



## Factors Associated with Cost Variations in Patients with Hip Fracture: Mini-Review

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### Abstract

**Introduction:** Osteoporotic hip fractures are important health problems in geriatric patients. Several studies have evaluated the impact of hospitalization for hip fracture on the utilization of health resources and costs for sanitary services with a significant increase of them in the last years. The cost is not only related with hospitalization but also with long term complications, functional disability, rehabilitation and drug consumption. The objective of this study is to describe the new knowledge in the factors associated with the increase in the costs in patients with hip fracture.

**Methods:** The present review was carried out by conducting an electronic search in OVID (Medline and Embase) on hip fracture, its costs and the factors associated with them. The search was limited to publications in the last 5 years and in English, Portuguese and Spanish. A total of 86 articles were obtained, of which 27 were finally selected.

**Results:** Papers can be grouped into those that find or not a relationship between cost variations and their associated factors. The factors most frequently associated with cost increases are the patient's previous functional status and comorbidity, the location and type of fracture, the occurrence of adverse events (infection or delirium) and the waiting time until surgery. On the other hand, the implantation of multidisciplinary teams (orthogeriatric units) reduces the costs of care in these patients.

**Conclusion:** The available evidence suggests that certain surgical interventions may be cost-effective, and although the Health Economic Evaluation (HEE) for patients with hip fractures are increasing in publication in recent years, most of these studies do not adopt a social perspective and the key aspects of its methodology are deficient.

### Introduction

Hip fractures are a serious consequence of osteoporosis and are frequent in the actual context of population ageing [1], in which women over 50 years old represent 75.1% of all hip fractures [2]. More than 90% of all fractures occur as the result of a fall, and are more frequent in people over 65 years old [3]. Hip fractures represent 14% of all fractures in the elderly but involve 72% of the total cost of fractures for this group of age [2] with a great impact in quality of life [4]. Thus, the number of fractures in USA will increase substantially in the context of ageing of the population in which patients over 65 years old will experiment a global increase from 506 million in 2008 up to 1300 million in 2040 [1]. The economic burden of hip fracture is significant when with important consequences approaching health and social attention. We should take into consideration that mortality associated with hip fractures secondary to osteoporosis can be observed up until a decade after the event [1].

The cost on the first 6 months of patients with hip fracture is estimated in 27,000\$, according to data from 2001 in USA, mainly related to cost of rehabilitation; this same study estimated an attributable cost of more than 81.000\$ [5] during lifetime. Other studies highlight the high cost regarding taking care of the elderly with hip fractures based upon the next data: 4.340.000 visits

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to emergency departments in USA during 2008 [6]; costs for direct hospitalization ranging from 8.358 up to 32.195\$ [7]; and costs estimated for direct attention during the first year after hospital discharge in 30.000\$ per patient [6]. As a summary, hip fractures generated a total cost in health of 15 billion dollars in 2008, with an average cost of 40.000 per patient during the first year, and 50.000 per year thereafter [8]. Given that estimates show around 620.000 hip fractures by the year 2040 that will involve a lifetime cost for hip fractures in USA above 47 billion dollars [5]. In England, the cost for hospital attention on patients with hip fracture was estimated in 1 billion Pounds for the year 2014 [9]. Several studies have evaluated the impact of hospitalization for hip fracture on the utilization of health resources and costs for sanitary services with a significant increase of them. The excess cost related to hip fracture was estimated between \$ 2 0.000 - \$ 37.000 per patient and during the first year [10]. This over cost is not only related with hospitalization but also with long term complications [11] and functional disability which in addition increase costs of rehabilitation and drug consumption [10]. Those patients with a previous diagnosis of osteoporosis and which presented a hip fracture had a ten-fold increase in costs related with medical assistance, and doubled total costs during the next year with respect to those that did not present a hip fracture [10].

The adverse events occurred during admission also increase sanitary costs related to the process. Pre-surgical delirium relates to a great impact among the costs of the surgical processes of a hip fracture from the perspective of the acute care and after discharge [12]. Previous comorbidities and the risk for adverse events during admission can briefly explain the complexity of patients by using several scales and scores. Likewise, this scales and indexes can be used to estimate indirectly the cost associated to hospitalization of hip fracture. This scales include the American Society of Anesthesiologists (ASA), the Elixhauser index, and the Charlson Comorbidity Index (CCI). The values on this scales and indexes have shown a relationship with higher hospital costs through the increase of hospital stay for higher values of ASA [13] and Elixhauser [14], whereas higher values for the CCI are related to higher hospital stay and costs [15], higher mortality during admission [16], on the next 30 days [17] and 90 days after discharge [18], with higher rates of readmission too [19].

Due to complexity of attention to the elderly when hospitalized with a hip fracture it is necessary a cost analysis associated to the process. Thus, the health economic evaluation, which can be defined as the comparative analysis of different paths in terms of costs and consequences [20], may be useful to know the detailed characteristics of the process. Approximately 76,000 people suffer from a hip fracture per year in United Kingdom, and the estimated cost for the National Health System (NHS) is 1.400 million Pounds per year [21]. This represents a considerable proportion of the total annual budget for musculoskeletal illnesses which has been quantified in 10 billion Pounds [22]. The prevalence of this condition and its association with mortality contributed to the development of publications which identified important aspects of the attention, such as waiting time before surgery [23], use of spinal anesthesia [24] and management directed by doctors who improve survival [25]. Thus, the implantation of financial, technical and human resources, based on the evidence available, is important to improve clinical results in this field of the medicine.

The aim of this review is to analyze scientific publications about costs in the attention of patients with hip fracture to obtain and

update of global costs and its breakdown on different elements that may generate changes on usual costs.

## Methods and Materials

The present review was carried out by conducting an electronic search in OVID (Medline and Embase), combining the following MeSH keywords: "hip fractures" and "cost and cost analysis" or "Economics [Subheading]" or "Cost Savings" or "Hospital Costs" or "Health care Costs" or "Health Expenditures". The search was limited to publications in the last 5 years; in English, Spanish and Portuguese; and in human subjects. The last OVID research was completed 28 February, 2018.

A total of 177 articles were obtained, of which 86 were finally selected. Some additional instructions were added for certain specific objectives where necessary. In 14 cases, supplementary information was obtained in the form of references of the selected articles. Details of the evaluation and selection process of the items are shown in Figure 1. The articles were selected by four investigators based on the following inclusion criteria: randomized clinical trials, cohort studies, case-control studies, observational studies, and before-after analyses in orthogeriatric units; population: geriatric patients with proximal femoral fracture; intervention: orthogeriatric treatment begun perioperatively; and outcomes: surgical delay, length of hospital stay, prognostic factors and mortality, functional recovery, geriatric syndromes, perioperative care such as renal function, anemia, second hip fracture and complications, surgical treatment, and costs. The exclusion criteria were letters to the Editor, case reports, articles with no available abstract or those with only the abstract published, and studies meeting the inclusion criteria but with 50% of the study sample aged under 65 years (i.e., predominantly non-geriatric). All the articles were reevaluated by the authors of the review, and final inclusion was restricted to those of sufficient quality to afford information pertinent to the objectives of this review. The outcome measures examined were mortality, length of hospital stay, functional status, medical complications, destination after discharge, functional recovery, secondary prevention treatments, and readmissions.

## Results

Eighty-six documents met the selection criteria. Of these, twenty-seven have been included in this mini-review. The authors have found studies that find a relationship between hip fracture surgeries and their cost.

A study published in 2016 [26], quantifies the temporary changes in the use of different implants for hip fractures from 2011 to 2015. It contains a total sample of 370 patients, where the average age corresponds to 85.99 years, being in 68.9% of the total women. Both mortality and the distribution of the level of independence of life at discharge are similar. However, the results of the study show that the use of intramedullary fixation for hip fractures increased year after year.

In a study published by Daniel J. Jhonson et al. In the USA [15]. The graphs of all patients older than 60 years than the energy fall fracture are evaluated, with a total sample of 615 patients who underwent surgical fixation of hip fracture or hemiarthroplasty secondary to hip fracture. Resulting in a final cost for the institution of \$ 4,530 per day. In addition, the duration of the stay was modeled according to the CCI score. The increase of each unit in the ICC score corresponded to an increase in the duration of the hospital stay and

therefore of the costs. These results were related to the ninth. The aim of the study was to review it, when the results were from the ASSA, the CC and the location of the fracture has an effect on the costs. The average total cost of care per patient is  $8853 \pm 5676$  € and the surgical treatment costs  $1972 \pm 956$  represent the main cost factors for the treatment of hip fracture.

Timo Purmonen et al. [27], published an article that talks about the budgetary impact of several warfarin reversal approaches, reaching the conclusion that the least expensive treatment is vitamin K, which represented € 289,000 in direct costs of medical care, and the most expensive treatment option is the interruption of warfarin, which represented € 1,157,000. Following the study published by Ehad Fliss et al. [28], which houses a sample of 9,650 patients, it is shown that in Israel, head fractures are associated with a significant increase in the utilization and costs of medical care, observing the greater in rehabilitation costs.

At Clinical Orthopedics, a study was published in 2015 [29] that performs an economic analysis to determine if the implementation of a shared care model for geriatric patients with hip fractures would be a cost-effective intervention in hospitals with a moderate volume. Resulting in cost savings when more than 318 patients are treated per year.

According to a Portuguese study published in 2015 [30], osteoporotic hip fractures are effectively associated with a high social burden in terms of costs.

Following a similar line of research, in March 2012, an algorithm for the treatment of intertrochanteric hip fractures [31] in the USA was introduced. The study on "Can the use of an evidence-based algorithm for the treatment of intertrochanteric hip fractures maintain quality at a reduced cost?" Showed that the total cost of the implants before the implementation of the algorithm was \$ 357,457; compared to 255,120 \$ 255 after its implementation. So the application of the algorithm to the pre algorithm group revealed a potential cost savings of \$ 70,295.

The study entitled "The effect of operating time on the results of hip fracture" [32], performs a retrospective analysis of patients with hip fractures treated during the day or night, comparing the postoperative results and the use of resources for both groups. Thus, he concludes that the cost increases significantly in hip fracture procedures performed between 7 AM and 5 PM.

On the other hand, the study on "Accelerated surgical care of hip fractures produces a significantly lower treatment cost" [33], which also states that early surgical intervention, reduces costs with an average saving of \$ 15,400. Results that it shares with another study published in 2015 [34], in which it is stated that the costs are actually lower for patients who undergo surgery on the same day, and with the study on "Economic analysis on the surgical treatment of Hip fracture in the elderly" [35].

Based on the fact that hip fractures have negative humanistic and economic consequences, one study off Cui et al [36], identifies predictors and subgroups of negative results after the fracture (high costs and extensive use of medical care) in patients with and without muscle atrophy/weakness. Reaching the conclusion that patients with MAW have a higher utilization and health care costs after the fracture than those without MAW. Conclusion that shares the study on "Clinical and economic characteristics of patients with total hip

replacement with high medical care costs and a high use of medical care." Published in the American Journal of Physical Medicine & Rehabilitation [37] by the same author.

The Norwegian study on "Health and care costs one year after hip fracture for elderly patients" [38] shows that the age of the patients and the functional state prior to the fracture contributes to the total cost, hence the importance of the Comprehensive geriatric care in the initial phase after a hip fracture.

A Japanese study by Fakuda [39], with a total sample of 837 cases of hip fracture surgery concluded on the basis of the results that total health expenditures increase during organized care compared to integrated multidisciplinary care.

Both the study on "Cost of hospitalization for patients with hip fracture administered with a model of orthogeriatric care in Singapore [40]", as well as the study on "Impact of an integrated program of hip fractures in hospitalized patients on the length of stay and the costs [41]" agree that, effectively, integrated multidisciplinary healthcare reduces costs, stay and pre-surgical time, as well as an ortho-geriatric approach.

However, there are several studies that establish as a result, the fact that in general there is a shortage of cost-utility analysis, that a social perspective is not adopted and that the key aspects of its methodology are deficient [42-44].

## Discussion

Several studies agree that the patient and the characteristics of the treatment are extremely important as determinants of the cost and days of hospitalization, observing a decrease in the same in patients undergoing hip fracture during the first 24 hours [30-35].

This is due to the fact that after a hip fracture, half of the patients become dependent and only one third recover the previous functional situation, doubling the monthly social and clinical costs during the following year. As well as, these patients associate the greatest increase in costs linked to rehabilitation treatments, infections after surgical treatment and the consequences of delirium. Infections and delirium are risk factors to increase hospital length of stay and mortality [28,42,45,46].

In addition, it is necessary to mention that due to bed rest prior to surgery, there is a loss of muscle mass, increasing the use of services, the consumption of resources and, therefore, the cost [36,37].

According to several studies, interventions to reduce costs should be implemented such as prevention programs and programs involving geriatric assessments, especially in the early stage of hospital admission by hip fracture. Integrated multidisciplinary healthcare reduces both the hospital stay, the pre-surgical time and costs [38,40,41,47].

A study on 837 cases of hip fracture surgery described total health expenses increased in usual care compared to integrated multidisciplinary care 18. Other study have also showed that a comprehensive assessment team in the management of hip fractures is more cost-effective than usual care; the authors provided that with 54 patients attended in a year this interdisciplinary team produces savings and with 318 patients attended in a year it is possible to obtain cost-effectiveness [29].

This kind of management also demonstrates lower mortality rates

for the treatment of hip fracture [48].

According to the results published by a study [31], the implementation of an algorithm for the treatment of intertrochanteric fractures reduces costs linked to a decreasing complications and readmissions rates.

Some surgical techniques are most cost-efficient than another ones. Dynamic sliding screw (THS) is more cost-efficient for stable intertrochanteric fractures [29], as opposed to the use of Intramedullary Devices (ID). ID does not confer any benefit and entail a higher cost, as stated in a study published in *Injury* [26].

On the other hand, another risk factor relate to the increasing costs in hip fracture elderly patients is the comorbidities. Charlson Comorbidity Index (CCI), together with the ASA SCORE and the location of the fracture are linked to increases in the global cost in these patients [15,49].

Hypoalbuminemia is predictor of mortality risk, hospital stay and costs [50] and time to surgery is associated with higher costs [32].

It should be pointed out that osteoporotic hip fractures, according to several studies carried out, despite their low incidence, are associated with a high social burden, in terms of costs, loss in HrQoL and mortality [30].

And, in contrast, as a remarkable fact in the different studies referenced, the use of vitamin K as a reversal method of the anticoagulant warfarin is the most cost-effective method [27].

In general, there is a shortage of cost-utility analysis in orthopedic trauma; however, the available evidence suggests that certain surgical interventions may be cost-effective, and although the Health Economic Evaluation (HEE) for patients with hip fractures are increasing in publication in recent years, most of these studies do not adopt a social perspective and the key aspects of its methodology are deficient [43,44]. Besides here the importance of maintaining a line of research that allows us to provide cost-effective services, maintaining the quality of them.

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