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ORIGINAL ARTICLE

Improving hip fracture care in Spain: evolution of quality indicators in the Spanish National Hip Fracture Registry

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Abstract

Summary This study was carried out to analyze the evolution of the quality indicators in the Spanish National Hip Fracture Registry, after disseminating a series of recommendations based on available clinical practice guidelines to the participating hospitals. Six of the seven proposed quality indicators showed a significant improvement.

Purpose The Spanish National Hip Fracture Registry (RNFC) arises from the need to know the process and improve the quality of care. Our goal was to analyze the changes in the RNFC's quality indicators after an intervention based on disseminating specific recommendations among the participating hospitals, following available clinical practice guidelines.

Methods Study comparing before and after performing an intervention in hospitals participating in the RNFC. Data from the hospitals that registered cases in 2017, and that kept registering cases in 2019. Seven quality indicators were chosen, and a standard to be achieved for each indicator was proposed. The intervention consisted in the dissemination of 25 recommendations with practical measures to improve each quality indicator, based on available clinical practice guidelines, by drafting and publishing a scientific paper and sending it via email and printed cards. Fulfilment of each quality indicator was measured after carrying out the intervention.

Results Forty-three hospitals registered 2674 cases between January and May, 2017, and 8037 during 2019. The quality indicators chosen and the degree of compliance were (all with $p<0.05$): (1) surgery ≤48 h increased from 38.9 to 45.8%; (2) patients mobilised on the first postoperative day increased from 58.9 to 70.3%; (3) patients with anti-osteoporotic medication at discharge increased from 34.5 to 49.8%; (4) patients with calcium supplements at discharge increased from 48.7 to 62.8%; (5) patients with vitamin D supplements at discharge increased from 71.5 to 84.7%; (6) patients developing a grade ≥2 pressure ulcer during admission decreased from 6.5 to 5.0%; (7) patients able to move on their own at 1 month fell from 58.8 to 56.4%. More than 48% of hospitals improved the proposed indicators.

Conclusion Establishing quality indicators and standards and intervening through the dissemination of specific recommendations to improve these indicators achieved an improvement in hospital performance results on a national level.

Keywords Hip fracture · Hip fracture audit · Quality indicators · Quality standards · Quality improvement

Introduction

Hip fractures are a catastrophic event for older persons, with severe functional repercussions as well as an increase in institutionalisations, health expenditure, morbidity and mortality [1–8].

Each year, approximately 45,000 people above the age of 65 suffer a hip fracture in Spain [9]. The magnitude of the functional impact is such that over 50% of older patients

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suffering hip fractures lose the ability to walk independently, and up to 60% becomes dependent for a basic activity of daily living in the year following the fracture [6, 10]. Of all fragility fractures, hip fractures cause the greatest costs, with an average cost per patient of €11,721 in the first year following the fracture [8].

The establishment of hip fracture audits has enabled monitoring the characteristics of the care process and has proven to improve the patients' quality of care. An example is the United Kingdom's National Hip Fracture Database (HNFD) which, based on the six standards of care proposed by the British Orthopaedic Association and the British Geriatrics Society and published in the Blue Book "The Care of Patients with Fragility Fractures"[11], has achieved an increase in the rates of early operative care and orthogeriatric intervention since its inception in 2007, as well as a reduction in length of stay and 30-day mortality[12, 13].

In Spain, the Spanish National Hip Fracture Registry (*Registro Nacional de Fracturas de Cadera*, or *RNFC*) began in 2017, with the aims of studying the characteristics of patients with hip fractures in Spain and their evolution during acute hospitalisation and at 1 month, as well as analysing clinical variability and improving quality of care. After evaluating the RNFC's 2017 results [14], it was clear that measures of hip fracture care could potentially be improved. One of the measures carried out to improve the care process was defining quality indicators and standards in order to perform continuous monitoring and feedback with the participating hospitals.

The goal of this study is to evaluate the changes observed in the RNFC quality indicators, after disseminating a series of specific recommendations based on available clinical practice care guidelines among the participating hospitals.

Material and method

We performed a prospective, descriptive, multicentric cohort study, comparing before and after performing an intervention in the hospitals participating in the RNFC. The RNFC is a prospective multicentric registry including patients aged 75 years and older diagnosed with fragility hip fractures in participating Spanish hospitals. Its design has been previously described [15, 16]. It uses an adapted version of the Minimum Common Dataset proposed by the Fragility Fracture Network [17]. Data is collected by healthcare personnel during hospitalisation and at 30-day follow-up after admission to hospital (in-person or via telephone interview). Then, the data is sent to an encrypted database to the data manager, who is in charge of unifying the data of all the hospitals, data clean-up and sending queries to the hospitals.

Participation in the registry is voluntary and required approval by each hospitals' institutional review board. Patients included in the registry had to be 75 years old or older, suffer a fragility hip fracture (caused by low-energy mechanism such as a fall from standing height) and consent to inclusion in the registry. High-energy injuries and pathologic fractures were excluded from the analysis.

We analysed patient data included by hospitals participating in the RNFC that had included cases between January 1 and May 31, 2017, and that continued registering cases between January 1 and December 31, 2019.

This study was developed in three phases. The methodology and results of the two first phases have been previously published [18]. An expert committee called Indicator Committee was created (comprised by PYCA, TPS, AMP, PSL and JIGM, included as authors of this report).

In the first phase (indicator definition phase—first trimester of 2018), the expert committee chose, based on data collected by the hospitals between January 1 and May 31, 2017, nine quality indicators that fulfilled the following criteria: (1) evaluation of the process or outcomes, (2) be clinically relevant for the patients and (3) be feasible to be modified through changes in healthcare practice[19]; a quality standard was established for convenience as the first quartile achieved by the group of participating hospitals in 2017 for each variable and was proposed for each indicator as an objective to be achieved by the participating hospitals. The indicators and standards were officially presented and debated in the First Annual Meeting of the RNFC, which took place on February 23, 2018.

Subsequently, it was decided to rule out (1) the proportion of patients who underwent surgery, because its overall result was already close to 100%, and (2) the proportion of patients deceased at 30 days, because the average frequency (6.7%) was very close to the standard (5.4%), and because it was felt that this was a very difficult goal to achieve at this stage of the RNFC.

In the second phase (intervention phase, second semester of 2018), the committee prepared a document with a detailed justification of each indicator and a proposal of 25 recommendations with concrete and practical measures to achieve improvements in each of the indicators, based on available clinical practice guidelines (Table 1). This document was subjected to review and comments by the RNFC steering group, whose opinions were taken into account, and was later published as an original article [18]. The final document was shared through the RNFC's official newsletter and via email to the delegates in the participating hospitals on three occasions, on August 31, September 28 and October 8, 2018, as well as through the delivery of 1,000 printed cards to the delegates and collaborators of the hospitals participating in the RNFC in December 2018.

The third phase (evaluation phase—first semester of 2020) evaluated the changes in each quality indicator after the intervention, in the hospitals participating in the first

Table 1. Proposed recommendations to improve the quality indicators of the Spanish National Hip Fracture Registry.

Indicator	Recommendations	
Proportion of patients operated on in ≤ 48h	Early geriatric assessment during admission. Joint action protocols and organization of roles, unified management of patients with antiplatelet/anticoagulant therapy, transmission of information, designation of a referent for each specialty. Guarantee availability of human resources and operating rooms. Prioritize over non-urgent surgeries.	
Proportion of patients mobilised the first postoperative day	Establish protocols that promote sitting the day after surgery. Prompt execution of postoperative radiographs and drainage removal, if indicated. Daily medical care: pain management, fluid-electrolyte balance, anaemia, delirium prevention. Training of personnel on the effects of bed rest and the importance of prompt mobilization. Early intervention of the physiotherapist/occupational therapist.	
Proportion of patients prescribed antiosteoporotic medication at discharge	Once the supply of calcium and vitamin D has been assured, consider initiating treatment of osteoporosis at discharge.	
	Medication	**Contraindications**
	Weekly Alendronate/Risedronate	Oesophageal or gastric disease, inability to remain upright, hypocalcaemia or ClCr < 30ml/min. Need of dental/mandibular surgery.
	Zoledronate	ClCr<30ml/min. Need of dental/mandibular surgery.
	Denosumab	Hypocalcaemia. Need of dental/mandibular surgery.
	Teriparatide	Hyperkalaemia, severe chronic renal disease, metabolic bone disease (hyperparathyroidism, Paget's disease), unexplained elevation of alkaline phosphatase, history of external radiation or radiotherapy of bone, bone tumours or metastases.
Proportion of patients prescribed calcium supplements at discharge	Request levels of calcium, phosphate and vitamin D during hospitalization. Ensure adequate daily intake of calcium (1000 mg daily) at discharge. If daily intake of calcium >1000mg (250cc of milk = 300mg calcium; 1 yoghurt (125cc) = 200mg; 100g cheese = 150-200mg), no supplements are needed. Otherwise, prescribe calcium carbonate or calcium citrate (if taking PPI) until completing the recommended daily dose. If this dose is included in a nutritional supplement, it shall not be prescribed separately. If the patient has renal disease with associated electrolyte imbalance, prescribe only vitamin D, without calcium.	
Proportion of patients prescribed vitamin D supplements at discharge	Request vitamin D and PTH levels during the first days of hospitalization. Schedule treatment depending on the vitamin D levels detected: 1. Deficit (< 21ng/ml): Actions: a. During hospitalization: 1 vial of calcifediol 180.000 UI, po. b. Vitamin D 16.000 UI monthly. c. Vitamin D 800 UI daily. 2. Insufficiency (21-30ng/ml): Actions b + c. 3. Normal (31-40ng/ml): Vitamin D 400-800 UI daily.	
Proportion of patients developing grade ≥2 in hospital pressure ulcers	Assess the risk of developing pressure sores using validated scores. Exquisite care of the skin, inspection. ü Perform nutritional screening using MNA-SF. Consider oral supplementation if there is a risk of malnutrition and/or inadequate nutritional intake. Early surgical treatment (<48 h), sitting the following day and prompt ambulation. Alleviate pressure with postural changes and passive exercises if necessary.	
Proportion of patients able to move on their own at 30 days	Early surgical treatment, sitting on the first postoperative day, early ambulation. Initiate an exercise/rehabilitation program promptly, even before surgery. Prevent and treat complications during hospitalization. Assess prior cognitive and functional status and adapt the level of care at discharge to try to achieve maximum functional recovery regarding mobility and activities of daily living (at home or in a functional recovery unit). Instruct and involve the patient, relatives and caretakers in the functional recovery process. Start a falls prevention program.	

PPI, proton pump inhibitor; *MNA-SF*, Mini Nutritional Assessment – Short Form; *ClCr*, Creatinine clearance.

Table adapted from: Condorhuamán-Alvarado PY, Pareja-Sierra T, Muñoz-Pascual A, et al (2019) First proposal of quality indicators and standards and recommendations to improve the healthcare in the Spanish National Registry of Hip Fracture. Rev Esp Geriatr Gerontol 54:257–264.

phase and still registering data between January 1 and December 31, 2019. The indicators were also compared with the corresponding quality standard.

The variables collected were as follows: age, sex, hospital, autonomous community, anaesthestic risk (according to the American Society of Anaesthesiologists' or ASA classification [20]), the dates and times of admission to hospital, surgery and discharge, prefracture residence, as well as at discharge and at 1 month, baseline and 1-month mobility, cognitive impairment at admission (defined as 3 or more errors in Pfeiffer's questionnaire[21]), treatment with calcium, vitamin D or anti-osteoporotic medication (antiresorptive or bone-forming) prescribed before the fracture, at discharge and at 1 month, the type of fracture (intracapsular vs. extracapsular) [22], development of pressure ulcers (grade 2 or above[23]) during admission, in-hospital and 30-day mortality, early postoperative mobilisation (the day of or after surgery), surgical delay, length of stay, and readmission and reoperation in the month following the fracture.

Missing data were quantified and excluded from the analysis.

Data was collected through a specially designed database and processed using SPSS version 20.0 (IBM, Armonk, NY, USA). Significance was set at $p<0.05$. For the description of continuous quantitative variables, we used the mean (± standard deviation), median and interquartile range; qualitative variables were described using frequencies (percentages). Continuous quantitative variables were compared using Student's *t* test or ANOVA, or, alternately, non-parametric tests such as Kruskal-Wallis or Mann-Whitney's *U* as indicated. The frequencies of qualitative variables were compared using Mantel-Haenzel's Chi-squared test, or Fisher's exact test.

Results

Patient characteristics

The characteristics of the patients included in the study are included in Table 2. Between January 1 and May 31, 2017, fifty-four hospitals collected 3107 cases. Of these, 11 hospitals that had not included cases during 2019 were excluded; leaving a total of 43 hospitals that had registered 2674 cases during the first observation period and 8037 cases between January 1 and December 31, 2019.

For both observation periods, the typical patient profile was that of an 87-year-old female previously able to walk on her own, with high preoperative comorbidity according to the ASA score (3 or 4) and who had previously not been prescribed anti-osteoporotic medication. The most common fracture type was extracapsular.

Compared to 2017, the population included in 2019 was slightly older, with a smaller proportion residing in nursing facilities before the fracture; most had been receiving vitamin D supplements before admission; had a lower preoperative comorbidity according to the ASA score (3 or 4); the most common fracture type was extracapsular and a lower proportion had cognitive impairment on admission. Surgical delay was lower (mean, 67 vs. 78 h), as well as hospital length of stay (10.2 vs. 10.9 days) and 30-day hospital readmission (2 vs. 3% patients).

Quality indicators

Figure 1 shows the performance in the different quality indicators for 2017 and 2019. The percentages of patients operated on in less than 48 h, mobilised on the first postoperative day, prescribed anti-osteoporosis medication, calcium supplements and vitamin D supplements at discharge, showed significant improvements in 2019. The proportion of patients suffering in-hospital pressure ulcers fell significantly. However, the percentage of patients able to move on their own at 30 days decreased.

Table 3 shows the overall percentage of hospitals that reach the quality standards for both study periods, as well as the proportion of those that improved the quality indicators in 2019.

The proportion of missing data was very low (between 0 and 4.5%), except for cognitive impairment (16.5% in 2017 and 18.8% in 2019). Similarly, excluding patients who died during the 30-day follow-up period, the percentage of missing values was low (between 1.2 and 10%).

Quality indicator 1: proportion of patients operated on in ≤48 h

In 2019, 45.8% of patients were operated on in the first 48 h after presentation, a significant improvement compared to 2017. The proportion of patients operated on in the first 48 h in each hospital varied between 0 and 100% in 2017, while the range was 10.6–91% for 2019. The number of hospitals that fulfilled the quality standard improved from 7 to 12. Though still far from the overall goal proposed, the proportion of patients with prompt surgery increased in 67% of hospitals between both study periods.

Quality indicator 2: proportion of patients mobilised the first postoperative day

The proportion of patients mobilised on the first postoperative day improved nearly 10% in 2019. The proportion of patients mobilised early in each hospital was between 0 and 100% in 2017, while it ranged from 6.9 to 98.5%

Table 2. Characteristics of the patients included by the 43 participating hospitals from the Spanish National Hip Fracture Registry (RNFC) in the observation periods of 2017 and 2019.

	Total *n*=10,711	January-May 2017 *n*=2,674	January-December 2019 *n*= 8,037	*p*
Age (years), mean (SD) [range]	87 (5.6) [75-106]	86.8 (5.6) [75-105]	87.1 (5.7) [75-106]	<0.05
Gender, female, *n* (%)	8,161 (76.2)	2,006 (75)	6,155 (76.6)	0.1
Living in nursing home, prefracture, *n* (%)	2,729 (25.5)	736 (27.5)	1,993 (24.8)	<0.05
Able to move on their own before the fracture, *n* (%)	8,703 (82.1)	2,125 (81.3)	6,578 (82.3)	0.2
Anaesthetic risk ASA ≥3, *n* (%)	10,211 (99.3)	2,555 (99.7)	7,656 (99.2)	<0.05
Anti-osteoporosis treatment, prefracture, *n* (%)	634 (5.9)	142 (5.3)	492 (6.1)	0.1
Calcium supplementation, prefracture, *n* (%)	1,356 (12.7)	313 (11.7)	1,043 (13.0)	0.1
Vitamin D supplementation, prefracture, *n* (%)	2,215 (20.7)	414 (15.5)	1,801 (22.4)	<0.001
Fracture type, extracapsular, *n* (%)	6,366 (59.9)	1,529 (58,3)	4,837 (60.5)	<0.05
Cognitive impairment*, *n* (%)	4,676 (53.4)	1,257 (56.3)	3,419 (52.4)	0.001
Surgical delay (h), mean (SD)	70 (63)	78 (65)	67 (62)	<0.001
Hospital length of stay (days), mean (SD)	10.4 (6.7)	10.9 (6.7)	10.2 (6.7)	<0.001
Mortality, in-hospital, *n* (%)	507 (4.7)	108 (4.0)	399 (5.0)	0.06
Destination at discharge, *n* (%)				
Home	4,234 (39.6)	969 (36.3)	3,265 (40.6)	<0.001
Nursing home/care facility	3,602 (33.7)	975 (36.6)	2,627 (32.7)	
Geriatric recovery unit	2,161 (20.2)	561 (21.0)	1,600 (19.9)	
Readmission at 30 days, *n* (%)	228 (2.3)	76 (3.0)	152 (2.0)	<0.05
Reoperation at 30 days, *n* (%)	229 (2.3)	66 (2.8)	163 (2.2)	0.1
Mortality, 30 days, *n* (%)	814 (7.7)	187 (7.2)	627 (7.9)	0.2
Destination at 30 days, *n* (%)				
Home	4,654 (49.1)	1,061 (47.0)	3,593 (49.7)	0.09
Nursing home/care facility	3,556 (37.5)	885 (39.2)	2,671 (37.0)	
Geriatric recovery unit	962 (10.1)	227 (10.1)	735 (10.2)	

Abbreviations: SD, standard deviation; ASA, American Society of Anaesthesiologists.

*Cognitive impairment defined as three of more errors in Pfeiffer's Short Portable Mental Status Questionnaire.

in 2019. Fifteen hospitals fulfilled the standard in both periods analysed, but over 60% of hospitals improved the proportion of patients mobilised on the first postoperative day in 2019 compared to 2017.

Quality indicator 3: proportion of patients prescribed anti-osteoporotic medication at discharge

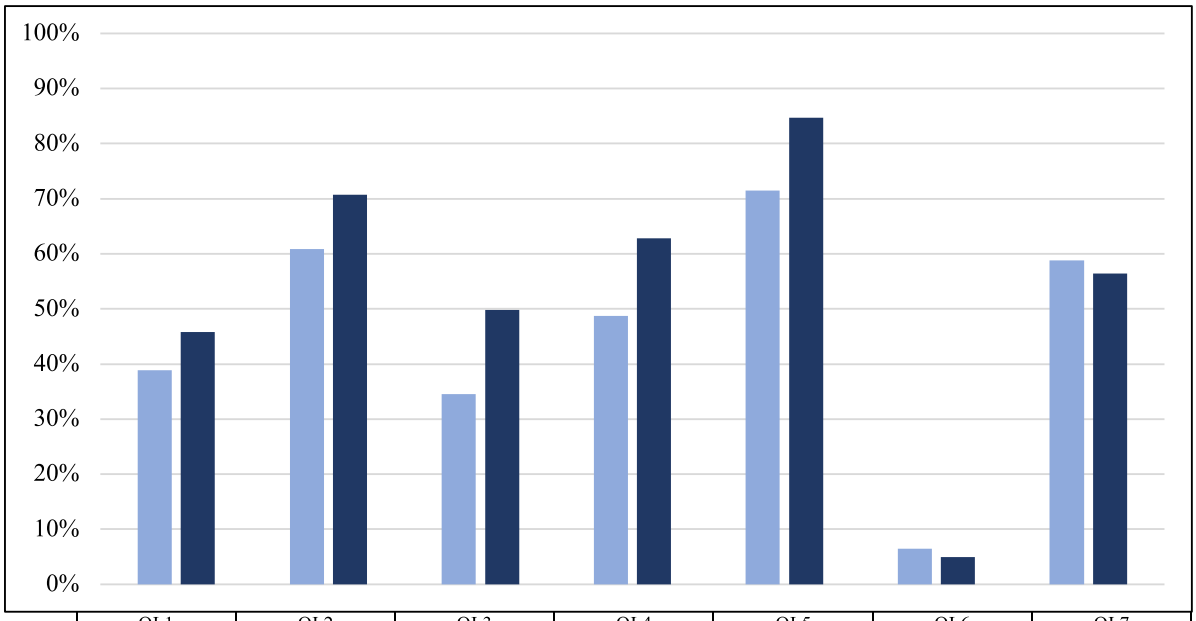
This proportion was over 15% higher in 2019 than 2017. The proportion of patients prescribed anti-osteoporotic medication at discharge ranged between 0 and 91.3% in 2017, and 0 and 92.9% in 2019. The number of hospitals meeting the quality standard grew from 12 to 13, and over 67% of hospitals improved the rate of prescription of anti-osteoporotic medication at discharge.

Quality indicator 4: proportion of patients prescribed calcium supplements at discharge

The proportion of patients prescribed calcium supplements at discharged grew over 14%. The prescription rate was highly variable between hospitals, ranging from 0 to 100% in 2017 and 0% and 93.6% in 2019. The hospitals meeting the corresponding quality standard increased from 11 to 14, and over 62% of hospitals improved the prescription rates for calcium supplementation at discharge in 2019.

Quality indicator 5: proportion of patients prescribed vitamin D supplements at discharge

The proportion of patients prescribed vitamin D supplements at discharge grew over 13%. The proportion of



	QI 1 Surgery ≤ 48 hours	QI 2 Mobilised the first postoperative day	QI 3 Anti - osteoporotic medication at discharge	QI 4 Calcium supplementation at discharge	QI 5 Vitamin D supplementation at discharge	QI 6 In-hospital pressure ulcers, grade ≥2	QI 7 Able to move on their own at 30-day follow-up
Quality Standard	63%	86%	61%	77%	92%	2.1%	70%
Jan-May 2017 n= 2,674	38.9% (995)	60.9% (1,535)	34.5% (879)	48.7% (1,222)	71.5% (1,798)	6.5% (166)	58.8% (1,311)
Jan-Dec 2019 n= 8,037	45.8% (3,528)	70.7% (5,431)	49.8% (3,800)	62.8% (4,791)	84.7% (6,460)	5.0% (393)	56.4% (3,987)
p	<0.001	<0.001	<0.001	<0.001	<0.001	0.004	<0.05

QI: quality indicator.

Fig. 1. Changes observed in the quality indicators proposed by the Spanish National Hip Fracture Registry (RNFC) in 2019 vs. 2017, among the 43 hospitals analysed for this study

Table 3. Hospitals that achieved the quality standard (2019 vs. 2017) and hospitals that improved the quality indicator in 2019, among the 43 hospitals analysed for this study.

Quality Indicator Hospitals that	Hospitals that achieved the quality standard		Hospitals that improved the quality indicator in 2019
	January–May 2017	January–December 2019	
Operated on in ≤ 48 h	7 (16.3%)	12 (27.9%)	29 (67.4%)
Mobilised the first postoperative day	15 (34.8%)	15 (34.8%)	26 (60.5%)
Anti-osteoporotic medication at discharge	12 (27.9%)	13 (30.2%)	29 (67.4%)
Calcium supplementation at discharge	11 (25.6%)	14 (32.5%)	27 (62.8%)
Vitamin D supplementation at discharge	12 (27.9%)	15 (34.8%)	29 (67.4%)
In-hospital pressure ulcers, grade >2	12 (27.9%)	10 (23.3%)	23 (53.5%)
Able to move on their own at 30-day follow-up	10 (23.3%)	4 (9.3%)	21 (48.8%)

patients prescribed vitamin D supplements at discharge was between 0 and 100% for each hospital in 2017, and 5.3% and 100% in 2019. The number of hospitals fulfilling the quality standard grew from 12 to 15. Over 67% of hospitals improved the prescription rates of vitamin D supplementation at discharge.

Quality indicator 6: proportion of patients developing grade ≥2 pressure ulcers during hospitalisation

The proportion of patients suffering newly acquired pressure ulcers fell 1.5%. In 2017, each hospital reported that between 0 and 33% of its patients developed grade 2 or above pressure ulcers during their stay, and this range fell to 0% and 25% in 2019. Though the number of hospitals reaching the quality standard fell from 12 to 10, over 50% improved the value reported in 2019 compared to 2017.

Quality indicator 7: proportion of patients able to move on their own at 30-day follow-up

The percentage of patients able to move on their own at 30 days decreased by 2.4%. The proportion of independent mobility at 1 month for each hospital ranged from 20 to 100% in 2017 and from 23.9% and 93.5% in 2019. The number of hospitals meeting the quality standard fell drastically from 10 to 4; however, 48.8% reported improved percentages in the year 2019 compared to 2017.

Discussion

This study analyzes the progress observed in several quality indicators after publicising recommendations. Between 2017 and 2019, six of the seven quality indicators improved significantly after disseminating the indicators, their corresponding quality standards and the recommendations for improvement, with a tendency towards achieving the proposed quality standards. Although the overall average hospitals participating in the registry is still far from achieving these standards, a significant proportion of them improved in the value reported for each quality indicator.

The RNFC was created with the main objective of ascertaining the hip fracture care process in Spain and improving quality of care. Establishment of the quality indicators and standards and dissemination of clinical practice guideline-based recommendations are the first step in an attempt to improve hip fracture care nationally.

Six of the seven indicators adopted by the RNFC are also evaluated by other international registries [16, 24]. The percentage of patients operated on in less than 48 h after admission increased by almost 7% between 2017 and 2019; in spite of this improvement, it was low compared with the delay observed in another eleven international audits (70.2–94.9%) [16]. Regarding the proportion of patients mobilised on the first postoperative day (70.7% in 2019), the percentage was higher than that reported by the Scottish audit (68%) [25], though inferior to that reported by five other audits (76–91%) [24, 26–29].

The proportion of patients prescribed anti-osteoporosis medication at discharge (49.8% in 2019) was much higher than that of other audits such as Germany (10%) [24], Australia (18%) and New Zealand (26%) [29], but remained below the UK's NHFD (56.6%) [26], Ireland's hip fracture database (71%) [28] and Denmark (90.3%) [27]. However, more patients received vitamin D supplementation at discharge (84.7% in 2019), surpassing the German registry (65%) [24]. Most patients were co-managed with a geriatrician or an internal medicine specialist, which could explain the high prescription rates.

The percentage of patients suffering pressure ulcers improved significantly, and approximately 120 grade 2 or above in-hospital pressure ulcers were avoided in 2019. In spite of this, the percentage was higher (5% in 2019) than that reported by three other audits (3–4%) [28–30] and equal to the German registry (5%) [24].

The only quality indicator that did not improve was the percentage of patients able to move on their own 1 month after the fracture. At 1-month follow-up, half of the patients remained in nursing care facilities or geriatric rehabilitation units; a 30-day period is likely to be too short to observe relevant improvements in ambulation. Most studies analysing the degree of functional recovery following hip fractures assess ambulation from the third month after the fracture, even after having applied different training programs, whose overall results suggest that the maximum degree of recovery is achieved between the third and sixth month after the fracture [6, 10, 31, 32]. Other international hip fracture audits that evaluate ambulation during follow-up, such as the United Kingdom [33], Germany [24] or Australia and New Zealand [29], do so at 120-day follow-up. The rehabilitation process following a fragility hip fracture is complex, with several contributing elements such as multidisciplinary teamwork, the availability of geriatric recovery units or social resources. Only one in five patients included in the RNFC was transferred to a geriatric recovery unit, which could account for the low rate of fulfilment of this standard.

Another difference found in the RNFC compared to other audits such as the United Kingdom's NHFD or Ireland's IHFD is the lack of an economic incentive such as the Best Practice Tariff that each hospital receives for every patient in which the quality standards are met[26, 28]. This measure has shown to reduce 30-day mortality, length of stay and readmissions, as well as increasing the rate of prompt surgery [34]. Spain currently does not have any economic incentive for achieving quality standards.

Our study has several strengths. It is the first study that analyzes the effect of an intervention on several quality indicators regarding hip fracture care on a national level in Spain. It is a multi-centric study with a large number of cases included, which used the Minimum Common Dataset proposed by the Fragility Fracture Network for international use

[17]. The group of hospitals included in our study is representative of all the hospitals participating in the RNFC. The cases included in 2019 amount to 61% of all cases included by the 80 hospitals participating in the RNFC in 2019, with similar age and sex distributions. Another study compared the RNFC data with the Minimum Common Basic Dataset (Conjunto Mínimo Básico de Datos, CMBD) of the Spanish Ministry of Health for the years 2017–2018, and found similar distributions for age, sex and fracture type in the cases collected by the RNFC compared to the total number of hip fractures treated in Spain.

We are aware that our study has several limitations. First, participation in the RNFC is voluntary, so it is common for hospitals to participate discontinuously. Eleven hospitals included in the initial 2017 cohort did not participate in 2019, accounting for 20% of the hospitals participating in that period. Second, healthcare personnel treating these patients collected the data, instead of through external observers, potentially adding observation bias to the study. Missing data may lead to biased results. One hundred percent completeness is not always possible as some data may not be available for some patients or from some sites. However, the percentage of missing values was very low. We believe that, in the case of such a large volume of patients, this low percentage has not produced bias in the results. Each hospital receives feedback on its results every 3 months. The RNFC publishes annual reports, allowing each center to know its performance and compare itself with the other participating hospitals. It can be argued that the overall improvement of the quality indicators in the RNFC could be explained partially by the Hawthorne effect [35], in which the simple fact of feeling observed and compared with peers can improve hospital performance. Another possible limitation of this study could be the difference in the duration of the pre-intervention (5 months) and post-intervention (12 months) periods, with a possible seasonal variation in characteristics of fractures, but both periods are long enough as to provide a representation of the total number of patients admitted to the respective hospitals.

Finally, the threshold defined as quality standard, the first quartile, i.e. the results of the 25% best performing hospitals, was arbitrary and possibly too demanding, and the observation period could be too short to reach the proposed objective of achieving the quality standards of care.

In conclusion, we would like to highlight: (1) it is possible to define and agree on quality indicators at the national level that can be accepted by a large number of hospitals; (2) an intervention designed to improve quality indicators based on publicising simple and practical recommendations manages to improve the results at the national level and initiate a path for improvement; (3) we need to continue in this line of improvement, evaluating whether the recommendations are sufficient or if others should be designed, whether the intervention dynamic is adequate (e.g. by carrying out a survey among participants) and persisting over a longer time period to maintain and increase the magnitude of quality improvement.

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Availability of data and material The authors confirm that the data supporting the findings of this study are available within the article.

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Declarations

Ethics approval All procedures performed in this study were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

Conflicts of interest The following authors have no conflicts of interest to declare: Jesús Diez Sebastián, Alicia Gutiérrez Misis, Teresa Alarcón Alarcón, Paloma Gómez Campelo, Laura Navarro Castellanos, Ángel Otero Puime.

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References

1. Sáez López P, Madruga Galán F, Rubio Caballero JA (2007) Detección de problemas en pacientes geriátricos con fractura de cadera. Importancia de la colaboración entre traumatólogo y geriatra. Rev Ortop y Traumatol 51:144–151. https://doi.org/10.1016/S0482-5985(07)75541-4
2. González Montalvo JI, Alarcón Alarcón T, Pallardo Rodil B et al (2008) Ortogeriatría en pacientes agudos (II). Aspectos clínicos. Rev Esp Geriatr Gerontol 43:316–329. https://doi.org/10.1016/S0211-139X(08)73574-1
3. Leibson CL, Tosteson ANA, Gabriel SE et al (2002) Mortality, disability, and nursing home use for persons with and without hip fracture: a population-based study. J Am Geriatr Soc 50:1644–1650. https://doi.org/10.1046/j.1532-5415.2002.50455.x
4. Abrahamsen B, Van Staa T, Ariely R et al (2009) Excess mortality following hip fracture: a systematic epidemiological review. Osteoporos Int 20:1633–1650. https://doi.org/10.1007/s00198-009-0920-3
5. Katsoulis M, Benetou V, Karapetyan T et al (2017) Excess mortality after hip fracture in elderly persons from Europe and the USA: the CHANCES project. J Intern Med 281:300–310. https://doi.org/10.1111/joim.12586
6. Dyer SM, Crotty M, Fairhall N et al (2016) A critical review of the long-term disability outcomes following hip fracture. BMC Geriatr 16:158. https://doi.org/10.1186/s12877-016-0332-0
7. Svedbom A, Hernlund E, Ivergård M et al (2013) Osteoporosis in the European Union: a compendium of country-specific reports. Arch Osteoporos 136. https://doi.org/10.1007/s11657-013-0137-0
8. Cancio JM, Vela E, Santaeugènia S et al (2019) Long-term impact of hip fracture on the use of healthcare resources: a population-based study. J Am Med Dir Assoc 20:456–461. https://doi.org/10.1016/j.jamda.2018.08.005
9. Azagra R, López-Expósito F, Martin-Sánchez JC et al (2014) Changing trends in the epidemiology of hip fracture in Spain. Osteoporos Int 25:1267–1274. https://doi.org/10.1007/s00198-013-2586-0
10. Alarcón Alarcón T, González-Montalvo JI (2004) Fractura osteoporótica de cadera. Factores predictivos de recuperación funcional a corto y largo plazo. An Med Interna 21:87–96. https://doi.org/10.4321/s0212-71992004000200010
11. (2007) The Care of Patients with Fragility Fracture. The Blue Book. British Orthopaedic Association and British Geriatric Society, London
12. Patel NK, Sarraf KM, Joseph S et al (2013) Implementing the National Hip Fracture Database: An audit of care. Injury 44:1934–1939. https://doi.org/10.1016/j.injury.2013.04.012
13. Neuburger J, Currie C, Wakeman R et al (2015) The impact of a national clinician-led audit initiative on care and mortality after hip fracture in England. Med Care 53:686–691. https://doi.org/10.1097/MLR.0000000000000383
14. Sáez-López P, Ojeda-Thies C, Alarcón T et al (2019) Spanish National Hip Fracture Registry (RNFC): first-year results and comparison with other registries and prospective multi-centric studies from Spain. Rev Esp Salud Publica 93:e201910072
15. Sáez-López P, González-Montalvo JI, Ojeda-Thies C et al (2018) Spanish National Hip Fracture Registry (SNHFR): a description of its objectives, methodology and implementation. Rev Esp Geriatr Gerontol 53:188–195. https://doi.org/10.1016/j.regg.2017.12.001
16. Ojeda-Thies C, Sáez-López P, Currie CT et al (2019) Spanish National Hip Fracture Registry (RNFC): analysis of its first annual report and international comparison with other established registries. Osteoporos Int 30:1243–1254. https://doi.org/10.1007/s00198-019-04939-2
17. Fragility fracture Network hip fracture audit database. Minimum common dataset (MCD). Version 1.5. https://www.fragilityfracturenetwork.org/what-we-do/hip-fracture-audit-database/. Accessed 22 Dec 2020
18. Condorhuamán-Alvarado PY, Pareja-Sierra T, Muñoz-Pascual A et al (2019) First proposal of quality indicators and standards and recommendations to improve the healthcare in the Spanish National Registry of Hip Fracture. Rev Esp Geriatr Gerontol 54:257–264. https://doi.org/10.1016/j.regg.2019.04.001
19. Voeten SC, Krijnen P, Voeten DM et al (2018) Quality indicators for hip fracture care, a systematic review. Osteoporos Int 29:1963–1985. https://doi.org/10.1007/s00198-018-4558-x
20. American Society of Anesthesiologists ASA Physical Status Classification System. http://www.asahq.org/clinical/physicalstatus.htm. Accessed 14 Jan 2021
21. González-Montalvo JI, Rodríguez-Mañas L, Ruipérez Cantera I (1992) Validación del cuestionario de Pfeiffer y la escala de incapacidad mental de la Cruz Roja en la detección del deterioro mental en los pacientes externos de un servicio de geriatría. Rev Esp Geriatr Gerontol 27:129–133
22. Bhandari M, Swiontkowski M (2017) Management of acute hip fracture. N Engl J Med 377:2053–2062. https://doi.org/10.1056/NEJMcp1611090
23. Shea JD (1975) Pressure sores. Classification and management. Clin Orthop Relat Res 112:89–100. https://doi.org/10.1097/00003086-197510000-00012
24. Sektion Alterstraumatologie der Deutschen Gesellschaft für Unfallchirurgie e.V. AUC - Akademie der Unfallchirurgie GMBH (2020) Jahresbericht 2020 - AltersTraumaRegister DGU®. http://www.alterstraumaregister-dgu.de/fileadmin/user_upload/alterstraumaregister-dgu.de/docs/ATR-DGU-Jahresbericht_2020.pdf. Accessed 15 Dec 2020
25. (2019) Scottish Hip Fracture Audit. Hip Fracture Care Pathway Report 2019. https://www.shfa.scot.nhs.uk/Reports/_docs/2019-08-20-SHFA-Report.pdf. Accessed 10 Dec 2020
26. Royal College of Physicians (2019) National Hip Fracture Database (NHFD) Annual Report 2019. https://www.nhfd.co.uk/files/2019ReportFiles/NHFD_2019_Annual_Report_v101.pdf. Accessed 10 Dec 2020
27. DRHOFTEBRUD (2020) Dansk Tværfagligt Register for Hoftenære Lårbensbrud. National årsrapport for 2019. https://www.sundhed.dk/content/cms/62/4662_hofte_lprrapport_2019_endelig_off.pdf. Accessed 10 Dec 2020
28. National Office of Clinical Audit (2020) Irish Hip Fracture Database. National Report 2019. https://www.noca.ie/documents/ihfd-national-report-2019. Accessed 15 Dec 2020
29. Australian and New Zealand Hip Fracture Registry (2019) ANZHFR Annual Report of Hip Fracture Care 2019. https://anzhfr.org/wp-content/uploads/2019/09/2019-ANZHFR-Annual-Report-FINAL.pdf. Accessed 20 Oct 2020
30. Royal College of Physicians (2020) Dashboard report for All NHFD 2018. https://www.nhfd.co.uk/20/nhfdcharts.nsf/fmdashboard?readform=&year=2018. Accessed 10 Jan 2021
31. Magaziner J, Mangione KK, Orwig D et al (2019) Effect of a multicomponent home-based physical therapy intervention on ambulation after hip fracture in older adults: the CAP randomized clinical trial. JAMA - J Am Med Assoc 322:946–956. https://doi.org/10.1001/jama.2019.12964
32. Handoll HHG, Sherrington C, Mak JCS (2011) Interventions for improving mobility after hip fracture surgery in adults. Cochrane Database Syst Rev CD001704. https://doi.org/10.1002/14651858.CD001704.pub4

33. Royal College of Physicians (2017) National Hip Fracture Database (NHFD) Annual report 2017. https://www.nhfd.co.uk/files/2017ReportFiles/NHFD-AnnualReport2017.pdf. Accessed 15 Oct 2019
34. Metcalfe D, Zogg CK, Judge A et al (2019) Pay for performance and hip fracture outcomes: an interrupted time series and difference-in-differences analysis in England and Scotland. Bone Joint J 101(B):1015–1023. https://doi.org/10.1302/0301-620X.101B8.BJJ-2019-0173.R1
35. McCambridge J, Witton J, Elbourne DR (2014) Systematic review of the Hawthorne effect: new concepts are needed to study research participation effects. J Clin Epidemiol 67:267–277. https://doi.org/10.1016/j.jclinepi.2013.08.015

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