review. *J Eval Clin Pract.* 1 de diciembre de. 2014;20(6):1106–23.
  48. Woo BFY, Lee JXY, Tam WWS. The impact of the advanced practice nursing role on quality of care, clinical outcomes, patient satisfaction, and cost in the emergency and critical care settings: a systematic review. *Hum Resour Health.* 11 de diciembre de. 2017;15(1):63.
  49. Martin-Misener R, Harbman P, Donald F, Reid K, Kilpatrick K, Carter N, et al. Cost-effectiveness of nurse practitioners in primary and specialised ambulatory care: systematic review. *BMJ Open.* 2015;5(6).
  50. Morilla-Herrera JC, Garcia-Mayor S, Martín-Santos FJ, Kaknani Uttumchandani S, Leon Campos Á, Caro Bautista J, et al. A systematic review of the effectiveness and roles of advanced practice nursing in older people. *Int J Nurs Stud* enero de. 2016;53:290–307.
  51. Blanco-Mavillard I, Rodríguez-Calero MA, Castro-Sánchez E, Bannasar-Veny M, De Pedro-Gómez J. Appraising the quality standard underpinning international clinical practice guidelines for the selection and care of vascular access devices: a systematic review of reviews. *BMJ Open.* 2018;8(10):e021040.
  52. Steinmetz H, Knappstein M, Ajzen I, Schmidt P, Kabst R. How effective are behavior change interventions based on the theory of planned behavior?: A three-level meta analysis. *Zeitschrift fur Psychologie/J Psychol.* 2016;224:216–33.
  53. Donald F, Martin-Misener R, Carter N, Donald EE, Kaasalainen S, Wickson-Griffiths A, et al. A systematic review of the effectiveness of advanced practice nurses in long-term care. *J Adv Nurs* octubre de. 2013;69(10):2148–61.
  54. Huang C, Ma Y, Wang C, Jiang M, Yuet Foon L, Lv L, et al. Predictive validity of the braden scale for pressure injury risk assessment in adults: A systematic review and meta-analysis. *Nurs Open.* 25 de febrero de. 2021;(nop2):792.
  55. Blanco-Mavillard I, de Pedro-Gómez JE, Rodríguez-Calero MÁ, Bannasar-Veny M, Parra-García G, Fernández-Fernández I, Bujalance-Hoyos J, Moya Suárez AB, Cobo-Sánchez JL, Ferrer-Cruz F, Castro-Sánchez E. Multimodal Intervention for Preventing Peripheral Intravenous Catheter Failure in Adults (PREBACP Study): A Multicentre, Cluster-Randomised Controlled Trial in Spain. *Lancet Haematol.* 2021;8:e637–647. <https://doi.org/10.2139/ssrn.3824685>.
  56. van Loon FH, Leggett T, Bouwman AR, Dierick-van Daele AT. Cost-utilization of peripheral intravenous cannulation in hospitalized adults: an observational study. *J Vasc Access* 23 de septiembre de. 2020;21(5):687–93.
  57. Ullman A, Ullman RNAJ, Gc P, Kleidon TR, Rickard RNCM. The role of the vascular access nurse practitioner in developing evidence, promoting evidence-based vascular access practice and improving health services. *Vasc. Access.* 2015;1(1):10–20.
  58. Brima N, Sevdalis N, Daoh K, Deen B, Kamara TB, Wurie H, et al. Improving nursing documentation for surgical patients in a referral hospital in Free-town, Sierra Leone: protocol for assessing feasibility of a pilot multifaceted quality improvement hybrid type project. *Pilot feasibility Stud.* 27 de enero de. 2021;7(1):33.
  59. Krakau K, Andersson H, Dahlin ÅF, Egberg L, Sterner E, Unbeck M. Validation of nursing documentation regarding in-hospital falls: a cohort study. *BMC Nurs.* 9 de diciembre de. 2021;20(1):58.
  60. Manzanares I, Sevilla-Guerra S, Peña-Ceballos J, Carreño M, Palanca M, Lombraña M, et al. The emerging role of the Advanced Practice Epilepsy nurse: a comparative study between two countries. *J Clin Nurs.* 20 de enero de. 2021;30(9-10):1263–72.
  61. Galiana-Camacho T, Gómez-Salgado J, García-Iglesias JJ, Fernández-García D. Advanced Practice Nursing in emergency care, a proposal for the change: Systematic review. *Rev Esp Salud Publica.* 10 de septiembre de. 2018;92.
  62. Donald F, Kilpatrick K, Reid K, Carter N, Martin-Misener R, Bryant-Lukosius D, et al. A systematic review of the cost-effectiveness of nurse practitioners and clinical nurse specialists: what is the quality of the evidence? Callaghan P, editor. *Nurs Res Pract.* 2014;2014:896587.
  63. Melnyk BM, Fineout-Overholt E. Evidence-based practice in nursing & healthcare: a guide to best practice. Fourth ed. Philadelphia: Wolters Kluwer; 2019. p. 782.
  64. McCambridge J, Witton J, Elbourne DR. Systematic review of the Hawthorne effect: New concepts are needed to study research participation effects. *J Clin Epidemiol.* 1 de marzo de. 2014;67(3):267–77.

## Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.