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► To cite this version:

Michael Mounie, Didier Fabre, Thomas Rapp, Yves Rolland, Hubert Blain, et al.. Costs and Survival of Patients having Experienced a Hospitalized Fall-Related Injury in France: A Population-Based Study. *Journal of the American Medical Directors Association*, 2023, 10.1016/j.jamda.2023.02.005 . hal-04079390

HAL Id: hal-04079390

<https://hal.science/hal-04079390v1>

Submitted on 24 Apr 2023

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Original Study

Costs and Survival of Patients having Experienced a Hospitalized Fall-Related Injury in France: A Population-Based Study

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A B S T R A C T

Keywords:

Hospitalized fall-related injury
economic evaluation
survival
real world evidence

Objectives: To assess the annual costs 2 years before and 2 years after a hospitalized fall-related injury (HFRI) and the 2-year survival among the population 75+ years old.

Design: We performed a population-based, retrospective cohort study using the French national health insurance claims database.

Setting and Participants: Patients 75+ years old who had experienced a fall followed by hospitalization, identified using an algorithm based on International Classification of Diseases codes. Data related to a non-HFRI population matched on the basis of age, sex, and geographical area were also extracted.

Methods: Cost analyses were performed from a health insurance perspective and included direct costs. Survival analyses were conducted using Kaplan-Meier curves and Cox regression. Descriptive analyses of costs and regression modeling were carried out. Both regression models for costs and on survival were adjusted for age, sex, and comorbidities.

Results: A total of 1495 patients with HFRI and 4484 non-HFRI patients were identified. Patients with HFRI were more comorbid than the non-HFRI patients over the entire periods, particularly in the year before and the year after the HFRI. Patients with HFRI have significantly worse survival probabilities, with an adjusted 2.14-times greater risk of death over 2-year follow-up and heterogeneous effects determined by sex. The annual incremental costs between patients with HFRI and non-HFRI individuals were €1294 and €2378, respectively, 2 and 1 year before the HFRI, and €11,796 and €1659, respectively, 1 and 2 years after the HFRI. The main cost components differ according to the periods and are mainly accounted for by paramedical acts, hospitalizations, and drug costs. When fully adjusted, the year before the HFRI and the year after the HFRI are associated with increase in costs.

Conclusions and Implications: We have provided real-world estimates of the cost and the survival associated with patients with HFRI. Our results highlight the urgent need to manage patients with HFRI at an early stage to reduce the significant mortality as well as substantial additional cost management. Special attention must be paid to the fall-related increasing drugs and to optimizing management of comorbidities.

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This work was supported by the Court of Auditors, a French public organization.
The authors declare no conflicts of interest.

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<https://doi.org/10.1016/j.jamda.2023.02.005>

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Fall rates among older adults is a major public health issue. The World Health Organization has estimated that, worldwide, the proportion of adults aged 70 or older who suffer a fall is 32% to 42% each year. In France, the overall incidence of falls among adults 70+ years old was estimated to be between 15,000 and 21,000 per 100,000 inhabitants in 2017.^{1,2} Falls frequently result in injury (up to 20% to 30%), including 10% to 15% of falls that lead to a fracture, mainly hip fractures, which are the most severe fall-related injury.^{3,4} In addition, falls are the leading cause of injury-related death. Data available on fall-related injury mortality are mainly assessed at a hospital level and focus only on falls with and without injury or on patients residing in a nursing home. Nevertheless, the 1-year mortality rate for older fallers with fractures has been estimated at 25%. This mainly occurs during the first 3 months after the inpatient stay associated with the fall, with a higher survival rate for women compared with men.^{5–7} In addition, in a 2022 study, Newgard et al⁸ found that the 1-year mortality rate for patients 65+ years old transported by ambulance after a fall in the United States was 21.1%. The 2 main risk factors of fall-related injury are increasing age and female sex due to osteoporosis.⁹ Psychotropic drug consumption, comorbidities, and frailty are further risk factors of falls and fall-related injury.^{10–15}

The high incidence of fall-related injury and the management of falls and related consequences lead to a substantial economic burden on health care systems. Despite studies focusing on the global economic burden of falls on a national scale, only a limited number of works describe the cost of illness associated with falls in a real-world setting.¹⁶ Two US studies have assessed the health-related expenditures associated with fall-related injury for both the year preceding and the year after the fall, with this being estimated at \$3937 and \$13,636, respectively, in a study comparing fallers with non-fallers, whereas the second study found the gross cost to be \$19,636 and \$47,543, respectively.^{17,18} In addition, a Belgian study conducted in 2015 found that the inpatient cost associated with fall-related injuries among older people was €5139.¹⁹

Thus, studies on the real-world net costs of hospitalized fall-related injury (HFRI) worldwide are sparse, and no study has focused on a broader follow-up, from 2 years preceding the fall to 2 years after the fall. In addition, no study assessed the mortality of older patients with HFRI 2 years after the fall. In this study, we aimed to compare health care costs up to 2 years before and 2 years after the HFRI, as well as the 2-year survival rate with all causes taken into account, for both an HFRI and non-HFRI population composed of individuals aged 75 years and older.

Methods

Data Sources

We performed a population-based, retrospective, cohort study using a sample of the French national health insurance database. The French national health insurance database is a claims data warehouse that provides access to the complete reimbursed health care consumption of 98.8% of the French population.^{20,21} The sample used is a random and representative sample based on age and sex, which corresponds to 1/97 of the French national health insurance population. Similar data are available in the database covering demographic data (age, sex, month, and year of death), ambulatory care reimbursement, inpatient care data, long-term diseases diagnoses, and characteristics of health care providers.²² Inpatient care data are primarily collected in the French national uniform hospital discharge database before being compiled at a national level and merged with the French national health insurance database. The French national uniform hospital discharge database was used to develop the identification algorithm enabling patients with HFRI to be identified, and the French

national health insurance database was used to assess the associated costs with these patients and their survival.

Population Identification

An algorithm developed for the study was used to identify a population of patients with HFRI among 75-year-old adults through the identification of discriminant International Classification of Diseases, 10th Revision codes related to a fall ([Supplementary Material](#) and [Supplementary Figure 1](#)).

The codes that were ultimately selected (ie, S42.40, S52.60, S72.10-40, T796) were then used in the French national health insurance database to identify patients with HFRI older than 75 years during 2015 and 2016. Patients for whom the main diagnosis corresponded to the identified discriminant codes within this period were placed in the HFRI group. Care was taken to ensure that these patients also had a 2-year period of follow-up before their fall-related hospitalization and a 2-year period of follow-up thereafter. The date of the HFRI-related hospitalization is regarded as the index date. We have focused on incident patients, that is, patients without HFRI codes 2 years before the HFRI index date.

A matched non-HFRI population was identified in the French national health insurance database, with 3 non-HFRI patients identified for each patient with HFRI to allow the net cost associated with the HFRI population and the higher mortality rate within this group to be assessed. The non-HFRI population was matched using the following criteria: similar age category of 5 years, sex and county of residence. January 1 of the year in question was chosen as the index date for the non-HFRI population. We were not able to use an exact age to match the non-HFRI population, given the low proportion of very old beneficiaries within the 1/97 sample database used.

Economic Evaluation

The cost analysis was performed from a French health insurance perspective and included direct medical costs (ie, inpatient care, visits, medical and paramedical procedures, drugs and medical equipment) and nonmedical costs (ie, transports). Inpatient care included stays at hospitals for acute and long-term care, private rehabilitation care, at-home hospitalization, and hospitalization in psychiatric units. Costs were estimated by multiplying the number of resources used by the corresponding reimbursement tariff given by French health insurance. The French insurance tariffs applied were directly available in the database. The costs of management of patients with HFRI were assessed on an annual basis from 2 years preceding the date of HFRI to 2 years after. Economic outcomes were summarized using net costs, that is, the differential costs between patients with HFRI and matched non-HFRI patients, to focus on costs inherent to the HFRI population. Costs are expressed in €2020.²³

Other Data

Comorbidities used in the Charlson Comorbidity Index (CCI) were identified on an annual basis for both the HFRI and non-HFRI groups through resource consumption (ie, discharge hospital's diagnosis, medical procedures, and drug consumption) and long-term disease diagnosis, using an algorithm specifically developed using the French national health insurance database.²⁴ The CCI was then implemented with updated weighting and was used categorically as an adjustment variable. Patients with HFRI and non-HFRI patients who died during the year of fall were excluded the next year. In this context, annual estimates accounted for extra costs due to the death in the periods but the estimates in the year 2 years after the HFRI do not consider deceased patients the year prior.

Statistical Analysis

Descriptive statistics were implemented to summarize the data using mean \pm SD or occurrence with percentage. Chi-squared tests were used to compare patients' characteristics between the HFRI and non-HFRI groups.

Annual cost management between the HFRI and the non-HFRI groups was compared using the mean and bias-corrected and accelerated bootstrap 95% CIs, and Mann-Whitney Wilcoxon nonparametric tests. Generalized estimating equation models with gamma distribution and log link were implemented to adjust for the cost differences between the HFRI and non-HFRI groups. Age in quantile, sex, annual CCI, and the interaction between periods and the group were used as adjustment variables. Given the strong link between the CCI, the probability of HFRI, and the cost, two models with and without the CCI as adjustment variable were implemented to more accurately assess the impact of HFRI on costs.^{13,14,25} CCIs equal to 2 or 3 were grouped in modeling.

Kaplan-Meier curves were used to compare the 2-year survival estimate for the HFRI and non-HFRI groups in addition to the log rank test. Cox regression modeling was used to assess the adjusted effect of HFRI on survival. Age, sex, the CCI, and the interaction between sex and HFRI were used as adjustment variables.

Statistical analyses were implemented using R software, version 4.0.3.

Results

Characteristics of the Population

We identified 1495 patients with HFRI and 4484 matched non-HFRI patients (Figure 1). The mean age of the patients with HFRI was 87.1 years and 78.7% were women (Table 1). The HFRI and non-HFRI groups had similar mean age, sex, and distribution in terms of geographic area. Hip fractures were the most represented, accounting for 57% of our population, followed by head and neck of femur

fractures (49%), then closed trochanteric fracture and traumatic ischemia of muscle, which accounted for respectively 23% and 13% of the HFRI population. In addition, patients with HFRI had a greater number of comorbidities than the non-HFRI patients over the entire period and notably during the year before and the year after the hospitalization for the injury (Supplementary Figure 2). A significant number of patients with HFRI without a comorbidity the year before the HFRI were identified as having comorbidities (CCI equal to 2 or 3) during the year after the HFRI.

Cost Analyses

The mean annual health care expenditure of patients with HFRI was significantly higher during the 4-year period than that of non-HFRI patients, with net costs amounting to €1294, €2378, €11,796, and €1659, respectively (see Figure 2 and Supplementary Tables 1–4 for details).

The main cost components during the 2 years before the HFRI were paramedical acts, hospitalizations, and drug costs, which accounted for 46%, 28%, and 11% of the net cost respectively. For the year preceding the HFRI, the total net cost was primarily accounted for by hospitalizations, paramedical acts, and drug costs, which represented 53%, 27%, and 7%, respectively. For the year following the HFRI, the net cost drastically increases, particularly due to the HFRI hospitalization (medicine, surgery) increasing the hospitalization cost to 93% of the total cost. The costs associated with rehabilitation care amounted to 13% of hospitalization costs. Ambulance-related costs also increased. Consultation and nurse services costs slightly decreased and medical devices costs slightly increased between the year before the HFRI and the year after the HFRI. In the second year after the HFRI, net costs decreased significantly to return to a cost close to that observed 2 years before the HFRI. Hospitalization costs remained the leading cost component, accounting for 70% of the total incremental costs followed by paramedical acts and transport.

When adjusted, we observed a significant cost increase in the HFRI group when compared with the non-HFRI group of 13%, 24% (ie,

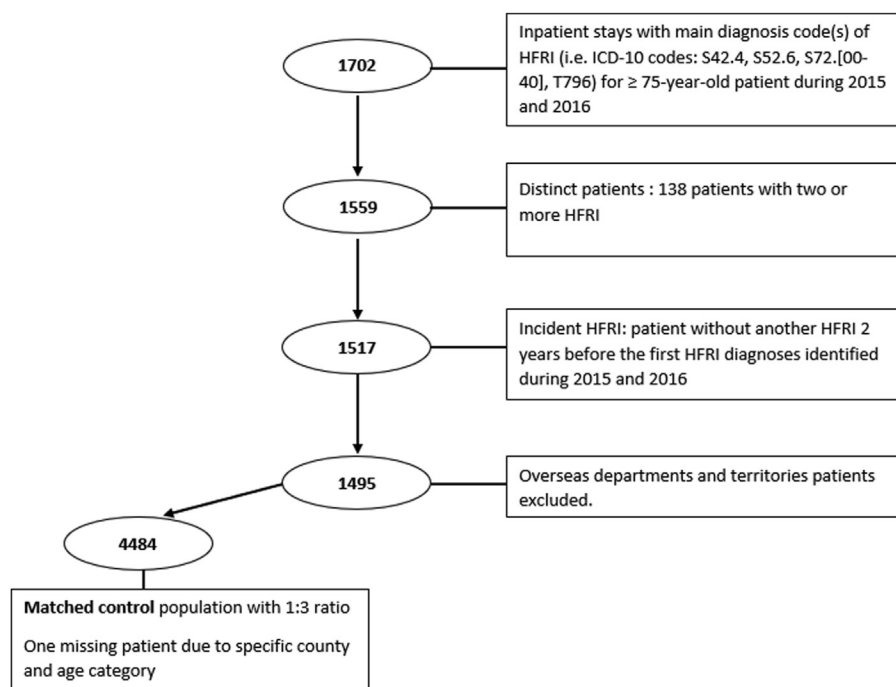


Fig. 1. Hospitalized fall-related injury patients' identification.

Table 1
Characteristics of the Patients With HFRI and Controls

		HFRI Group n = 1495	Control Group n = 4484	P Value
Age, mean (SD)		87.1 (5.68)	86.9 (5.89)	-
Women, n (%)		1177 (78.73)	3531 (78.75)	-
Main HFRI Diagnosis, n (%)	S42.40: Fracture of lower end of humerus	25 (1.67)	-	-
	S52.60: Fracture of lower end of ulna	39 (2.61)	-	-
	S72.00: Fracture of head and neck of femur	738 (49.36)	-	-
	S72.10: Closed trochanteric fracture	347 (23.21)	-	-
	S72.20: Subtrochanteric fracture of femur	67 (4.48)	-	-
	S72.30: Fracture of shaft of femur	46 (3.08)	-	-
	S72.40: Fracture of lower end of femur	33 (2.21)	-	-
	T796: Traumatic ischemia of muscle	200 (13.38)	-	-
0–12 mo: no. of deaths (%)		349 (23.34)	334 (7.45)	$P < .001$
0–24 mo: no. of deaths (%)		496 (33.18)	617 (13.76)	$P < .001$
CCI, n (%)	-24 to -12 mo			$P < .001$
	CCI = 0	747 (49.97)	3014 (62.79)	
	CCI = 1	536 (35.85)	1348 (28.08)	
	CCI = 2	168 (11.24)	359 (7.48)	
	CCI = 3	44 (2.94)	79 (1.65)	
	-12 to -0 mo			$P < .001$
	CCI = 0	631 (42.21)	2695 (60.1)	
	CCI = 1	595 (39.8)	1273 (28.39)	
	CCI = 2	203 (13.58)	415 (9.26)	
	CCI = 3	66 (4.41)	101 (2.25)	
	0 to 12 mo			$P < .001$
	CCI = 0	435 (29.1)	2538 (56.6)	
	CCI = 1	595 (39.8)	1307 (29.15)	
	CCI = 2	303 (20.27)	467 (10.41)	
	CCI = 3	162 (10.84)	172 (3.84)	
	12 to 24 mo*			$P < .001$
	CCI = 0	457 (39.88)	2308 (55.61)	
	CCI = 1	446 (38.92)	1252 (30.17)	
	CCI = 2	178 (15.53)	424 (10.22)	
	CCI = 3	65 (5.67)	166 (4.00)	

*Deaths of patients during the final period were excluded (HFRI group: n = 1146; Control group n = 4150).

1.13*1.1), and 269% (ie, 1.13*2.38) for the year 2 years before the HFRI, the year before the HFRI, and the year after the HFRI, respectively (Table 2). The HFRI-related increase in costs 2 years before the HFRI is largely explained by the presence of comorbidities. When the CCI was used as an adjustment variable, patients with HFRI during the first (Exp(β) = 1.05; CI = 0.94–1.16; $P = .418$) and the last (Exp(β) = 0.91;

CI = 0.8–1.04; $P = .184$) period were not associated with a cost increase. The year preceding the HFRI and the year following the HFRI are associated with 19% (ie, 1.05*1.13) and with 259% (ie, 1.05*2.47) cost increase, respectively. Finally, the lower cost for women (Exp(β) = 0.9; CI = 0.82–0.99; $P = .031$) did not remain when adjusted by the CCI in model 2.

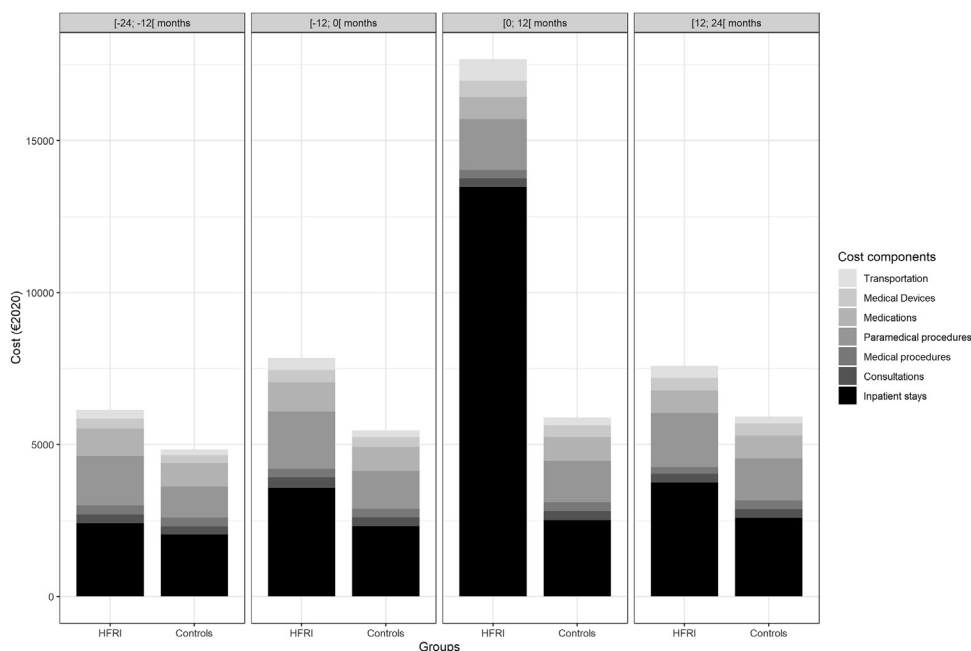


Fig. 2. Main cost component description over time according to groups.

Table 2
Adjusted Generalized Estimating Equation Models on Costs

Variable		Model 1			Model 2		
		Exp(β)	CI	P	Exp(β)	CI	P
Sex	Men	1			1		
	Women	0.9	[0.82–0.99]	.031	0.99	[0.91–1.08]	.820
Age	75–85	1	-	-	1	-	-
	85–90	0.96	[0.74–1.26]	.786	0.92	[0.73–1.16]	.460
	90+	0.99	[0.76–1.29]	.943	0.89	[0.71–1.12]	.328
HFRI	Control	1	-	-	1	-	-
	HFRI	1.13	[1–1.28]	.042	1.05	[0.94–1.16]	.418
Years according to the HFRI	1: –2 to –1	1	-	-	1	-	-
	2: –1 to 0	1.08	[1.03–1.14]	.001	1.03	[0.99–1.08]	.191
	3: 0 to 1	1.17	[1.11–1.24]	<.001	1.06	[1–1.11]	.047
	4: 1 to 2	1.23	[1.16–1.31]	<.001	1.05	[0.99–1.11]	.109
	HFRI* year –1 to 0	1.1	[1.01–1.2]	.030	1.13	[1.03–1.23]	.008
HFRI* Years	HFRI* year 0 to 1	2.38	[2.12–2.66]	<.001	2.47	[2.22–2.75]	<.001
	HFRI* year 1 to 2	0.86	[0.75–0.99]	.033	0.91	[0.8–1.04]	.184
	CCI						
	0			1			
	1			1.91	[1.79–2.04]	<.001	
	2			3.43	[3.15–3.72]	<.001	

*Interaction term; Model 1: without CCI adjustment; Model 2: with CCI adjustment.

Survival Analyses

The 2-year survival rate of the HFRI population was significantly lower than that of the non-HFRI population, being 0.77 and 0.67 for the first year and second year, respectively, compared with 0.93 and 0.85 for the non-HFRI group (Figure 3). The gap quickly widened during the first semester and increased slightly during the subsequent period. Once adjusted, patients with HFRI were estimated to be 2.14 times more likely to die during the 2 years following an HFRI than the non-HFRI group (CI = 1.9–2.41; $P < .001$) (Supplementary Table 5). This effect tended to differ according to sex [ie, interaction term: hazard ratio (HR) = 0.79; CI = 0.61–1.02; $P = .076$]. Men and women who had experienced an HFRI were at, respectively, 2.54-times and 2.00-times greater risk of death than the non-HFRI group during the 2 years after the HFRI. Women who have suffered an HFRI have a 40% lower risk of death compared with men who have suffered an HFRI

(HR = 0.76*0.79), or conversely, men who have suffered an HFRI are 67% more likely to die than women who have suffered an HFRI.

Discussion

Using a real-world claim database, we assessed annual costs from both the 2 years before and the 2 years after the HFRI and the 2-year survival in patients with HFRI compared with matched controls. First, unadjusted net costs amounted to €1294, €2378, €11,796, and €1659, respectively, for the 4 periods. When adjusted, an HFRI leads to 19% and 259% more expensive annual cost of management for the year before the HFRI and the year after the HFRI. The burden of comorbidities explained a major part of these differences. Extra comorbidities had already been identified in the 2 years before the HFRI (Supplementary Figure 2), with a lesser proportion of patients with HFRI with CCI0 and a higher proportion within the other categories.

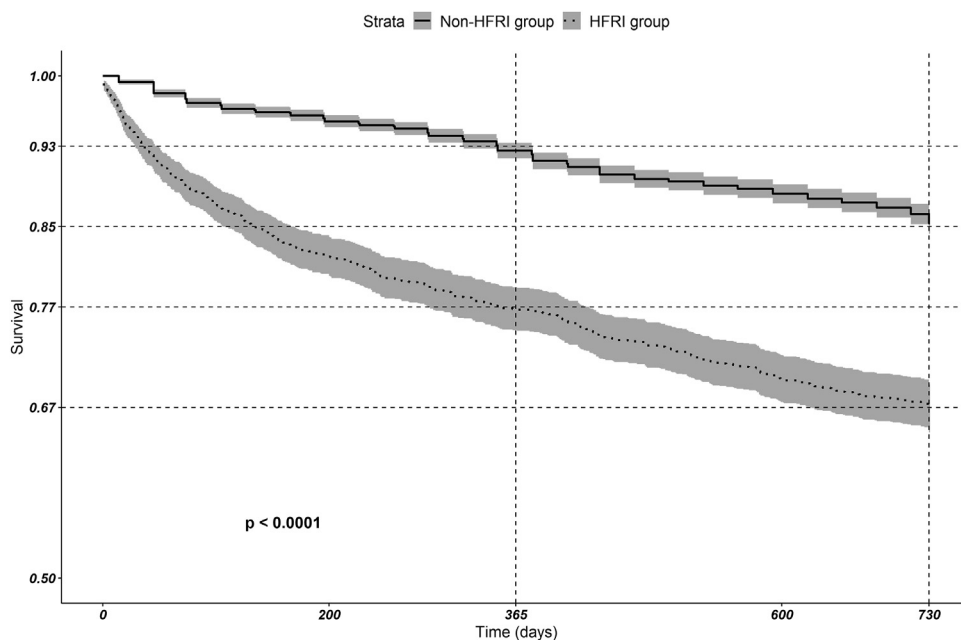


Fig. 3. Kaplan-Meier curves between groups 2 years after the HFRI.

This is confirmed in model 2, which uses the CCI as the adjustment variable, in which the effect of the HFRI on costs decreases during these years. This underlines the association between comorbidities and falls.^{13–15} More broadly, extra costs were likely linked to a global frailty of patients, defined as “a state of vulnerability to adverse outcomes,” which leads to an increased risk of falls and hospitalizations.^{26,27} This may explain the larger costs identified, particularly for paramedical acts, due to the costs of nurses, and the larger costs for medications before the HFRI. In line with our results, using French data, Sirven and Rapp²⁸ found additional ambulatory care costs for pre-frail and frail individuals in 2017 to be €750 and €1500, respectively. Worldwide, frailty also affects health care resource consumption, which varies between countries and health care systems and increases according to the severity of frailty.^{29–31} Given the high prevalence of frailty among older adults, our results emphasize the need to appropriately allocate health care resources to frail older populations to prevent significant costs being incurred due to adverse outcomes associated with frailty, such as a HFRI.³²

The higher cost of medication before the HFRI, which we have identified is not surprising, as it has been shown in the “Fall-Risk-Increasing Drugs” studies that cardiovascular, psychotropic, and anti-Parkinson, opioid, and antiepileptic drugs and polypharmacy increase the risk of falls.^{9–11} A higher proportion of patients with HFRI consuming psychotropic drugs (antipsychotic and antidepressant drugs) were identified throughout the entire period, with significant cost increases for patients with HFRI between the periods 2 years before the HFRI and the period 2 years after (€93 vs €62, €77 vs €52, €50 vs €42, €50 vs €38). These differences are particularly observable before the HFRI, which also suggests these drugs increase the risk of a fall.¹¹ This greater consumption is likely linked to the larger proportion of patients with dementia in the HFRI population, which is 23.41% vs 10.66% and 35.52% vs 13.36% in the year before the fall and the year after the fall, respectively. Nevertheless, no significant difference in costs was found between groups for cardiovascular drugs, proton pump inhibitors, or opioids.^{10,12}

Our results are consistent with those of the literature, with exacerbated costs in the US health care systems. Hoffman et al¹⁷ estimated \$13,636 to be the mean cost per patient for patients with a fall-related injury and \$21,424 for patients with HFRI. As was the case in our study, additional costs were already found before the fall. Another US study calculated the costs for patients who had been transported by ambulance to an emergency department to be \$19,636 and \$47,543 for the year preceding a fall and the year following a fall, respectively; however, this study did not use a control group.¹⁸ Furthermore, in Europe, a Belgian study in 2015 estimated the cost of an inpatient stay related to a fall to be €5139.¹⁹ Our results are rather similar, even if we did not focus only on inpatient stay-related costs. Comparisons between studies around the world remain difficult, especially owing to differences between health care organizations, reimbursement conditions, and unit prices used to value health care resources.

The CCI is correlated with the probability of a fall and with a higher cost. To take into account this association, we summarized the 2 models with and without the CCI to adjust the cost of management.³³ These models make it possible to identify the extra cost mechanism in the years before the HFRI, which is mainly due to the comorbid conditions and the overall frailty of patients. Thus, our results highlight the crucial need for preventive care, improving the management of the elderly and frail persons, minimizing the use of drugs that increase the risk of a fall, optimizing comorbidity management, and implementing measures to prevent HFRI, in order to reduce the higher mortality rate and costs associated with HFRI. Deceased patients in both groups were not excluded during the year of the death to consider the extra costs due to its management. The higher mortality rate in the HFRI group is a consequence of the HFRI, the comorbidities, and the global degraded health of the patients with HFRI, and we

believe it was crucial to consider these extra costs. Nevertheless, patients who died the year after the HFRI were excluded in the last period because they were no longer contributing to the annual costs. It explains the nonsignificant difference in cost between the 2 groups in the last period, given the excluded patients who were deceased were generally more comorbid and had costlier management.

An HFRI results in a significantly increased adjusted 2-year mortality rate, whereby men and women have a 2.54-times and 2-times higher risk of dying, respectively, compared with non-HFRI patients, respectively. In 2022, Newgard et al⁸ found that the 1-year mortality rate for a community-dwelling population of individuals aged ≥ 65 years who had experienced a fall and required emergency services in the United States to be 21.1%. Our results are similar, with an estimated 23% mortality rate at 1 year, despite our study population being older. Finally, the mortality rate reaches 33% within 2 years, and as can be observed in the survival curves, we have also confirmed that most deaths occur following the acute care period.⁸ Unfortunately, Newgard et al⁸ do not use a comparison population to assess the net mortality rate. Johnson et al⁵ assessed survival disparities among fallers aged 65 and older who required hospitalization in Canada using data from 1995 to 2005, with a special focus on disparities based on age, sex, and area of residence. Because they only used information on deaths at hospitals, we cannot compare our survival estimates. Nevertheless, in this study, as in our own, a worse survival rate was observed among men compared with women. In 2012, Coutinho et al⁶ estimated that the 1-year reduction in the survival rate of fallers aged 60 and older with a severe fracture was 25%. Nevertheless, this work is a research note originating in Brazil, where the organization of health care differs from France. This underlines the great need for studies to be conducted in countries with different health care structures to add to our knowledge in this field.

We were not able to assess informal costs, which may be a non-negligible part of the total costs given the older, frail, and comorbid conditions of our HFRI population. As shown in 2021 in Sweden, the annual societal costs of informal care for frail older people was estimated at €7477.³⁴ The HFRI identification algorithm represents another limitation to this study, as its performances have not been evaluated. Based on our conservative choices to include only patients aged 75 or older, in addition to the expert validation, the codes taken into consideration must have correctly identified patients with HFRI. The CCI was evaluated using an algorithm based on resource consumption and focused on treated comorbidities. Bias with regard to estimates due to misidentification or overidentification of comorbidities could occur. Nevertheless, the algorithm used is based on the reference in the French health insurance database, allowing the CCI to be correctly determined.²⁴

Comorbidities such as dementia may be underidentified if no hospitalization occurs due to the particular management of these diseases. Therefore, an overrepresentation of comorbidities could be observable in the year of the HFRI. All patients with HFRI were included based on an inpatient stay, which is also used by the algorithm to identify the comorbidities. The HFRI made it possible to identify a new comorbidity, which is detected during the inpatient management and the algorithm could identify a comorbidity already known but unidentifiable by the algorithm in the year before the HFRI. Unfortunately, the French national health database is a claim database and no clinical or socioeconomic data were available. In this context, all confounding factors may not be identified and used in the multivariate analyses, leading to possible residual confounding.

The main strength of this study is the use of real-world data that allow us to provide detailed and accurate estimations of real-life net costs associated with HFRI and mortality in France. Using several models to take into account confounding bias and causal inference, we described the cost and survival variation mechanisms.

Conclusions and Implications

HFRI occur mostly in older comorbid patients, causing further deterioration to their health and increasing the cost of management and the mortality rate. Our study thus provides accurate and detailed estimates of cost management and mortality rates in older patients following an HFRI in a real-world setting, up to 2 years before the HFRI and 2 years thereafter. There was found to be a strong association between comorbid conditions, HFRI, survival, and cost management. In this context, early management of older patients with comorbid conditions is needed to help prevent HFRI. Extra funds and programs addressing falls and fracture risk in the older population would likely reduce excess mortality and costs. Special attention must be given to reducing the use of drugs known to increase the likelihood of a fall and to optimizing comorbidity management.

Acknowledgment

This was an observational study on anonymous data. In accordance with French legislation, approval by an ethics committee was not required (French Law on Privacy: National Commission of Information Technology and Liberty Decision No. 89-117). The manuscript was reread by an English native person.

References

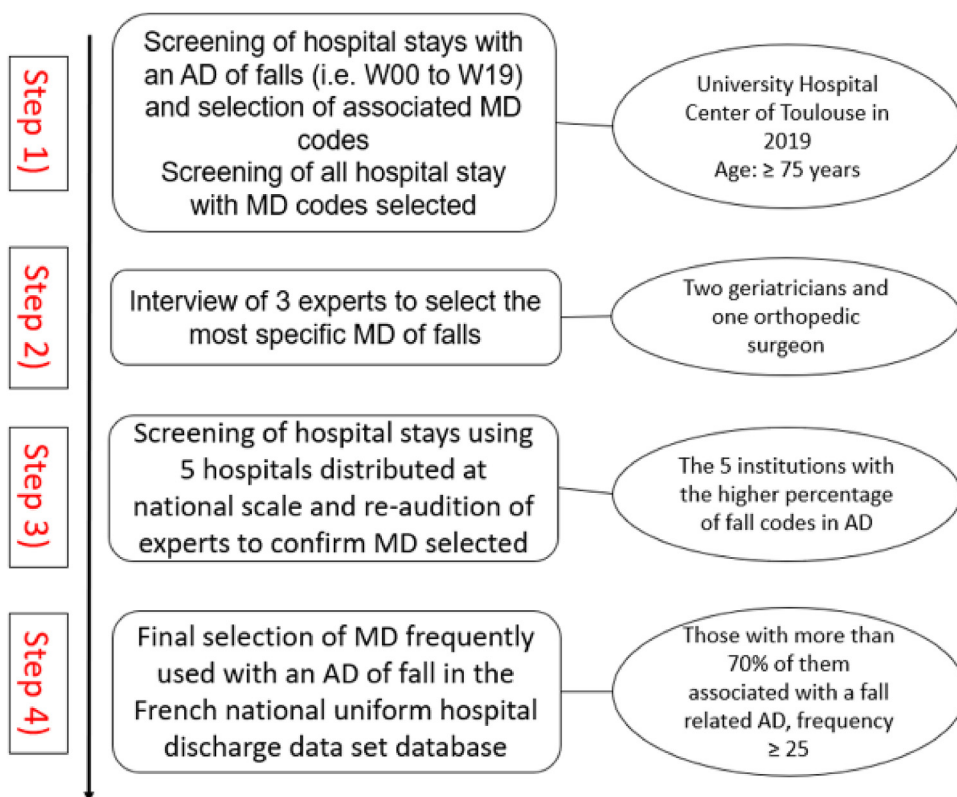
- World Health Organization. *WHO Global Report on Falls Prevention in Older Age*. World Health Organization; 2008.
- Haagsma JA, Olij BF, Majdan M, et al. Falls in older aged adults in 22 European countries: Incidence, mortality and burden of disease from 1990 to 2017. *Inj Prev*. 2020;26:i67–i74.
- EuroSafe. *Injuries in the European Union, Summary on injury statistics 2012e2014*. European Association for Injury Prevention and Safety Promotion (EuroSafe); 2016.
- Berry SD, Miller RR. Falls: Epidemiology, pathophysiology, and relationship to fracture. *Curr Osteoporos Rep*. 2008;6:149–154.
- Johnson S, Kelly S, Rasali D. Differences in fall injury hospitalization and related survival rates among older adults across age, sex, and areas of residence in Canada. *Inj Epidemiol*. 2015;2:24.
- Coutinho ESF, Bloch KV, Coeli CM. One-year mortality among elderly people after hospitalization due to fall-related fractures: comparison with a control group of matched elderly. *Cad Saude Pública*. 2012;28:801–805.
- Hartholt KA, Lee R, Burns ER, van Beeck EF. Mortality from falls among US adults aged 75 years or older, 2000–2016. *JAMA*. 2019;321:2131–2133.
- Newgard CD, Lin A, Caughey AB, et al. Falls in older adults requiring emergency services: Mortality, use of healthcare resources, and prognostication to one year. *West J Emerg Med*. 2022;23:375–385.
- Resnick B, Nahm ES, Zhu S, et al. The impact of osteoporosis, falls, fear of falling, and efficacy expectations on exercise among community-dwelling older adults. *Orthop Nurs*. 2014;33:277–288. <https://doi.org/10.1097/NOR.0000000000000084>.
- De Vries M, Seppala LJ, Daams JG, van de Glind EMM, Masud T, van der Velde N. EUGMS task and finish group on fall-risk-increasing drugs. Fall-risk-increasing d: A systematic review and meta-analysis: I. cardiovascular drugs. *J Am Med Dir Assoc*. 2018;19:371.e1–371.e9.
- Seppala LJ, Wermelink AMAT, de Vries M, Ploegmakers KJ, van de Glind EMM, Daams JG, van der Velde N. EUGMS task and finish group on fall-risk-increasing drugs. Fall-risk-increasing drugs: A systematic review and meta-analysis: II. Psychotropics. *J Am Med Dir Assoc*. 2018;19:371.e11–371.e17.
- Seppala LJ, van de Glind EMM, Daams JG, Ploegmakers KJ, de Vries M, Wermelink AMAT, van der Velde N. EUGMS task and finish group on fall-risk-increasing drugs. Fall-risk-increasing drugs: A systematic review and meta-analysis: III. others. *J Am Med Dir Assoc*. 2018;19:372.e1–372.e8.
- Vu T, Finch CF, Day L. Patterns of comorbidity in community-dwelling older people hospitalised for fall-related injury: A cluster analysis. *BMC Geriatr*. 2011;11:45.
- Jørgensen TS, Hansen AH, Sahlberg M, et al. Falls and comorbidity: The pathway to fractures. *Scand J Public Health*. 2014;42:287–294.
- Cheng MH, Chang SF. Frailty as a risk factor for falls among community dwelling people: Evidence from a meta-analysis. *J Nurs Scholarsh*. 2017;49:529–536.
- Davis JC, Robertson MC, Ashe MC, Liu-Ambrose T, Khan KM, Marra CA. International comparison of cost of falls in older adults living in the community: A systematic review. *Osteoporos Int*. 2010 Aug;21:1295–1306.
- Hoffman GJ, Hays RD, Shapiro MF, Wallace SP, Ettner SL. The costs of fall-related injuries among older adults: Annual per-faller, service component, and patient out-of-pocket costs. *Health Serv Res*. 2017;52:1794–1816.
- Newgard CD, Lin A, Caughey AB, et al. The cost of a fall among older adults requiring emergency services. *J Am Geriatr Soc*. 2021;69:389–398.
- Di Pierdomenico L, Uwiteka I, Senterre C, et al. Évaluation économique des lésions associées aux chutes des personnes âgées vivant à domicile [cost evaluation of hospital inpatient stays induced by injuries due to falls for elderly people]. *Geriatr Psychol Neuropsychiatr Vieil*. 2015;13:36–44.
- Bezin J, Duong M, Lassalle R, et al. The national healthcare system claims databases in France, SNIIRAM and EGB: Powerful tools for pharmacoepidemiology. *Pharmacoepidemiol Drug Saf*. 2017;26:954–962.
- Tuppin P, Rudant J, Constantinou P, et al. Value of a national administrative database to guide public decisions: From the système national d'information interrégimes de l'Assurance Maladie (SNIIRAM) to the système national des données de santé (SNDS) in France. *Rev Epidemiol Sante Publique*. 2017;65-(Suppl 4):S149–S167.
- Moulis G, Lapeyre-Mestre M, Palmaro A, Pugnet G, Montastruc J-L, Sailler L. French health insurance databases: What interest for medical research? *Rev Med Interne*. 2015;36:411–417.
- OECD. *Inflation (CPI) (indicator)*. 2022. <https://doi.org/10.1787/eee82e6e-en>. Accessed on 09 May 2022.
- Bannay A, Chaignot C, Blotière PO, et al. The best use of the Charlson Comorbidity Index with electronic health care database to predict mortality. *Med Care*. 2016;54:188–194.
- Chao CT, Yang RS, Huang WJ, Tsai KS, Chan DD. Risk factors for poor functional recovery, mortality, recurrent fractures, and falls among patients participating in a Fracture Liaison Service Program. *J Am Med Dir Assoc*. 2019;20:1129–1136.e1.
- Howlett SE, Rockwood K. New horizons in frailty: Ageing and the deficit-scaling problem. *Age Ageing*. 2013;42:416–423.
- Fried LP, Tangen CM, Walston J, et al. Frailty in older adults evidence for a phenotype. *J Gerontol A: Bio Sci Med Sci*. 2001;56:M146–M157.
- Sirven N, Rapp T. The cost of frailty in France. *Eur J Health Econ*. 2017;18:243–253.
- Han L, Clegg A, Doran T, Fraser L. The impact of frailty on healthcare resource use: A longitudinal analysis using the clinical practice research Datalink in England. *Age Ageing*. 2019;48:665–671.
- Simpson KN, Seamon BA, Hand BN, et al. Effect of frailty on resource use and cost for Medicare patients. *J Comp Eff Res*. 2018;7:817–825.
- Fuertes-Guiró F, Viteri Velasco E. The impact of frailty on the economic evaluation of geriatric surgery: Hospital costs and opportunity costs based on meta-analysis. *J Med Econ*. 2020;23:819–830.
- Le Cossec C, Perrine AL, Beltzer N, Fuhrman C, Carcaillon-Bentata L. Pre-frailty, frailty, and multimorbidity: Prevalences and associated characteristics from two french national surveys. *J Nutr Health Aging*. 2016;20:860–869.
- Glass TA, Goodman SN, Hernán MA, Samet JM. Causal inference in public health. *Annu Rev Public Health*. 2013;34:61–75.
- Alwin J, Karlson BW, Husberg M, Carlsson P, Ekerstad N. Societal costs of informal care of community-dwelling frail elderly people. *Scand J Public Health*. 2021;49:433–440.

Supplementary Material

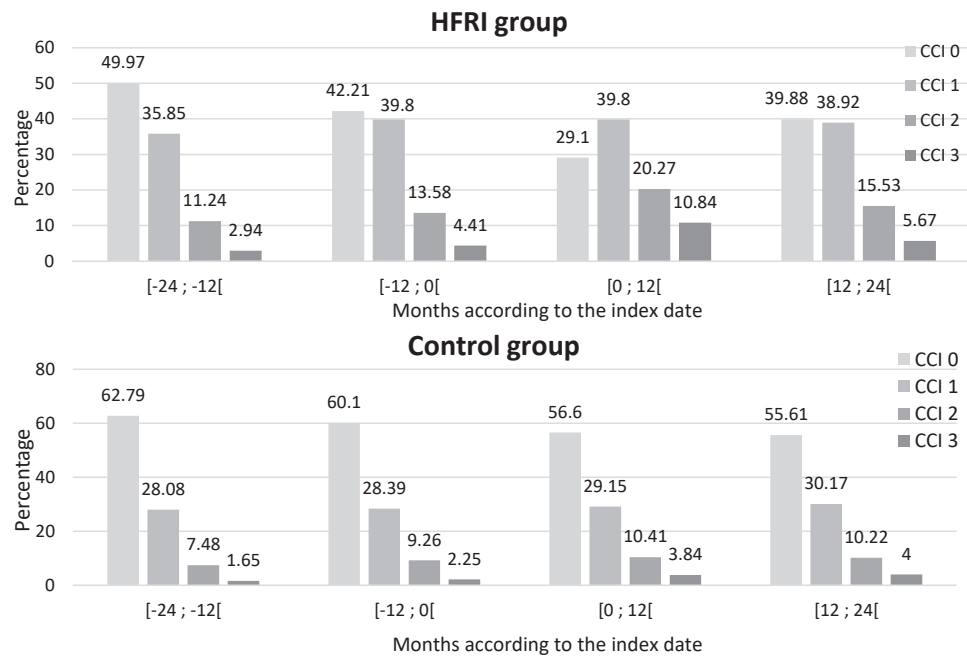
Algorithm Development

We had to develop a new algorithm to avoid the use of older algorithms based on ICD-9 codes, which are outdated in our context. French hospitals are funded based on the French national uniform hospital discharge database and only use ICD-10 codes to describe inpatient stays. Three kinds of diagnoses are used, together or

otherwise, to ascertain the purpose of the hospitalization: the Main Diagnosis, the Related Diagnosis, and the Associated Diagnosis. Codes associated with falls are available in the ICD-10 encoding (ie, W00 to W19, R29.6), but they are used heterogeneously on a national scale, as the codes are not linked with a particular type of patient management. The code R29.6 was excluded because it can relate to a history of falls. The algorithm that we have developed, allowing discriminant ICD-10 codes related to falls to be identified, comprises 4 main steps and focuses on the population aged 75 years or older. It is described in [Supplementary Figure 1](#).



Supplementary Fig. 1. Description of steps for selecting final Main Diagnoses codes related to an HFRI. AD, Associated Diagnoses; MD, Main Diagnoses; The University Hospital of Toulouse was primarily used because it ensures a very satisfactory level of completeness and quality of the coding of hospital stays, particularly in the area of falls.



Supplementary Fig. 2. CCI according to groups and periods (%).

Supplementary Table 1

Detailed Cost (€ 2020) Description According to Cost Component, Patients With HFRI, and Control Group From 2 Years To 1 Year Before HFRI

	HFRI Group		Control Group		Δ Cost (HFRI – Control)	P
	Frequency Mean [95% CI]	Cost Mean [95% CI]	Frequency Mean [95% CI]	Cost Mean [95% CI]		
Hospitalizations	1.13 [0.91–1.61]	2405 [2106–2791]	0.98 [0.81–1.34]	2037 [1871–2230]	368	.001
Medicine, surgery, obstetrics	0.95 [0.74–1.44]	1930 [1700–2199]	0.86 [0.68–1.22]	1752 [1614–1923]	177	.012
Home care service	0.03 [0–0.12]	97 [0–292]	0.01 [0–0.03]	27 [7–104]	70	.999
Rehabilitation care	0.13 [0.09–0.18]	219 [147–328]	0.11 [0.09–0.13]	167 [133–213]	52	.103
Other inpatient care*	-	159 [101–293]	-	91 [77–130]	68	.002
Consultations	10.31 [9.91–10.73]	302 [289–316]	9.99 [9.75–10.24]	272 [264–280]	30	<.001
General practitioner	8.65 [8.3–9.04]	222 [211–234]	8.23 [8.02–8.46]	198 [192–204]	24	<.001
Specialist	1.66 [1.51–1.85]	48 [43–53]	1.75 [1.66–1.86]	47 [44–50]	1	.179
Other consultations [†]	-	33 [31–36]	-	27 [26–29]	5	.351
Paramedical acts	81.96 [74.33–90.22]	1618 [1440–1822]	52.18 [48.25–56.12]	1018 [932–1120]	600	<.001
Nurse	64.73 [58.11–72.22]	1263 [1110–1450]	38.81 [35.5–42.43]	757 [680–848]	506	<.001
Physiotherapist	16.18 [14.46–18.15]	316 [280–359]	12.81 [11.75–13.88]	241 [220–264]	75	<.001
Other paramedical acts [‡]	-	39 [28–56]	-	21 [15–30]	19	.009
Medical acts	9.77 [9.16–10.42]	292 [271–319]	9.21 [8.89–9.54]	286 [275–300]	6	.76
Laboratory tests	6.74 [6.26–7.29]	127 [118–138]	5.77 [5.51–6.04]	105 [101–109]	23	.002
Imaging acts	1.27 [1.18–1.37]	61 [56–66]	1.38 [1.32–1.43]	68 [65–72]	-7	.202
Other medical acts [§]	-	104 [91–125]	-	114 [106–124]	-10	<.001
Medical devices	5.16 [4.73–5.61]	314 [277–357]	4.17 [3.95–4.44]	256 [235–285]	58	<.001
Medications	38.86 [37.46–40.15]	919 [837–1049]	28.5 [27.98–29.09]	781 [747–820]	137	<.001
Transportation	2.02 [1.78–2.33]	286 [217–419]	1.46 [1.34–1.63]	192 [157–264]	94	<.001
Ambulance	1 [0.84–1.25]	184 [125–321]	0.65 [0.58–0.76]	107 [78–183]	77	<.001
Other transportations	-	102 [81–135]	-	85 [69–114]	17	<.001
Global	-	6137 [5674–6695]	-	4843 [4595–5139]	1294	<.001

P value from Mann-Whitney-Wilcoxon test. P value associated with the cost comparison. - indicates Frequency not applicable because the category is a sum of different cost component.

*Other inpatient care: hospital-reserved drugs, hospital outpatient department, dialysis.

[†]Other consultations: teleconsultations, mark-up, flat-rate participation.

[‡]Other paramedical acts: pedicure-podiatrist, speech therapists, orthoptists, midwives, thermal baths.

[§]Other medical acts: anesthesia, surgery, dental, obstetrics.

^{||}Other transportation: taxi, light medical vehicles, personal vehicles.

Supplementary Table 2

Detailed Cost (€ 2020) Description According to Cost Component, Patient With HFRI, and Control Group the Year Before HFRI

	HFRI Group		Control Group		Δ Cost (HFRI – Control)	P
	Frequency Mean [95% CI]	Cost Mean [95% CI]	Frequency Mean [95% CI]	Cost Mean [95% CI]		
Hospitalizations	1.62 [1.33–2.12]	3582 [3193–4005]	1.04 [0.87–1.39]	2314 [2116–2586]	1267	<.001
Medicine, surgery, obstetrics	1.35 [1.08–1.91]	3062 [2730–3496]	0.91 [0.75–1.23]	1904 [1754–2093]	1158	<.001
Home care service	0.04 [0–0.21]	43 [5–192]	0.02 [0–0.07]	111 [35–310]	–68	.883
Rehabilitation care	0.23 [0.17–0.31]	284 [215–383]	0.11 [0.09–0.15]	188 [145–256]	97	.068
Other inpatient care*	–	192 [132–338]	–	112 [88–158]	80	<.001
Consultations	10.97 [10.54–11.43]	336 [322–352]	10.37 [10.1–10.65]	294 [285–303]	42	<.001
General practitioner	9.12 [8.72–9.53]	244 [233–259]	8.54 [8.31–8.77]	209 [202–216]	36	<.001
Specialist	1.84 [1.66–2.09]	56 [50–64]	1.82 [1.73–1.94]	52 [49–55]	4	.289
Other consultations†	–	35 [33–38]	–	33 [32–35]	2	.101
Paramedical acts	95.62 [87.67–104.12]	1880 [1697–2085]	62.1 [57.99–66.72]	1238 [1136–1357]	642	<.001
Nurse	75.32 [68.25–83.03]	1467 [1303–1664]	46.4 [42.7–50.43]	929 [835–1028]	538	<.001
Physiotherapist	19.22 [17.26–21.32]	374 [333–420]	14.97 [13.83–16.22]	282 [260–308]	92	<.001
Other paramedical acts‡	–	39 [28–55]	–	28 [20–38]	12	.105
Medical acts	10.12 [9.53–10.79]	291 [272–314]	9.44 [9.11–9.78]	285 [274–299]	5	.168
Laboratory tests	7.12 [6.62–7.69]	138 [128–150]	6.11 [5.84–6.41]	110 [105–115]	28	<.001
Imaging acts	1.39 [1.29–1.5]	68 [63–74]	1.41 [1.35–1.47]	69 [66–73]	–1	.483
Other medical acts§	–	84 [75–101]	–	106 [98–117]	–22	<.001
Medical devices	6.31 [5.87–6.8]	406 [364–461]	4.91 [4.66–5.2]	325 [298–358]	81	<.001
Medications	57.78 [56.02–59.64]	967 [875–1109]	47.78 [46.73–48.91]	789 [753–834]	178	<.001
Transportation	2.62 [2.38–2.92]	391 [309–535]	1.69 [1.55–1.88]	227 [190–307]	163	<.001
Ambulance	1.46 [1.3–1.65]	271 [200–408]	0.81 [0.73–0.94]	129 [98–203]	142	<.001
Other transportations	–	120 [93–162]	–	98 [80–131]	21	<.001
Global	–	7851 [7299–8491]	–	5473 [5187–5836]	2378	<.001

P value from Mann-Whitney-Wilcoxon test. P value associated with the cost comparison.

*Other inpatient care: hospital-reserved drugs, hospital outpatient department, dialysis.

†Other consultations: teleconsultations, mark-up, flat-rate participation.

‡Other paramedical acts: pedicure-podiatrist, speech therapists, orthoptists, midwives, thermal baths.

§Other medical acts: anesthesia, surgery, dental, obstetrics.

||Other transportation: taxis, light medical vehicles, personal vehicles.

Supplementary Table 3

Detailed Cost (€ 2020) Description According to Cost Component, Patients with HFRI, and Control Group the Year After HFRI

	HFRI Group		Control Group		Δ Cost (HFRI – Control)	P
	Frequency Mean [95% CI]	Cost Mean [95% CI]	Frequency Mean [95% CI]	Cost Mean [95% CI]		
Hospitalizations	4.11 [3.74–4.73]	13,480 [12923–14115]	1.16 [0.98–1.5]	2515 [2337–2732]	10,965	<.001
Medicine, surgery, obstetrics	2.74 [2.42–3.3]	11,095 [10690–11545]	1.02 [0.85–1.39]	2142 [1985–2327]	8953	<.001
Home care service	0.13 [0.08–0.22]	438 [281–700]	0.02 [0.01–0.05]	77 [44–133]	361	<.001
Rehabilitation care	1.24 [1.07–1.47]	1782 [1541–2104]	0.11 [0.09–0.15]	178 [136–240]	1605	<.001
Other inpatient care*	–	165 [137–246]	–	119 [96–163]	46	<.001
Consultations	8.92 [8.49–9.39]	284 [269–300]	10.19 [9.92–10.47]	293 [285–303]	–10	.003
General practitioner	7.59 [7.19–8]	217 [204–231]	8.38 [8.16–8.62]	207 [200–214]	10	.291
Specialist	1.33 [1.19–1.48]	37 [33–42]	1.81 [1.7–1.91]	52 [49–56]	–15	<.001
Other consultations†	–	29 [28–32]	–	34 [33–36]	–5	<.001
Paramedical acts	89.52 [82.85–96.29]	1676 [1527–1840]	66.13 [62.05–70.82]	1365 [1258–1486]	311	<.001
Nurse	57.32 [51.61–63.93]	1088 [958–1233]	49.14 [45.47–53.01]	1034 [939–1144]	55	.519
Physiotherapist	31.59 [29.36–33.95]	566 [523–612]	16.27 [15.05–17.67]	306 [282–334]	260	<.001
Other paramedical acts‡	–	22 [15–33]	–	26 [19–36]	–4	.791
Medical acts	9.57 [8.99–10.19]	273 [255–296]	9.49 [9.14–9.85]	290 [277–307]	–18	.049
Laboratory tests	7.3 [6.8–7.83]	121 [113–131]	6.32 [6.03–6.63]	116 [111–121]	6	.994
Imaging acts	1.26 [1.16–1.37]	52 [47–56]	1.42 [1.36–1.48]	66 [63–70]	–15	<.001
Other medical acts§	–	100 [87–115]	–	108 [98–123]	–9	<.001
Medical devices	7.31 [6.8–7.9]	533 [482–597]	5.45 [5.18–5.75]	383 [354–420]	150	<.001
Medications	51.95 [49.98–53.93]	731 [666–825]	64.65 [63.4–66.03]	784 [744–835]	–53	.02
Transportation	5.48 [5.15–5.93]	708 [623–880]	2.02 [1.85–2.26]	258 [220–333]	450	<.001
Ambulance	4.34 [4.09–4.74]	594 [513–742]	1.02 [0.92–1.18]	152 [120–226]	441	<.001
Other transportation	–	115 [96–152]	–	106 [87–139]	9	<.001
Global	–	17684 [17049–18454]	–	5889 [5610–6237]	11796	<.001

P value from Mann-Whitney-Wilcoxon test. P value associated with the cost comparison.

*Other inpatient care: hospital-reserved drugs, hospital outpatient department, dialysis.

†Other consultations: teleconsultations, mark-up, flat-rate participation.

‡Other paramedical acts: pedicure-podiatrist, speech therapists, orthoptists, midwives, thermal baths.

§Other medical acts: anesthesia, surgery, dental, obstetrics.

||Other transportation: taxis, light medical vehicles, personal vehicles.

Supplementary Table 4

Detailed Cost (€ 2020) Description According to Cost Component, Patients With HFRI, and Control Group the Second Year After HFRI (continued)

	HFRI Group		Control Group		Δ Cost (HFRI- Control)	P
	Frequency	Cost	Frequency	Cost		
	Mean [95% CI]	Mean [95% CI]	Mean [95% CI]	Mean [95% CI]		
Hospitalizations	1.35 [1.15–1.68]	3754 [3325–4265]	1.19 [0.98–1.58]	2588 [2392–2823]	1166	<.001
Medicine, surgery, obstetrics	1.05 [0.88–1.36]	3057 [2694–3484]	1.07 [0.85–1.46]	2255 [2083–2472]	801	<.001
Home care service	0.06 [0.03–0.12]	152 [79–333]	0.02 [0.01–0.03]	76 [43–162]	76	.005
Rehabilitation care	0.25 [0.17–0.38]	358 [241–532]	0.11 [0.08–0.14]	135 [104–171]	223	.012
Other inpatient care*	-	188 [115–348]	-	121 [98–168]	66	.004
Consultations	8.98 [8.46–9.55]	283 [266–301]	9.82 [9.56–10.1]	289 [280–298]	-6	.046
General practitioner	7.89 [7.44–8.39]	229 [213–244]	8.19 [7.97–8.42]	208 [202–215]	20	.283
Specialist	1.09 [0.93–1.42]	32 [27–40]	1.63 [1.53–1.75]	47 [44–52]	-16	<.001
Other consultations†	-	23 [21–25]	-	33 [32–35]	-10	<.001
Paramedical acts	92.04 [83.9–101.82]	1781 [1597–2011]	69.01 [64.53–73.56]	1385 [1274–1510]	396	<.001
Nurse	63.55 [55.26–72.27]	1242 [1067–1451]	51.92 [48.17–56.28]	1052 [952–1161]	190	<.001
Physiotherapist	27.83 [24.99–30.92]	515 [461–576]	16.42 [15.21–17.79]	308 [283–335]	207	<.001
Other paramedical acts‡	-	24 [16–38]	-	25 [19–34]	-1	.941
Medical acts	7.79 [7.19–8.44]	225 [204–252]	9.23 [8.89–9.59]	284 [271–302]	-59	<.001
Laboratory tests	5.63 [5.15–6.18]	108 [99–120]	6.16 [5.88–6.47]	114 [109–120]	-6	.013
Imaging acts	1 [0.9–1.11]	46 [41–52]	1.37 [1.3–1.43]	62 [59–66]	-16	<.001
Other medical acts§	-	72 [60–92]	-	108 [98–123]	-37	<.001
Medical devices	6.27 [5.66–6.92]	416 [361–496]	5.69 [5.38–6.01]	392 [359–432]	24	.126
Medications	56.58 [54.28–59.01]	737 [661–855]	64.44 [63.06–65.82]	758 [719–806]	-21	.05
Transportation	2.78 [2.51–3.16]	392 [319–530]	2.01 [1.83–2.23]	233 [196–304]	158	<.001
Ambulance	1.97 [1.74–2.27]	304 [234–439]	1.01 [0.91–1.2]	139 [111–214]	164	<.001
Other transportation	-	88 [64–148]	-	94 [77–126]	-6	.333
Global	-	7588 [7017–8343]	-	5929 [5622–6279]	1659	<.001

P value from Mann-Whitney-Wilcoxon test. P value associated with the cost comparison.

*Other inpatient care: hospital-reserved drugs, hospital outpatient department, dialysis.

†Other consultations: teleconsultations, mark-up, flat-rate participation.

‡Other paramedical acts: pedicure-podiatrist, speech therapists, orthoptists, midwives, thermal baths.

§Other medical acts: anesthesia, surgery, dental, obstetrics.

||Other transportation: taxis, light medical vehicles, personal vehicles.

Supplementary Table 5

Cox Regression Models on Survival at 2 years

Variable	Modality	Model 1			Model 2		
		HR	95% CI	P	HR	95% CI	P
HFRI	Control	1			1		
	HFRI	2.14	[1.9–2.41]	<.001	2.54	[2.03–3.18]	<.001
Sex	Men	1			1		
	Women	0.69	[0.6–0.78]	<.001	0.76	[0.64–0.91]	.002
Age	75; 85	1			1		
	86; 90	1.67	[1.39–2]	<.001	1.67	[1.4–2]	<.001
	91; +	3.15	[2.67–3.71]	<.001	3.15	[2.68–3.72]	<.001
CCI	0	1			1		
	1	2.19	[1.84–2.6]	<.001	2.19	[1.85–2.61]	<.001
	2	4.07	[3.45–4.81]	<.001	4.05	[3.43–4.78]	<.001
Sex × HFRI				0.79	[0.61–1.02]	.076	

Model 1: Without the interaction between sex and HFRI; Model 2: With the interaction between sex and HFRI.