# Outcomes Evaluation after Application of Multidisciplinary Protocol of Shared Hospital Care in Patients Aged 65 Years and Older and Operated for Hip Fracture

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# Abstract

**Purpose**: In geriatric patients, hip fracture is considered the greatest complication of osteoporosis in terms of morbidity, mortality, and cost. The aim of this study is to assess the effects of a multidisciplinary shared care protocol (trauma services, internal medicine, emergencies, anesthesia, nursing, hematology, pharmacy, rehabilitation, home hospitalization unit, and social services) on hospital stay and in-hospital mortality in inpatients aged 65 years or older and operated for hip fracture.

**Methods:** Retrospective cohort study between January 2011 and December 2017. The unexposed group was made up of patients who did not receive care according to the multidisciplinary protocol, while the exposed group did. We excluded patients with polytrauma, conservative treatment, bilateral hip fracture, pathological fracture, or previous fracture already included in the series. Variables analyzed were demographic data, medical comorbidities, Charlson index, hemoglobin levels, hematocrit and blood transfusion, antiplatelet drugs, length of surgical delay, length of hospital stay, in-hospital mortality, and a composite risk outcome considering in-hospital mortality and/or hospital stay of more than 10 days. We fit a multivariable logistic regression model to calculate the odds ratio (OR) of experiencing outcomes.

**Results**: The cohort included 681 patients: 310 were unexposed and 371, exposed. Compared to the unexposed group, patients receiving protocolized multidisciplinary care showed significantly lower in-hospital mortality (3.5% versus 7.7%; p = 0.015) and were less likely to have a hospital stay of more than 10 (16.4% versus 24.2%; p = 0.012). Mean length of hospital stay was 0.7 fewer days in the exposed group. Multivariable analysis showed the composite risk outcome was 51% lower in the exposed group, after adjusting for age, sex, heart failure, days to surgery, blood transfusion after surgery, and postoperative hemoglobin levels.

**Conclusion**: Implementing the multidisciplinary shared care protocol halved the risk of in-hospital mortality and/or a hospital admission of more than 10 days in patients over 65 years with proximal femur fracture. It also reduced mean length of hospital stay.


# Introduction

In geriatric patients, hip fracture is considered the greatest complication of osteoporosis in terms of morbidity, mortality, and cost [1]. Eighty-six percent of these fractures occur in patients aged 65 years or older, and 1 out of every 3 women, plus 1 out of every 12 men, will break their hip over the course of their lifetime [2]. Every year, around 300,000 people in the United States [3] and 45,000 in Spain [4] have a hip fracture. By 2050, there are expected to be 6 million cases a year worldwide [5].

The high incidence of these injuries entails an important impact on health systems. In Spain, the average total cost of the first admission for hip fracture is EUR 5096.30. Mean length of hospital stay is 11.8 days, with a daily hospitalization cost of EUR 431.89 [6]. These figures are similar to other countries such as Germany and Ireland, where each patient's hospital stay generates an expense between EUR 7000 to EUR 9000; the United Kingdom, where annual health system expenditure for hip fractures reaches EUR 2.3

billion [5,7]; and the United States, where total costs are estimated at EUR 8.1 billion, with an average daily expenditure of EUR 2804 per admission [1].

In addition to the high cost, a hospital stay of more than 10 days is usually due to complications, and it has been associated with an increase in mortality in the first month post-fracture, making it a poor prognostic factor [8]. Likewise, in-hospital mortality is another key indicator: in patients with hip fracture, the rate ranges from 4.5% to 11.4%, and it is associated with various risk factors and complications during the hospital stay [9,10].

Since 1950, diverse protocols for multidisciplinary care have been developed for this patient population, based in orthogeriatric units staffed by geriatricians, traumatologists, physiotherapists, and rehabilitation physicians [11]. Nowadays, these shared-care groups comprise numerous other specialized services. Several authors have described improvements in patient outcomes like in-hospital mortality, length of hospital stay, and complications during admission, but no strong evidence has yet been provided [12,13,14,15].

The objective of this study is to assess the impact of a multidisciplinary shared care protocol on length of hospital stay and in-hospital mortality in patients aged 65 years or older who were operated for proximal femoral fracture.

# Material And Methods

Retrospective cohort study in the University Hospital San Juan de Alicante, Spain, a center with a catchment area of 216,610 inhabitants. Included patients were aged 65 or older and underwent surgery for proximal femoral fracture (intracapsular: subcapital fracture, or extracapsular: pertrochanteric and subtrochanteric fracture) between January 2011 and December 2017. Exclusion criteria were conservative treatment, pathological fracture, polytrauma, bilateral hip fracture, and a previous hip fracture during the study period.

Data were collected in patients who were admitted for hip fracture prior to this intervention (unexposed: admissions between January 2011 and December 2014) and following implementation (exposed: admissions between January 2015 and December 2017).

### Multidisciplinary shared care protocol

The multidisciplinary care protocol, which took effect in January 2015, sets out the responsibilities and activities among all services that participate in the care of these patients as follows.

*Emergency Service*: performance of initial assessment, examination and diagnosis.

*Orthopedic Surgery and Traumatology Service*: coordination of admission and care protocol; re-examination; study of the patient; and decision regarding surgical treatment.

*Internal Medicine Service*: co-responsibility for the patient during admission; initial assessment of comorbidities; daily clinical evolution; and joint medical decision-making with the Traumatology Service.

*Rehabilitation and Physiotherapy Service*: physiotherapy during hospitalization and subsequent rehabilitation upon discharge.

*Anesthesia Service*: assessment of the patient and possible complications before and after surgery; pre-operative study; collaboration with Traumatology and Internal Medicine to estimate the date and time of surgery and postoperative analgesia; preoperative antibiotic prophylaxis with cefazolin, or with vancomycin in case of allergies.

*Hematology Service*: evaluation of patients with anti-coagulant and/or anti-platelet treatment; pre-operative regimen and reintroduction upon discharge.

*Hospital Nursing Service*: patient care during admission.

*Hospital Pharmacy Service*: monitoring of treatment in multi-pathological and polypharmacy patients.

*Home Hospitalization Unit* (composed of doctors and primary care nurses): assessment of potential discharge from the third postoperative day; home visit and home care (e.g. dressing surgical wound, ambulation) during the first three to four weeks post-discharge. Ambulatory care depends on residence (geographic location, home versus institution) and available family support (presence of caregivers).

*Social services***:** assessment and individualized patient assistance; initiation of necessary steps to apply for admission to geriatric institution upon discharge if deemed appropriate.

After surgery, the Anesthesia Service is in charge of patient care in the recovery room. Once stabilized, the patients return to the Orthopedic Surgery and Traumatology ward.

On the first postoperative day, the attending anesthesiologist, internist, and traumatologist assess patients' analytical parameters, mobility, pain, and postoperative radiography. The patient starts sitting and joint mobility exercises. On the second postoperative day, the drainage is removed, the wound is dressed, and the patient begins assisted walking. On day 3, the home hospitalization professionals consider whether the patient is ready for discharge. The patient has a blood test, and the multidisciplinary care team reaches a consensus regarding the decision to discharge the patient based on each service's recommendations and treatment guidelines.

## Variables

The variables studied during admission were: age, sex, length of hospital stay (as both a quantitative and dichotomous variable, using 10 days as the cutoff), surgical delay, in-hospital mortality, comorbidities (hypertension, coronary heart disease, atrial fibrillation, heart failure, chronic obstructive pulmonary disease [COPD], stroke, Parkinson's disease, dementia, diabetes, rheumatic disease, and kidney failure), hemoglobin values (g/dL) on admission and postoperatively, blood transfusion and number of

preoperative and postoperative red blood cell concentrates, treatment with antiplatelet drugs (yes/no), Charlson index [16], and total number of comorbidities.

### Statistical analysis

We performed a descriptive analysis of the sample,presenting quantitative variables as means, with range and standard deviation (SD), and dichotomous categorical variables as absolute and relative frequencies. To analyze the impact of the protocol intervention, our primary outcome was a composite measure considering both in-hospital mortality and prolonged (> 10 days) hospital stay.

To compare the characteristics between exposure groups and to analyze the incidence of outcomes, we constructed 2×2 tables for categorical variables, applying the Chi-square test of association. Quantitative variables were analyzed by means of the student's T test.

To estimate the magnitude of association between exposure and outcome, we fit a multivariable logistic regression model, calculating the odds ratio (OR) and 95% confidence interval (CI). Variables for inclusion in the final model were selected using backward stepwise regression, based on the Akaike information criterion (AIC). Potential confounders were taken into account in the final model. The Chi-square value and predictive indicators were calculated as the area under the receiver operating characteristics curve (AUC) and its 95% CI.

We used the SPSS (v.25) statistical package and R (v.3.5.1) software for analyses.

## Results

Our study included 681 patients: 74.4% of patients (n = 507) were women, and 25.6% (n = 174) were men. The mean age was 83.78 years (range 65 to 104), and the most frequent comorbidities were arterial hypertension (n = 456, 67%), dementia (n = 204, 30%), and diabetes (n = 170, 25%). Patients' characteristics are shown in tables 1 and 2.

**Table 1**. Descriptive analysis of the sample. Categorical variables.

| Variable | | N = 681 n | % |
|---|---|---|---|
| Group | 2011-2014 | 310 | 45.5% |
| | 2015-2017 | 371 | 54.5% |
| Composite outcome (hospital stay of > 10 days and/or in-hospital mortality) | No | 517 | 75.9% |
| | Yes | 164 | 24.1% |
| Length of hospital stay | ≤ 10 days | 545 | 80.0% |
| | > 10 days | 136 | 20.0% |
| In-hospital death | No | 644 | 94.6% |
| | Yes | 37 | 5.4% |
| Gender | Men | 174 | 25.6% |
| | Women | 507 | 74.4% |
| Arterial hypertension | No | 225 | 33.0% |
| | Yes | 456 | 67.0% |
| Atrial fibrillation | No | 550 | 80.8% |
| | Yes | 131 | 19.2% |
| COPD | No | 592 | 86.9% |
| | Yes | 89 | 13.1% |
| Stroke | No | 577 | 84.7% |
| | Yes | 104 | 15.3% |
| Parkinson’s disease | No | 641 | 94.1% |
| | Yes | 40 | 5.9% |
| Dementia | No | 477 | 70.0% |
| | Yes | 204 | 30.0% |
| Heart failure | No | 545 | 80.0% |
| | Yes | 136 | 20.0% |
| Diabetes mellitus | No | 511 | 75.0% |
| | Yes | 170 | 25.0% |
| Rheumatic disease | No | 643 | 94.4% |
| | Yes | 38 | 5.6% |
| Antiplatelet treatment | No | 502 | 73.7% |
| | Yes | 179 | 26.3% |
| Coronary artery disease | No | 574 | 84.3% |
| | Yes | 107 | 15.7% |
| Kidney failure | No | 593 | 87.1% |
| | Yes | 88 | 12.9% |
| Preoperative blood transfusion | No | 632 | 92.8% |
| | Yes | 49 | 7.2% |
| Postoperative blood transfusion | No | 476 | 69.9% |
| | Yes | 205 | 30.1% |
| Intraoperative blood transfusion | No | 661 | 97.1% |
| | Yes | 20 | 2.9% |

**Table 2**. Descriptive analysis of the sample (N = 681). Quantitative variables.

| Variable | Mean | SD | Range | |
|---|---|---|---|---|
| Age | 83.78 | 7.30 | 65.00 | 104.00 |
| Charlson index | 1.55 | 1.39 | 0.00 | 7.00 |
| Days until surgery | 3.30 | 1.93 | 0.00 | 18.00 |
| Total number of comorbidities | 2.49 | 1.64 | 0.00 | 7.00 |
| Length of hospital stay (days) | 8.71 | 4.1 | 1.0 | 35 |
| Hemoglobin on admission (g/dL) | 12.48 | 1.80 | 5.90 | 17.90 |
| Postoperative hemoglobin (g/dL) | 10.39 | 1.77 | 5.90 | 16.00 |
| N red cell concentrates transfused intraoperatively | 0.04 | 0.23 | 0.00 | 2.00 |
| N red cell concentrates transfused postoperatively | 0.64 | 1.05 | 0.00 | 8.00 |

There were 310 patients in the unexposed group and 371 who were exposed (tables 3 and 4). Following implementation of the protocol, in-hospital mortality dropped from 7.7% to 3.5% (p = 0.015). Mean length of hospital stay was reduced by 0.7 days (p = 0.031), and the proportion of patients who were admitted for more than 10 days fell from 24.2% to 16.4% (p = 0.012). Significant differences were also observed for surgical delay, total number of comorbidities, Charlson index, rheumatic disease, kidney failure, postoperative transfusion, and number of packed red blood cells transfused intraoperatively and postoperatively.

**Table 3**. Comparison of cohorts. Categorical variables.

| Variable | | 2011-2014 (N = 310) | | 2015-2017 (N = 371) | | |
|---|---|---|---|---|---|---|
| | | n | % | n | % | p value |
| Length of hospital stay | ≤ 10 days | 235 | 75.8% | 310 | 83.6% | 0.012* |
| | > 10 days | 75 | 24.2% | 61 | 16.4% | |
| In-hospital death | No | 286 | 92.3% | 358 | 96.5% | 0.015* |
| | Yes | 24 | 7.7% | 13 | 3.5% | |
| Gender | Men | 80 | 25.8% | 94 | 25.3% | 0.89 |
| | Women | 230 | 74.2% | 277 | 74.7% | |
| Arterial hypertension | No | 114 | 36.8% | 111 | 29.9% | 0.058 |
| | Yes | 196 | 63.2% | 260 | 70.1% | |
| Atrial fibrillation | No | 258 | 83.2% | 292 | 78.7% | 0.13 |
| | Yes | 52 | 16.8% | 79 | 21.3% | |
| COPD | No | 274 | 88.4% | 318 | 85.7% | 0.30 |
| | Yes | 36 | 11.6% | 53 | 14.3% | |
| Stroke | No | 266 | 85.8% | 311 | 83.8% | 0.48 |
| | Yes | 44 | 14.2% | 60 | 16.2% | |
| Parkinson’s disease | No | 288 | 92.9% | 353 | 95.1% | 0.22 |
| | Yes | 22 | 7.1% | 18 | 4.9% | |
| Dementia | No | 217 | 70.0% | 260 | 70.1% | 0.89 |
| | Yes | 93 | 30.0% | 111 | 29.9% | |
| Heart failure | No | 253 | 81.6% | 292 | 78.7% | 0.35 |
| | Yes | 57 | 18.4% | 79 | 21.3% | |
| Diabetes mellitus | No | 234 | 75.5% | 277 | 74.7% | 0.81 |
| | Yes | 76 | 24.5% | 94 | 25.3% | |
| Rheumatic disease | No | 301 | 97.1% | 342 | 92.2% | 0.005* |
| | Yes | 9 | 2.9% | 29 | 7.8% | |
| Antiplatelet treatment | No | 230 | 74.2% | 272 | 73.3% | 0.80 |
| | Yes | 80 | 25.8% | 99 | 26.7% | |
| Coronary artery disease | No | 261 | 84.2% | 313 | 84.4% | 0.95 |
| | Yes | 49 | 15.8% | 58 | 15.6% | |
| Kidney failure | No | 289 | 93.2% | 304 | 81.9% | <0.001* |
| | Yes | 21 | 6.8% | 67 | 18.1% | |
| Preoperative blood transfusion | No | 289 | 93.2% | 343 | 92.5% | 0.70 |
| | Yes | 21 | 6.8% | 28 | 7.5% | |
| Postoperative blood transfusion | No | 305 | 98.4% | 356 | 96.0% | 0.061 |
| | Yes | 5 | 1.6% | 15 | 4.0% | |
| Intraoperative blood transfusion | No | 236 | 76.1% | 240 | 64.7% | 0.001* |
| | Yes | 74 | 23.9% | 131 | 35.3% | |

COPD: chronic obstructive pulmonary disease.

*Statistical significance at $p < 0.05$ level

**Table 4**. Comparison of cohorts. Quantitative variables.

| | Group | n | Mean | SD | p value |
|---|---|---|---|---|---|
| Age | 2011-2014 | 310 | 83.55 | 7.37 | 0.44 |
| | 2015-2017 | 371 | 83.98 | 7.24 | |
| Charlson Index | 2011-2014 | 310 | 1.39 | 1.31 | 0.005* |
| | 2015-2017 | 371 | 1.69 | 1.45 | |
| Days until surgery | 2011-2014 | 310 | 3.62 | 2.10 | <0.001* |
| | 2015-2017 | 371 | 3.03 | 1.73 | |
| Length of hospital stay (days) | 2011-2014 | 310 | 9.1 | 3.6 | 0.031* |
| | 2015-2017 | 371 | 8.4 | 4.6 | |
| Total number of comorbidities | 2011-2014 | 310 | 2.18 | 1.49 | <0.001* |
| | 2015-2017 | 371 | 2.75 | 1.71 | |
| Hemoglobin on admission (g/dL) | 2011-2014 | 310 | 12.58 | 1.78 | 0.18 |
| | 2015-2017 | 371 | 12.40 | 1.82 | |
| Postoperative hemoglobin (g/dL) | 2011-2014 | 310 | 10.38 | 1.71 | 0.94 |
| | 2015-2017 | 370 | 10.39 | 1.82 | |
| N red cell concentrates transfused intraoperatively | 2011-2014 | 310 | 0.02 | 0.13 | 0.016* |
| | 2015-2017 | 371 | 0.06 | 0.29 | |
| N red cell concentrates transfused postoperatively | 2011-2014 | 310 | 0.48 | 0.85 | <0.001* |
| | 2015-2017 | 371 | 0.78 | 1.18 | |

SD: standard deviation

*Statistical significance at p < 0.05 level

The incidence of the composite outcome was greater in the unexposed group (31% vs. 18.3%; p < 0.001) and in patients with atrial fibrillation (p = 0.005), coronary disease (p = 0.023), heart failure (p <0.001), and COPD (p = 0.002). Patients presenting the composite outcome also showed significantly higher mean values for the Charlson index (p <0.001), surgical delay (p <0.001), total number of comorbidities (p <0.001), hemoglobin levels on admission (p = 0.004), preoperative (p = 0.004) and postoperative blood transfusion (p <0.001), and number of packed red blood cells transfused postoperatively (p <0.001) (tables 5 and 6).

**Table 5**. Primary outcome (hospital stay of > 10 days and/or in-hospital mortality), according to categorical variables.

| Variable | | Outcome no | | Outcome yes | | |
|---|---|---|---|---|---|---|
| | | n | % | n | % | p value |
| Group | 2011-2014 | 214 | 69.0% | 96 | 31.0% | <0.001* |
| | 2015-2017 | 303 | 81.7% | 68 | 18.3% | |
| Gender | Men | 123 | 70.7% | 51 | 29.3% | 0.062 |
| | Women | 394 | 77.7% | 113 | 22.3% | |
| Arterial hypertension | No | 177 | 78.7% | 48 | 21.3% | 0.24 |
| | Yes | 340 | 74.6% | 116 | 25.4% | |
| Atrial fibrillation | No | 430 | 78.2% | 120 | 21.8% | 0.005* |
| | Yes | 87 | 66.4% | 44 | 33.6% | |
| COPD | No | 461 | 77.9% | 131 | 22.1% | 0.002* |
| | Yes | 56 | 62.9% | 33 | 37.1% | |
| Stroke | No | 443 | 76.8% | 134 | 23.2% | 0.22 |
| | Yes | 74 | 71.2% | 30 | 28.8% | |
| Parkinson’s disease | No | 490 | 76.4% | 151 | 23.6% | 0.20 |
| | Yes | 27 | 67.5% | 13 | 32.5% | |
| Dementia | No | 363 | 76.1% | 114 | 23.9% | 0.86 |
| | Yes | 154 | 75.5% | 50 | 24.5% | |
| Heart failure | No | 436 | 80.0% | 109 | 20.0% | <0.001* |
| | Yes | 81 | 59.6% | 55 | 40.4% | |
| Diabetes mellitus | No | 389 | 76.1% | 122 | 23.9% | 0.83 |
| | Yes | 128 | 75.3% | 42 | 24.7% | |
| Rheumatic disease | No | 492 | 76.5% | 151 | 23.5% | 0.13 |
| | Yes | 25 | 65.8% | 13 | 34.2% | |
| Antiplatelet treatment | No | 383 | 76.3% | 119 | 23.7% | 0.70 |
| | Yes | 134 | 74.9% | 45 | 25.1% | |
| Coronary artery disease | No | 445 | 77.5% | 129 | 22.5% | 0.023* |
| | Yes | 72 | 67.3% | 35 | 32.7% | |
| Kidney failure | No | 453 | 76.4% | 140 | 23.6% | 0.45 |
| | Yes | 64 | 72.7% | 24 | 27.3% | |
| Preoperative blood transfusion | No | 488 | 77.2% | 144 | 22.8% | 0.004* |
| | Yes | 29 | 59.2% | 20 | 40.8% | |
| Postoperative blood transfusion | No | 384 | 80.7% | 92 | 19.3% | <0.001* |
| | Yes | 133 | 64.9% | 72 | 35.1% | |
| Intraoperative blood transfusion | No | 505 | 76.4% | 156 | 23.6% | - |
| | Yes | 12 | 60.0% | 8 | 40.0% | |

*Statistical significance at $p < 0.05$ level

**Table 6**. Quantitative variables, according to presentation of primary outcome (hospital stay of > 10 days and/or in-hospital mortality)

| Variable | Outcome no (N = 517) Mean | SD | Outcome yes (N = 164) Mean | SD | p value |
|---|---|---|---|---|---|
| Age | 83.49 | (7.11) | 84.71 | (7.81) | 0.060 |
| Charlson Index | 1.44 | (1.34) | 1.92 | (1.49) | <0.001* |
| Days until surgery | 2.86 | (1.40) | 4.68 | (2.61) | <0.001* |
| Total number of comorbidities | 2.35 | (1.59) | 2.94 | (1.72) | <0.001* |
| Hemoglobin on admission (g/dL) | 12.59 | (1.79) | 12.13 | (1.79) | 0.004* |
| Postoperative hemoglobin (g/dL) † | 10.57 | (1.78) | 9.81 | (1.62) | <0.001* |
| N red cell concentrates transfused intraoperatively | 0.03 | (0.24) | 0.05 | (0.22) | 0.51 |
| N red cell concentrates transfused postoperatively | 0.53 | (0.96) | 0.98 | (1.27) | <0.001* |

*Statistical significance at $p < 0.05$ level

Multivariable analysis showed that the risk of in-hospital mortality and/or hospital admission beyond 10 days decreased by 51% in the 2015-2017 period compared to 2011-2014, after adjusting for age, sex, heart failure, days until surgery and postoperatively transfused red cell concentrates ($Chi^2$ 161.3; AUC 0.8020, 95% CI: 0.7631-0.8409; $p < 0.001$; table 7; figure 1).

**Table 7**. Composite risk of in-hospital mortality and/or hospital admission beyond 10 days (N = 681)

| Variable | | Adjusted OR | 95% CI | p value |
|---|---|---|---|---|
| Age | | 1.02 | (0.99-1.05) | 0.32 |
| Gender | Men | 1 | | |
| | Women | 1.13 | (0.72-1.79) | 0.60 |
| Group | 2011-2014 | 1 | | |
| | 2015-2017 | 0.49 | (0.32-0.74) | 0.001* |
| Heart failure | No | 1 | | |
| | Yes | 2.72 | (1.71-4.31) | <0.001* |
| Days until surgery | | 1.75 | (1.53-1.99) | <0.001* |
| N red cell concentrates transfused postoperatively | | 1.56 | (1.28-1.90) | <0.001* |

Notes: Results from final multivariable logistic regression model.

# Discussion

In our study, implementation of a multidisciplinary, shared care protocol in elderly patients with hip fracture reduced the risk of in-hospital mortality and/or a prolonged hospital stay by 51%. This result reflects the decrease in these two adverse events following the protocol intervention. A benefit was also observed for both outcomes measured separately and for mean length of hospital stay.

Health services evaluation is of critical importance for modern health systems, representing the only way to improve patient care and clinical, economic, and functional outcomes. To control variability in care, a systematic analysis of quality indicators is necessary. In a 2005 study involving 319 patients, Vidán et al [14] observed a reduction in in-hospital mortality from 5.6% to 0.6%, but no difference in length of stay. Likewise, in 2008, Pedersen et al [13] conducted a study in 535 patients aged over 40 years, reporting a reduction in the mean length of hospital stay from 15.8 to 9.7 days. A year later, Ho and colleagues [15] analyzed 554 patients, including those receiving conservative treatment; like us, they found differences for in-hospital mortality, length of hospital stay, and surgical delay. In a 2018 study, Wallace et al [12] reported a 2.41 day reduction in mean hospital stay after implementation of a multidisciplinary care pathway in 271 elderly patients with hip fractures but no differences in in-hospital mortality. In our study, the absolute reduction in risk of in-hospital mortality was 4.2%, the mean length of stay decreased by 0.7 days, and the proportion of patients with a hospital stay of longer than 10 days dropped by 6.6% ($p = 0.027$). Overall, the literature [11,12] shows better outcomes with multidisciplinary teams that are increasingly specialized and include more specialties, in studies with large sample sizes; this is also in line with our results.

In our study, there was a higher incidence of our composite outcome in patients with COPD and heart failure, which is consistent with the published literature, since these are known risk factors for in-hospital mortality and prolonged hospital stay in this type of population [10,16,18]. Hemoglobin levels and transfusions were also closely related to the risk of the composite outcome. This result could support the use of medications or devices to minimize blood loss in the operating room, such as tranexamic acid, which decreases blood loss in patients with hip fracture [19].

# Conclusions

Implementing the multidisciplinary shared care protocol halved the risk of in-hospital mortality and/or a hospital admission of more than 10 days in patients over 65 years with proximal femur fracture. It also reduced mean length of hospital stay and surgical delay.

# List Of Abrebiations

OR: odds ratio

CI: confidence interval

AUC: receiver operating characteristics curve

COPD: chronic obstructive pulmonary disease

SD: standard deviation

# Declarations

Ethics approval and consent to participate.

Research and ethics commission of the Sant Joan d’ Alacant University Hospital approved the use of patient data for research.

Consent for publication

Not applicable

Availability of data and material

The datasetsused and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have not competing interest

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Authors' contributions

JSM: Study design, acquisition of data and subjects, interpretation of data, preparation of manuscript.

FJFM: Study design, acquisition of data and subjects, interpretation of data.

JMSR: Acquisition of data and subjects, preparation of manuscript.

JAQR: Statistic analysis.

DOB: Study design

MCCM: Interpretation of data, preparation of manuscrip.

JFML: Study design

JCMC: Study design, interpretation of data, preparation of manuscrip.

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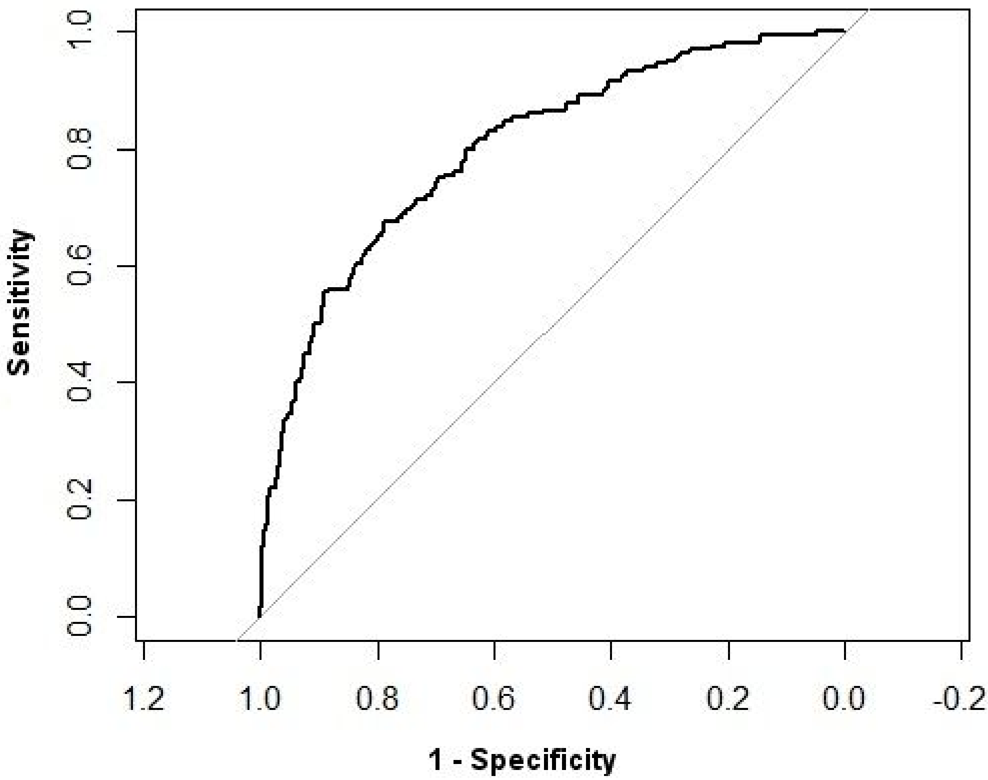
# Figures




## Figure 1

Receiver operating characteristic curve. The area under the curve demonstrates the accuracy of the model to predict the composite outcome of in-hospital mortality and/or prolonged hospital stay (> 10 days) following the implementation of the multidisciplinary shared-care protocol.