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RESEARCH ARTICLE

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## Annual Cost of Patients with Osteoarthritis of the Hip and Knee in France

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### ABSTRACT

**Objectives:** The economic burden of osteoarthritis [OA] has not recently been evaluated in France. This study aimed to provide a health economic update of the patient costs associated with hip or knee OA treated in the community and in medical, surgical and obstetric care [MSO] and post-acute care and rehabilitation [PAC] hospitals in France.

**Methods:** We analyzed data from the Disease Analyzer<sup>®</sup> database of medical records collected by a representative sample of French general practitioners in 2009–2010 and from the French medical information system program for public and private hospitals in 2010.

**Results:** In 2010, 90 946 patients were hospitalized in MSOs for hip OA [median age: 75 years] and 84 848 patients for knee OA [median age: 71 years], of whom 44% and 61%, respectively, were transferred to PACs. Up to 94.5% of patients underwent joint replacement. Hospitalization engendered annual costs of €9797 per patient with hip OA and €11 644 per patient with knee OA, that is, a total cost of €1.955 billion for patients hospitalized for hip or knee OA in 2010. A total of 18 976 community patients [mean age: 66 ± 12.7 years] with OA were followed up for 1 year in the Disease Analyzer<sup>®</sup> database. The annual costs per patient were €715 and €764 for hip and knee OA, respectively, including a cost to the healthcare system of €425 and €454, respectively, that is, an estimated €3.5 billion [€2 billion to the healthcare system] for 4.6 million patients.

**Conclusion:** Patients with OA generate considerable healthcare costs in France.

**KEYWORDS:** Costs and cost analysis, healthcare costs, osteoarthritis

### INTRODUCTION

Osteoarthritis [OA] is the most common joint disorder worldwide (1), with 9.6% of men and 18.0% of women over the age of 60 years exhibiting symptoms (2) and the leading cause of disability in the elderly (3). In France, in the 1990s, 6 million new patients were diagnosed with OA each year (4). This degenerative joint disease is associated with pain and reduced quality of life: 80% of patients with OA will experience limitations in movement and 25% cannot perform their usual daily activities (2).

A recent study of 24 682 French adults on the respective contribution of chronic conditions to disability reports that musculoskeletal impairment contributed most to self-reported disability (5).

Although the exact cause of OA remains unknown, increased mechanical stress, ligament changes, cartilage destruction, subchondral bone changes and muscular impairment are involved in the development of OA in weight-bearing joints (3). The management of OA is determined by consensus and universally applicable guidelines (6,7).

However, it is symptomatic only and focuses on pain and disability reduction. In cases of bone destruction, surgery can allow hip or knee joint replacement. Based on a recent study in the age group of 40- to 75-year-old people (8), the prevalence of knee OA was estimated to be 6.6% for females and 4.7% for males and 2.5% and 1.9%, respectively, for hip OA. Although the number of patients with other types of OA is substantially higher, OA of the hip or knee causes the greatest disability (9). In addition, prosthetic replacements are essentially offered for OA of the hip or knee; in France, about 360 000 people aged >75 years are living with a replacement hip [8% of the population] and 140 000 with a replacement knee [3% of the population] (10). It is for this reason that this study focuses on OA of the hip and knee in assessing hospital costs.

Patients with OA are at higher risk of death than the general population (11). This excess mortality is related mainly to the presence of walking disability and a more frequent history of diabetes, cancer or cardiovascular disease (11), suggesting the importance of co-morbidities in OA patients.

As age and obesity are important risk factors for OA (12), in conjunction with the absence of structural treatment in OA, the incidence of the disease is increasing rapidly due to demographic changes, resulting in a growing burden on primary and secondary care. In France, the annual cost was ~€1.8 billion in 2003 (13), representing an increase of >80%, that is, 8% per year, since 1993 (4). Much of this cost was borne by the French healthcare system, which enables all individuals living in France to benefit from basic insurance providing wide access to healthcare and covering ~75% of the costs. For long-term residents with the lowest incomes, the universal health insurance [CMU, “couverture maladie universelle”] covers 100% of the costs.

To update health economic data and evaluate the current economic burden of patients with OA in France, we estimated the total cost and the cost to the healthcare system of patients with hip or knee OA treated in the community and in medical, surgical, obstetric, post-acute care and rehabilitation hospitals.

## PATIENTS AND METHODS

### Study design

This was a retrospective analysis of data extracted from two databases:

- The “Disease Analyzer™” database [IMS Health, Puteaux, France] is a database of longitudinal

electronic medical records [EMRs] collected since 2000 for about 5 million patients visiting a nationally representative panel of 1200 French general practitioners [GPs]. Anonymous data are collected continuously via medical software, allowing longitudinal follow-up of all the visits of any given patient consulting the same GP in the panel. The data collected include administrative, demographic, anthropometric, clinical, laboratory and therapeutic information. The validity and representativeness of this database have been demonstrated by comparison with other administrative data (14).

- The PMSI: French Medical Information System Program [Programme Médicalisé des Systèmes d’Information] in medical, surgical and obstetric [MSO] and post-acute care and functional rehabilitation [PAC] units, covering short- and medium-term stays, respectively, in all private and public hospitals (15). The PMSI is a comprehensive and sustainable French hospital-based database that has been developed for budgeting purposes (16–18). Data extraction from the Diagnosis Related Group [DRG] database of public and private institutions involved in public service has the advantage of providing incontrovertible administrative data. In particular, the usability of PMSI data has greatly improved since the introduction of chaining through an anonymous national single patient identifier that enables the care pathway of a single patient to be followed, even across several different hospital facilities, whether private or public.

The following data were collected: demographics, clinical, treatment and, for inpatients, average length of stay, conditions of admission and discharge for MSOs and type of stay. The proportion of patients who were referred to a PAC after their hospital stay in an MSO was evaluated by linking the PAC and MSO databases using the patient’s anonymous number.

In terms of ethical approval, these databases are established in accordance with ethical, regulatory and legal requirements. As this was a retrospective analysis considering anonymous data, no other approval was necessary.

### Patients

#### Community patients

This analysis included data from the medical records of patients diagnosed with OA of the hip [hip OA, M16 according to ICD10 (19)], of the knee [knee OA, M17] or other OA [polyosteoarthritis, M15; OA of the first metacarpal joint, M18; Other OA, M19; Spondylosis, M47] between April 2009 and March 2010 and who undertook a visit during the following 6 months. Patients diagnosed with OA

at several different locations during the observation year were classified as having polyosteoarthritis, especially those with both hip and knee OA. Patients were followed up for 12 months.

#### *Inpatients*

Patients diagnosed with hip OA [M16] or knee OA [M17] [primary or associated diagnosis] who were hospitalized in MSO and/or PAC units in 2010 were selected from the PMSI database.

#### Cost analysis

##### *Community patients*

For each patient, the first time that the diagnosis was mentioned during the study period constituted the start date of the observation year during which the cost was calculated [reference date]. The economic analysis was performed from both a societal and a healthcare system perspective. The calculation included all the medical costs of the study patients, including GP visits and drugs prescribed, regardless of the condition treated. In this study, the costs corresponding to “Diagnostic agents” and “Various” [respectively, T and V classes, according to the European Pharmaceutical Marketing Research Association, EphMRA (20)] were not considered. From the societal perspective, the cost of drugs prescribed by their international nonproprietary name was calculated from the average public price of the corresponding generic medicinal product at the time of prescription. VAT was included in the calculation to be consistent with inpatient cost estimates. From the healthcare perspective, the French national healthcare reimbursement rates were applied to these prices. The cost of the doctor’s consultation was evaluated using the current basic fee for a medical consultation by a GP (€23) from the societal perspective, whereas a 70% reimbursement rate was applied from the healthcare perspective.

#### *Inpatients*

Economic analysis focused on patients with hip or knee OA as the primary diagnosis. The average cost of patients hospitalized for OA in 2010 was estimated separately for patients with OA of the hip and those with OA of the knee. In order to avoid any overestimation or underestimation that might be linked to environmental parameters or other factors, the PMSI data for 2009 were also analyzed. The protocol stipulated that, if the results were similar, only the most recent data [2010] were to be used. The estimated cost was calculated on the basis

of the most recent national cost scale [available on the ATIH website (21)] – which includes VAT – for all patients treated in MSO units. For patients treated for OA in PAC units, as the specific national cost scale had not been updated since 2003, the evaluation was based on the Activity Valuation Index [IVA, Index de Valorisation de l’activité], a health economic indicator used to evaluate the activity by day of presence. This index has been designed to provide a cost estimate of the medical care afforded to hospitalized patients. It attributes a reference cost to the various types of medical care received by patients during their stay, as reported in their standardized weekly summary [RHS, “Résumé Hebdomadaire Standardisé”]. The IVA index is the result of a multivariate analysis, taking into account the patient’s age, homogenous disease group [HDG], cognitive and physical dependence score, etc. In 2009, the national value of an IVA point was €0.1536 (22).

#### Subgroup analysis

For community patients, the costs of drugs and consultations were distinguished according to the patients’ age at the reference date for the start of study, based on the following classes: <50 years, between 50 and 65 years and >65 years as well as on the OA location. The cost of pharmacological treatments prescribed was also detailed according to the following classes: slow-acting antirheumatic drugs [SAARDs] [EphMRA class: M05X], including conventional SAARDs and glucosamine; nonsteroidal anti-inflammatory drugs [NSAIDs] [EphMRA class: M01A]; nonopioid analgesics [EphMRA class: N02B]; proton pump inhibitors [PPIs] [EphMRA class: A02B2], with or without NSAIDs; other drug prescriptions.

## RESULTS

#### Population description

##### *Community patients*

The medical records of 18 976 patients with OA and a follow-up of at least 12 months were collected. Only 4.6% of the population presented with “OA of the hip” [M16], 17.7% with “OA of the knee” [M17] and 77.7% with “other OA”. More than half of the patients were aged >65 years at the beginning of the follow-up; patients older than 65 years were more frequently in the hip OA group than in the “other OA” group [56.9% versus 52.7%; Table 1].

TABLE 1. Distribution of patients with OA by age and type of OA.

	Gender	Age (years)	Community patients n (%)	MSO patients n (%)	PAC patients n (%)
OA of the hip			878	90 946	45 622
	Missing data		3	–	–
	Male	<50	49 (5.6)	2829 (3.1)	793 (1.7)
		50–65	149 (17.0)	13 926 (15.3)	3935 (8.6)
		>65	210 (23.9)	23 440 (25.8)	10 589 (23.2)
	Female	<50	33 (3.8)	1846 (2.0)	646 (1.5)
		50–65	146 (16.6)	12 420 (13.7)	4888 (10.7)
		>65	288 (32.8)	36 485 (40.1)	24 771 (54.3)
OA of the knee			3351	84 848	59 632
	Missing data		6	–	–
	Male	<50	123 (3.7)	2404 (2.8)	648 (1.1)
		50–65	525 (15.7)	10 834 (12.8)	5216 (8.7)
		>65	666 (19.9)	18 914 (22.3)	13 407 (22.5)
	Female	<50	166 (4.9)	1780 (2.1)	668 (1.1)
		50–65	762 (22.7)	14 651 (17.3)	9126 (15.3)
		>65	1103 (32.9)	36 265 (42.7)	30 567 (51.3)
Other OA			14 747	–	–
	Missing data		35	–	–
	Male	<50	603 (4.1)	–	–
		50–65	1726 (11.7)	–	–
		>65	2472 (16.8)	–	–
	Female	<50	1137 (7.7)	–	–
		50–65	3488 (23.7)	–	–
		>65	5286 (35.8)	–	–

### Inpatients

Only 3.4% of the 90 946 patients with hip OA and 3.0% of the 84 848 patients with knee OA were hospitalized twice in MSOs, and 0.2% and 0.1%, respectively, three or more times. Patients with OA of the hip were older [median age: 75 years] than patients with knee OA [median age: 71 years]. The gender bias in favor of female patients was greater in PACs than in MSOs [male/female sex ratio: 0.52 versus 0.80 for OA of the hip, and 0.48 versus 0.61 for OA of the knee, respectively]. The median length of stay in MSOs was 8 d. In PACs, the median length of stay was 22 and 24 d for patients with hip OA and knee OA, respectively. Most patients hospitalized in MSOs came from their own home [99.5%]. During their stay, 94.5% of patients underwent surgery for either hip or knee joint replacement. According to discharge codes, after their stay in an MSO, 40.8% of the patients with hip OA and 56.4% of those with knee OA were transferred to other medical units [PACs in 85% of cases for both hip and knee OA], whereas the others returned home. Linking of the MSO and PAC databases showed that 44 and 61% of patients with hip or knee OA, respectively, actually went to PAC. In PAC units, the type of stay mostly involved inpatient post-acute care [56%] for OA of the hip,

whereas it was mostly inpatient functional rehabilitation [52%] for OA of the knee.

### Cost analysis

#### Community patients

The estimated cost of a patient with OA treated by a GP was calculated as €755/year, with almost 60% [€447] funded by the healthcare system [Table 2]. The estimated annual cost of a patient with hip OA was lower, both on the societal [€715] and on the healthcare [€425] levels, than the cost of patients experiencing knee OA [€764 and €454, respectively] or other OA [€756 and €447, respectively]. Eighty percent of the societal cost was accounted for by drugs and 20% by consultations [Table 2]. From the healthcare perspective, the greater impact of consultations [24%] resulted from a higher rate of reimbursement for consultations than the estimated reimbursement rate for drugs. The analysis of costs by age group [Table 2] showed that the estimated annual treatment costs for a patient with OA increased with age, both for society and for the healthcare system. Furthermore, the impact of drug costs also increased with age, regardless of the type of OA diagnosed.

Analyzing the annual cost of drugs according to therapeutic classes showed that “other drug” costs



TABLE 2. Relative contribution of the cost of drugs and consultations to the estimated annual cost of management of OA patients by GPs, depending on the patient's age and localization of OA, to society and the national healthcare system.

Cost (€)	n	Society					Healthcare system				
		Consultations		Drugs		Total	Consultations		Drugs		Total
		Cost	Percent	Cost	Percent		Cost	Percent	Cost	Percent	
By diagnosis											
Other osteoarthritis	14 747	153.9	20.3	602.2	79.7	756.0	107.7	24.1	339.5	75.9	447.2
Hip osteoarthritis	878	139.3	19.5	575.4	80.5	714.7	97.5	22.9	327.9	77.1	425.3
Knee osteoarthritis	3351	150.7	19.7	613.1	80.3	763.8	105.5	23.2	348.9	76.8	454.3
By age group (years)											
<50	2119	140.0	31.2	309.5	68.8	449.6	98.0	37.3	165.0	62.7	263.0
50–65	6811	149.4	22.2	524.1	77.8	673.5	104.6	26.4	291.4	73.6	396.0
>65	10 046	157.5	18.0	718.2	82.0	875.6	110.2	21.1	411.1	78.9	521.3
Total	18 976	152.6	20.2	602.9	79.8	755.5	106.8	23.9	340.6	76.1	447.5

accounted for >76% of all costs, implying that “OA-related” drug prescriptions represented 24% of the total costs [Table 3]. This observation was true for all OA locations [hip, knee, other]. Among the “other drug” prescriptions, cholesterol- and triglyceride-regulating preparations [EphMRA class: C10A] and angiotensin-II antagonists, combinations [EphMRA class: C09D] represented the highest costs [about 9.5% and 5.0%, respectively]. Prescriptions of SAARDs accounted for the greatest proportion of OA-related drug costs [8% of total costs]. From a healthcare perspective, the highest pharmaceutical cost related to OA treatment was due to PPIs [9% of the total drug costs], whereas SAARDs, which benefited from a lower reimbursement rate, accounted for only 4% of total drug costs.

Finally, the distribution of drug costs according to age shows that the older the patient, the greater the weight of the prescription of “other drugs” [80% for patients aged >65 years versus 66% for patients aged <50 years], from both societal and healthcare perspectives. A sensitivity analysis was performed, taking into account only the treatments prescribed in the arthritis management setting. The total cost directly related to OA was €300 from a societal perspective and €182 from the healthcare perspective [Table 4].

#### Inpatients

The total estimated annual cost of a patient with OA of the hip receiving hospital-based management [MSOs and PACs in 44% of cases] was estimated to be €9800 [€7065 + [0.44 × €6208]], whereas the figure for a patient with OA of the knee was higher, €11 640 [€7700 + [0.61 × €6,465]; Table 5]. For all patients with hip OA hospitalized in 2010, the total estimated annual cost was €921 million

and reached €1.034 billion for all patients hospitalized for knee OA.

### DISCUSSION

In France, the cost of a patient with OA has been evaluated by measuring the cost of inpatient and outpatient management for both hip and knee OA. In 2010, 90 946 patients were hospitalized in MSOs for hip OA and 84 848 patients for knee OA, of whom, respectively 44% and 61% were transferred to PACs. This engendered annual costs of €9800 per patient with hip OA and €11 640 per patient with knee OA. The same analysis was performed for patients hospitalized in 2009, and yielded results in line with 2010 data [data not shown]. For patients managed by GPs and experiencing less severe or advanced OA than hospitalized patients, the costs were €715 and €764 for hip and knee OA, respectively, including a cost to the healthcare system of €425 and €454, respectively. The lower cost of GP treatment for patients with hip OA, despite their older age compared with patients with knee OA or other types of OA, could be explained by the fact that only GP prescriptions were included and that hip OA was more likely to be managed by rheumatologists or hospital physicians. Given that OA was reported to affect about 9–10 million patients in France, including 4.6 million with symptoms, in 2001 (23), the global cost of outpatient management of OA could be estimated to be €3.4 billion [estimated individual cost of €740 × 4.6 million], including €2 billion for the healthcare system [estimated individual cost of €440 × 4.6 million]. It should be noted that the figure of 4.6 million was used by the French COART® health economic study (23) and is likely to be an underestimate. However, we preferred this estimate of

TABLE 3. Distribution of the cost of drug prescriptions by therapeutic class, age and perspective (societal and healthcare system) of community patients.

Age (years)	Perspective	Total drug prescriptions		NSAIDs <sup>a</sup>		PPI <sup>b</sup>		of which PPI with NSAIDs		of which PPI alone		SAARDs <sup>c</sup>		of which conventional SAARDs		of which glucosamine		Non-opioid analgesics <sup>d</sup>		Other drug prescriptions	
		Cost	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
<50	societal	309.5	100.0	5.4	9.0	3.8	5.2	10.2	10.1	0.1	9.0	66.4									
	healthcare	165.0	100.0	6.1	11.0	4.7	6.3	5.9	5.8	0.0	10.4	66.7									
50–65	societal	524.1	100.0	3.6	8.9	3.3	5.6	10.3	10.3	0.0	5.9	71.3									
	healthcare	291.4	100.0	3.9	10.4	3.8	6.6	5.6	5.6	0.0	6.5	73.6									
>65	societal	718.2	100.0	2.0	7.4	1.8	5.6	6.7	6.7	0.0	4.8	79.1									
	healthcare	411.1	100.0	2.0	8.4	2.1	6.3	3.5	3.5	0.0	5.2	80.8									
Total	societal	602.9	100.0	2.7	7.9	2.4	5.6	8.1	8.0	0.0	5.4	75.9									
	healthcare	340.6	100.0	2.8	9.1	2.7	6.4	4.3	4.3	0.0	5.9	77.8									

<sup>a</sup>Nonsteroidal anti-inflammatory drugs (EphMRA class: M01A).

<sup>b</sup>Proton pump inhibitors (EphMRA class: A02B2).

<sup>c</sup>Slow-acting antirheumatic drugs (EphMRA class: M05X).

<sup>d</sup>EphMRA class: N02B

prevalence to the one published by Guillemin et al. (8), who assessed the prevalence of OA in subjects aged between 40 and 75 years. Indeed, in our study, the proportion of patients aged 75 years was high and in France in 2010 more than 5 million people were aged  $\geq 75$  years.

More specifically, according to the sensitivity analysis which included only the prescription of drugs related to OA management, the overall cost of outpatient management of OA could be estimated as €1.37 billion [estimated individual cost of €298  $\times$  4.6 million], including €0.8 billion for the healthcare system [estimated individual cost of €182  $\times$  4.6 million].

With regard to demographic data, our results were consistent with previously identified risk factors, such as age or sex (24). Indeed, in our study we showed that the prevalence of OA increased in subjects aged  $>65$  years [Table 1], in line with current epidemiologic evidence which shows a direct relationship between age and the frequency of OA (25). In terms of economic data, to our knowledge, no study evaluating the cost of OA patients in France has been published recently. The nearest available data come from the French COART<sup>®</sup> study (23), the objective of which was to evaluate the economic impact of OA on the healthcare system. This study showed that the direct costs of OA in 2002 exceeded €1.6 billion and contributed to about 1.7% of the expenses of the French health insurance system. However, this study focused exclusively on OA-related costs of care [GP, specialists, hospital and drug prescriptions]. In contrast, in our study of community patients, we evaluated the global cost of a patient with OA, including the management of co-morbidities. Consequently, the only relevant item for comparison would be potentially OA-related drug prescriptions by GPs, such as SAARDs, NSAIDs, PPIs and analgesics. However, as drug reimbursement rates have changed since 2002, a comparison of the burden of drug costs on the healthcare system between 2002 and 2010 would reflect both the changes in therapeutic management of the disease and the change in reimbursement rates for the various drugs. According to a study by INSEE [the French National Institute of Statistics and Economic Studies] (26), whereas the costs of hospital care, consultations and subsidized drugs increased overall between 2000 and 2010 by 66%, 71% and 75%, respectively, drug costs specifically related to arthritis decreased markedly [–61%], which could be explained by the use of generic drugs, decreased drug prices and the withdrawal of reimbursement. On the other hand, the costs of

TABLE 4. Direct drug and consultation costs to society and the healthcare system related to the management of OA only.

Cost (€)	By age group (years)	n	Society				Healthcare system					
			Consultations		Drugs		Total	Consultations		Drugs		Total
			Cost	Percent	Cost	Percent	Cost	Cost	Percent	Cost	Percent	Cost
<50		2119	140	57.4	104.0	42.6	244.0	98	64.1	54.9	35.9	152.9
50–65		6811	149.4	49.8	150.4	50.2	299.8	104.6	57.6	76.9	42.4	181.5
>65		10 046	157.5	52.0	145.3	48.0	302.8	110.2	58.3	78.9	41.7	189.1
Total		18 976	152.6	51.2	145.3	48.8	297.9	106.8	58.5	75.6	41.5	182.4

TABLE 5. Cost of management of a patient hospitalized in MSO or PAC in 2010 according to the localization of OA.

Annual cost by OA localization		MSO	PAC
Hip OA	n	90 329	45 539
Cost per patient	Mean ± SD	€7065 ± 1751	€6208 ± 5561
	Median	€6796	€4847
	[min–max]	[€626 – €42 377]	[€90 – €99 098]
Total cost (all patients)		€638 144 332	€282 706 112
Knee OA	n	84 362	59 469
Cost per patient	Mean ± SD	€7700 ± 2557	€6465 ± 5475
	Median	€8258	€5139
	[min–max]	[€626 – €42 377]	[€94 – €129 410]
Total cost (all patients)		€649 555 509	€384 467 085

hospital care and consultations related to OA increased [41% and 55%, respectively, for a comparable population size]. In particular, the costs related to hospitalization for OA have increased considerably, from €260 million in 1993 (4), to >€800 million in 2002 (23) and €1.955 billion for patients hospitalized for hip or knee OA in 2010. These rocketing costs might be explained in part by a growing number of hospitalizations for joint replacement surgery and PAC stays related to demographic changes, such as the aging of the population, associated with an increased incidence of vulnerability, poverty and dependency over the last decade. The exponential rise in OA hospitalization costs can also be explained by the medical progress achieved in surgery and analgesia, which allows joint replacements to be performed in older patients, leading to more frequent and longer PAC stays and increased morbidity-related costs. Further comparisons of these estimated costs with estimates from other studies or countries are difficult to perform. Indeed, according to Xie et al. (27), substantial variations in costs of OA across studies and countries may be due to differences in study design or in demographics. In order to allow international comparisons, standardization of data collection and longitudinal studies of the cost of OA would be required. However, a trend to an

increased prevalence of joint arthroplasty and, hence, increased costs has been observed elsewhere in Europe, as shown in Italy by Piscitelli et al. (28), who estimated that the costs of total joint arthroplasty performed for symptomatic hip and knee OA increased by 46% over the period 2001–2005. Likewise, in the UK, Chen et al. (29) observed a 66% increase in the costs of total joint arthroplasty over the period 2000–2010.

In France, the cost of care for patients with OA, probably underestimated in our evaluation in 2010, is about 2–3% of the total cost of management of all diseases for the healthcare system (30). Two-thirds of the costs result from hospitalization for hip or knee surgery, involving ~200 000 patients [as confirmed by the number of replacement hips and knees sold in France] out of 4.6 million subjects with OA. As a consequence, <5% of patients accounted for nearly two-thirds of the expenses. The need to provide care to just over one in two patients after surgery consumes a third of the hospital's budget. Follow-up care is often necessary because subjects undergoing hip or knee surgery are usually old and cannot return home because they have little or no autonomy.

Due to its design, the main limitation of this study relates to the fact that it was not possible to link outpatient and inpatient care. For instance,

the costs of outpatient care of hospitalized patients after their discharge have not been considered. However, importantly, our study took into account all co-morbidities of patients, whether treated in hospitals or in the community, in the calculation of costs and not just OA-related costs. We adopted this strategy because, for a large proportion of drug prescriptions for community patients, the only information provided by the GP was “prescription renewal”. Therefore, to have considered only prescriptions and visits specifically related to OA would have led to a significant underestimation. Thus, the evaluated cost was the annual cost of treatment of a patient with OA and not the cost of OA treatment. The relevance of our choice to determine a global cost is confirmed by studies showing that inadequate adjustment for co-morbid conditions can modify the size of OA attributable costs (31,32). A small discrepancy was observed between the percentage of patients reported as being discharged to a PAC after their stay in an MSO and the percentage of patients actually hospitalized in PAC. Our cost analysis was based on the slightly higher actual percentage determined by database linking. Finally, this work is not a cost-effectiveness study and, as such, its goal was not to assess the most relevant management from an economic point of view, nor to judge the effectiveness of outpatient drug treatment prescribed by doctors. The objective was to describe the economic burden of OA, deliberately adopting conservative assumptions [taking into account only the cost of knee and hip OA in the hospital and GP outpatient setting].

It should be mentioned that the estimated cost of patients with OA for society is likely to be underestimated for several reasons. First, our study of inpatients focused on two main OA diagnoses – hip and knee – and did not estimate the cost of patients with OA affecting other joints. Second, osteoarthritic patients treated as outpatients by rheumatologists or orthopedic surgeons have not been considered. Moreover, visits to physiotherapists or rehabilitation specialists were not taken into account, which may also lead to an underestimation of the cost of OA patients. Furthermore, the cost of drugs for community patients is also underestimated. Indeed, even though most of the drugs in the classes studied have a corresponding generic product, nongeneric medicinal products are likely to have been prescribed. Finally, this study did not account for indirect costs incurred by OA: time lost from employment and leisure, unpaid informal caregivers, etc. It has been shown previously that a lack of assessment of indirect costs, such as

productivity loss, leads to significant underestimation of the actual burden of OA (33). Furthermore, the estimated cost to the French healthcare system is also likely to be underestimated, as our evaluation did not take into account patients who were partially exempt from co-payment. Indeed, OA does not belong to the list of chronic diseases that are recognized by the French healthcare system as long-term diseases. However, considering the population studied and its average age, it is likely that a not inconsiderable proportion of these patients were in fact exempt from co-payment.

Partly because of the lack of nonsurgical therapeutic options, total hip or knee replacements and follow-up care and rehabilitation engender considerable healthcare expenditure, OA is likely to lead to a growing socioeconomic and individual burden with the aging population and the rise of obesity, hence the absolute necessity for therapeutic education in the treatment of OA [reduction of risk factors such as being overweight, maintenance of suitable physical activity (34), equipment, etc.]. A recently published Italian study (35) showed the economic relevance of performing surgery early in the progression of hip OA in younger subjects, who tolerate surgery best, while having a positive impact on quality of life issues. As Lévy et al. (4) wrote as long as 20 years ago: “novel treatments capable of substantially reducing [OA-related] costs would be of great value”.

#### ACKNOWLEDGEMENTS

We are grateful to Françoise Nourrit and Marielle Romet, Santé Active Edition and David P. Figgitt PhD, Content Ed Net, for medical writing assistance.

#### DECLARATION OF INTEREST

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this article.

This study and medical writing assistance was funded by Pierre Fabre Laboratories.

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