

# Direct and indirect costs of osteoarthritis of the knee

G. Leardini<sup>1</sup>, F. Salaffi<sup>2</sup>, R. Caporali<sup>3</sup>, B. Canesi<sup>4</sup>, L. Rovati<sup>5</sup>, R. Montanelli<sup>6</sup>,  
and the Italian Group for Study of the Costs of Arthritis (GISCA)

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<sup>1</sup>Division of Rheumatology, Venice; <sup>2</sup>Department of Rheumatology, University of Ancona;  
<sup>3</sup>Chair of Rheumatology, IRCCS Policlinico S. Matteo, Pavia; <sup>4</sup>Division of Rheumatology,  
Ca' Granda Niguarda Hospital, Milan; <sup>5</sup>Department of Clinical Pharmacology, Rotta Research  
Laboratorium S.p.A., Monza (MI); <sup>6</sup>CeRGAS, Bocconi University of Milan, Milan, Italy.

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## Abstract

### Background

Rheumatic diseases have an economic impact of 1–2.5% of GDP in industrialized countries and osteoarthritis is the most common joint disorder. Osteoarthritis of the knee is especially common and is a major cause of disability requiring extensive utilization of health care resources.

### Objective

To estimate the burden of osteoarthritis of the knee in Italy, we studied retrospectively a cohort of 254 patients over a period of 12 months in 2000–2001.

### Methods

Twenty-nine rheumatology institutes took part in the study. A bottom-up approach was used, analytically measuring pro capita consumption. We considered medical (hospitalization, diagnosis, and therapies) and non-medical costs (transport, temporary caregivers, and auxiliary devices) as direct costs. We calculated losses of productivity borne by patients and caregivers, and informal care provided by caregivers as indirect costs.

### Results

Direct costs came to € 934 per patient per year: € 233 were spent on hospitalization, € 209 on diagnostic procedures (56% on visits and 44% on instrumental and laboratory tests), € 146 on therapy (58% on physiotherapy and 42% on drugs), and € 346 on non-medical costs (73% on salaries to temporary caregivers, 14% on transport, and 13% on auxiliary devices). It is interesting to point out that at least 37% of costs were charged directly to patients. Indirect costs were almost 30% higher and came to € 1236 per patient per year: 31% was due to loss of productivity of patients, 60% due to informal care provided by primary caregivers, and 9% by other caregivers.

### Conclusions

This study confirms that the direct and indirect costs attributable to osteoarthritis of the knee are substantial.

### Key words

Osteoarthritis of the knee, economic impact.

Please address correspondence and reprint requests to: Gianni Leardini, MD, Division of Rheumatology, Castello 6777, 30100 Venice, Italy.

E-mail: gianni.lear dini@ulss12.ve.it

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## Introduction

Rheumatic diseases have a considerable economic impact in industrialized countries, varying from 1 to 2.5% of gross domestic product (GDP) with reference to local situations and to changes of costs of illness (COI) resulting from evolution of social policies (1-4). Osteoarthritis (OA) is a major cause of musculoskeletal pain and is the single most important cause of disability and handicap in western industrialized countries. It is an important community healthcare burden in lost time at work and early retirement with significant health and welfare costs (5-8). The knee joint is a common site of OA (9, 10), and OA of the knee has been identified as one of the five diseases responsible for the greatest proportion of physical disability in non-institutionalized elderly men and women (11).

The high economic burden of arthritis is a result of both direct and indirect costs. Indirect costs represent lost resources, including the value of productivity lost to the disease. Direct costs are those for which payments are made, the bulk of which are medical expenditures. Many authors have studied the direct costs of OA and calculated different amounts depending on patients' age, reference years and localization of articular damage (12-14). Moreover, the size and the distribution of the sample can modify the final results, since measures of costs are not usually normally distributed (15). The indirect costs, resulting from loss of labor productivity, have been studied less frequently and there is no agreement on their full amount: in the United States they would be almost the same as direct costs, while in Europe they are only half the direct costs (16).

In Italy only the medical costs (hospitalizations, diagnostics, and out-patient treatments) have been analyzed and, although they have been calculated by different methods, the results are similar (about € 500 per patient per year) (17-19). We do not have any data on the indirect and the intangible costs of OA. This study was undertaken to calculate current direct and indirect costs of symptomatic OA of the knee in a large national population.

## Materials and methods

The study was retrospective, covering the 12-month period 2000-2001, and carried out on patients suffering from painful OA of the knee. The diagnosis of OA was made according to the American College of Rheumatology (ACR) criteria (20). We based our classification of knee radiographs on the standard Kellgren and Lawrence (K/L) criteria (21) (Grade 0, absence of any sign of radiological OA (ROA); Grade 1, doubtful narrowing of joint space and possible osteophytic lipping; Grade 2, definite osteophytes and possible narrowing of joint space; Grade 3, moderate multiple osteophytes, definite narrowing of joint space, and some sclerosis and possible deformity of bone ends; Grade 4, large osteophytes, marked narrowing of joint space, severe sclerosis, and definite deformity of bone ends. ROA is defined as a score higher than 2, and severe ROA as a score higher than 3 in the left and/or right joint. Radiographs used in this study were generally obtained within 1 year from the date of the clinical assessment for all patient. To be eligible, all patients had to be symptomatic; we decided to include only patients requiring medication to control their pain (either non-steroidal anti-inflammatory drugs (NSAID) or pure analgesic or both). The knee designated as the "study joint" was the primary source of pain or disability in the lower extremity. Exclusion criteria were as follows: concurrent systemic inflammatory rheumatic disease, medical comorbidity that would render the patient unable to participate fully in study procedures (e.g. terminal conditions such as end-stage renal disease, heart failure, or malignancy), alcohol abuse or a psychiatric disorder, previous or planned knee arthroplasty of the study joint.

Twenty-nine rheumatology institutes, forming the Italian Group of Study of the Costs of Arthritis (GISCA) and representative of the whole country, took part in the multicenter study: 15 in the north, 7 in the center, and 7 in the south of Italy. Every institute involved two general practitioners (GPs): they enrolled consecutive patients, 5 at most, in the period from October 2000 to March

2001. The characteristics of the study, the data collection system and the ACR criteria for the diagnosis of knee OA were explained to the GPs by a rheumatologist. All centers had approval from their respective ethics committees. The GPs were not rheumatologists and had to possess the patients' records, computerized if possible, so that information about tests and therapies prescribed within the last 12 months could be obtained; all this information was also available for the specialists. A total of 254 patients were enrolled and the following data collected: socio-demographic and clinical features (sex, age, school attendance, severity of the articular damage categorized according to K/L radiological classification, and comorbidity). The measurement of the costs was carried out according to a bottom-up technique, collecting all the data from each patient. All patients provided informed consent.

Data collection was carried out by the rheumatologist, to whom each patient was sent by the GP. The rheumatologist validated the diagnosis and collected data using both the GP files and the specially prepared questionnaire.

#### *Direct costs*

Direct costs were calculated by identifying, measuring, and appraising the medical and non-medical resources absorbed by the patients. Among medical costs we took into account hospitalizations, visits by the GPs and to the specialists, instrumental and laboratory tests, medical and physical therapies. Non-medical costs were equivalent to the costs borne by the patient because of OA (transport, temporary caregivers, and auxiliary devices). Appraising direct costs, each day hospital (DH) admission was estimated at €199.87 per day, equivalent to the refund paid by Lombardy Region for diseases belonging to the major disease category, "Diseases of the Musculoskeletal System and Connective Tissue", ICD-9-CM (22). In-patient care was evaluated at €211.75 per day or €438.99 per day in the medical and surgical areas, respectively, as a result of sampling in the rheumatologic and orthopedic depart-

ments. To value in-patient care in rehabilitative departments, we appraised a cost of €237.05 per day, according to the National List of Rates (Tariffario Nazionale—D.M. 30 giugno 1997). Specialists' visits, instrumental and laboratory tests, and physiotherapy given within the Italian National Health Service (SSN) were evaluated according to the List of Rates of Specialist Services (Nomenclature Tariffario delle Prestazioni Specialistiche – D.M. 22 luglio 1996) (23). GPs' visits were evaluated at €5.94 each, resulting from the ratio between the expenditure reported by the Ministry of Health for GP payments and the number of the GP visits estimated by the Italian Federation of General Practitioners (FIM-MG). The same services given in private were calculated as referred from the patients. The costs of drugs were calculated on the basis of the fixed prices in the Italian List of Drugs (Informatore Farmaceutico 2000) (24). Other items forming direct costs were calculated as charged to the patients.

#### *Indirect costs*

Indirect costs were measured and appraised according to the impact of OA on the economic activity and leisure time of the patients and their caregivers. In particular, we took into account the production losses due to change of work, working days lost, permanent reduction or loss of working activity and informal care provided by caregivers. Losses borne by working people, appraised using the human capital approach (15), were measured in terms of salary evaluation (including the tax burden charged to employers) with the assumption that income reflects productivity. The average annual costs of work in different sectors of activity were estimated according to the data from the National Statistics Institute (ISTAT) (25,26). On this basis, we calculated daily costs varying from €88 for a farmer to €161 for a medical doctor. Loss of work by housewives was measured and evaluated using the replacement cost approach (15). Housewives' services were estimated on the basis of their corresponding value in the market, that is €47 per day,

equivalent to the income of a housemaid, according to the National Agreement for Home Labor Service. Production losses due to permanent loss of working activity were considered only if they occurred during the 12 months under observation and to people of legal age. The same method was applied to estimate the monetary value for informal care provided by caregivers during leisure time (27-29). An hourly wage of €6.20, equivalent to the wage of a daily help, was used to quantify direct care (cleaning, preparation of meals, etc.) and an hourly wage of €3.46, equivalent to the wage of a housemaid, was used to appraise supervision by a caregiver.

#### *Statistical analysis*

Statistical analysis was performed using the statistical package, SPSS 9.0.1 for Windows. We calculated descriptive analysis, analysis of variance (ANOVA) to compare the quantitative variables among the groups of patients categorized by K/L radiological classification, and Spearman's rank test to study the correlation between ordinal variables.

#### **Results**

The cohort of 254 patients, 192 females and 62 males, had a mean age 65.8 years (range 38–89 years); the most frequent age class was from 60 to 79 years (66%). Three-quarters of the patients were housewives (42.1%) or work pensioners (35.4%), while only 21.3% were still at work. Mean duration of OA was 8.6 years (range 0–57 years) and more than a half the patients (54.7%) were suffering from another disease, mostly cardiovascular (29.9%) and metabolic (13.4%) disorders. OA was localized only in the knee in 21.4% of cases; it was oligoarticular (2–4 joints) in 63.3% of cases and it was polyarticular in all other patients (15.4%). The majority of the patients (83.9%) presented primary OA, affecting the medial compartment of the right knee. Evaluating radiological severity according to the K/L scale, we categorized 23 patients in grade 1 (9.1%), 84 (33.1%) in grade 2, 120 (47.2%) in grade 3, and 27 (10.6%) in grade 4. As expected, the

**Table I.** Direct and indirect costs of OA of the knee (€ per patient per year)

			%	Mean	95% CI
Medical costs	Hospitalization	Routine	63	233	95–371
		Day Hospital	10		
		Rehabilitation	27		
	Diagnosis	Visits	56	209	191–228
		Instrumental diagnostics	44		
	Therapy	Drugs	42	146	118–172
Physiotherapy		58			
Non-medical costs		Transport	13	346	210–482
		Auxiliary devices	14		
		Temporary caregiver	73		
<b>Total direct costs</b>				<b>934</b>	<b>723–1145</b>
Patient	Loss of productivity	Working days lost	89	382	228–536
		Other losses	11		
Primary caregiver	Loss of productivity	Working days lost	5	740	390–1091
		Other losses	4		
		Informal care	91		
Other caregivers (informal care)			114	44 - 184	
<b>Total indirect costs</b>				<b>1236</b>	<b>830–1643</b>
<b>Social costs</b>				<b>2170</b>	<b>1694–2647</b>

severity of structural damage was correlated with the age of the patients and the duration of the disease.

*Direct costs*

Table I shows the means and 95% confidence intervals (CI) of the medical costs, categorized in macro classes: hospitalization, diagnosis, therapy, and non-medical costs. The percent incidence of the items forming each macroclass is also given. The mean direct cost of OA of the knee was € 934 per patient per year, with 95% CI varying from €723 to € 1145.

Hospitalization was the first medical cost and absorbed 25% of resources, although it was necessary in only few cases (10 surgical admissions, 8 medical admissions, 2 rehabilitative admission and 5 DH admissions). The direct costs for these patients were six times higher than for outpatients.

Costs for diagnostics were € 209 per patient per year: visits formed 56% of the total, while instrumental and laboratory tests formed the remaining 44%. Every patient went to their GP on average 4.6 times a year, spending € 52. Seventy-five percent of the patients went

to specialists, on average 2.4 visits a year, spending € 66; most visits were to rheumatology (45%) and orthopedic (42%) specialists. Almost all patients (98%) had at least one instrumental test during the period of observation, on average 1.8 tests a year, spending little more than €73 per patient.

Costs for therapy were the cheapest at € 144 per patient per year: 42% was invested in drugs and 58% in physiotherapy. About 88% of the sample were taking drugs for OA, spending about € 61 per patient. Ninety-six percent of the patients taking drugs used NSAIDs; these drugs were the first expenditure among the costs for therapy (€ 53 per patient per year). Only 70% of the packets of NSAIDs purchased were actually used. Analgesics were used by 10% of the patients; almost all the packets purchased were used, a spending of less than € 3 per patient per year. About € 18 were invested in chondroprotective drugs, which were taken by 13% of the patients for a period of 53 days. Fifty-six percent of the patients resorted to physiotherapy, with an average 13 sessions per patient at a cost of € 84 per year.

Among non-medical costs, temporary caregivers paid by the patients were the highest expenditure at 37% of the direct costs, even if the users were only 14% of the cohort. Auxiliary devices were bought by 12% of the patients and while the annual cost per patient was only € 44, the cost per user was € 362.

*Indirect costs*

Indirect costs came to € 1236 per patient per year with 95% CI varying from € 830 to € 1643 (Table I). About 22% of the patients lost working days and 2% had to change employment; nobody lost working activity within the period of observation, so no cost came from this item, even if throughout the disease 2.4% of the patients had ceased to work due to OA of the knee. Overall OA caused a loss of productivity of € 382 per patient per year (50% of working day losses). The patients losing working days due to the disease lost on average 25 days in the previous 12 months. Seventeen patients had one caregiver at least: in 75% of cases the caregiver was a relative and more frequently (73%) the caregiver was female. The mean age of the caregivers was 50

years, in comparison with that of the patients (66 years), and often they had received secondary school education. Loss of productivity borne by the caregivers came to about € 70, mainly coming from working day losses (€ 39). Informal care provided by caregivers was the first indirect cost, representing 63% of these costs, and came to € 671 per patient per year. It was the result of 2.6 h daily provided by caregivers: 1.1 h in direct care and 1.5 h in supervision. Evaluating the distribution of caregivers according to the severity of OA, we observed that the percentage of patients receiving care increased from 9% to 37% passing from the 1st to the 4th grade according to K/L radiological classification. Nineteen (7.5%) patients used another caregiver, mostly he was a son and on average he provided 5.1 h a week of informal care, losing productivity equivalent to € 114 per patient per year. Indirect costs consisted of losses of € 379 due to working days lost, €72 due to changes of work, and €785 due to informal care.

#### Social costs and their distribution

The total amount of the social costs of our sample including direct and indirect costs came to more than €553,000 with a cost of €2170 per patient per year and a 95% CI varying from € 1694 to €2647; 57% was indirect costs. Looking at the distribution of social costs, this proved to be very asymmetric and that can explain why just 10% of the more expensive patients absorbed more than 50% of resources, while 50% of the less expensive patients absorbed less than 5% of resources (Fig.1). Moreover, social costs varied as a consequence of severity of the disease measured according to K/L radiological classification and increased linearly from €1393 per patient per year in the 1st grade to €3784 per patient per year in the 4th grade (Table II). Evaluating social costs as a function of socio-demographic and clinical features of the patients, we obtained interesting information about sex, age class, and comorbidity (Table III). Females (€ 2332 per patient per year) absorbed more resources than males (€ 1699 per patient per year), both as regards direct costs and loss of

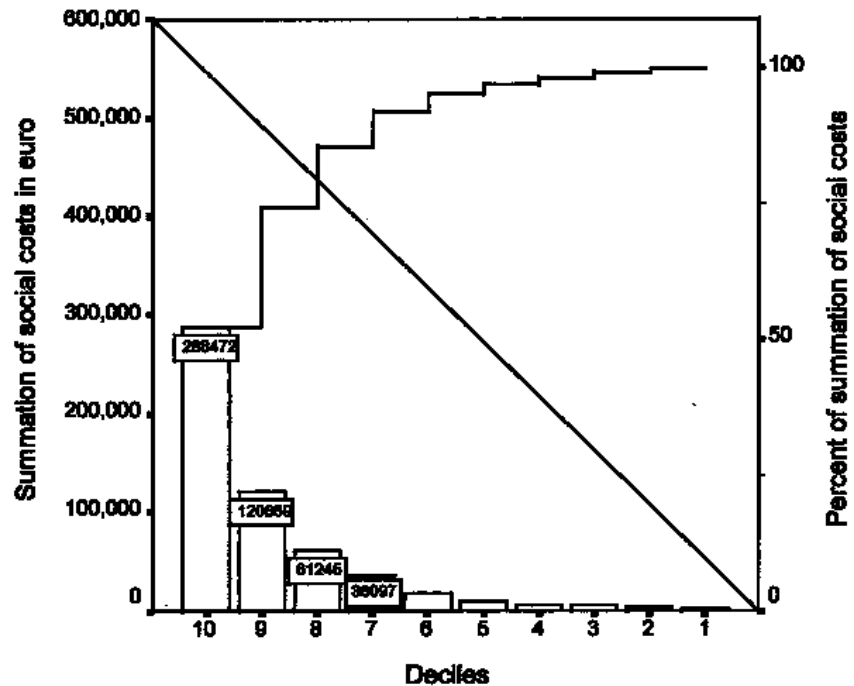


Fig. 1. Distribution of social costs.

productivity, even if they were mainly housewives who did not stay away from work. Social costs as a function of patients' age class presented a peak of expenditure from 38 to 49 years (€ 2788 per patient per year), which reflected both direct and indirect costs; in the following decade, social costs reduced (€1774 per patient per year) and they then increased linearly according to age. Finally, patients presenting comorbidity (€2566 per patient per year) had higher costs than those suffering from OA of the knee alone (€ 1692 per patient per year); that was the result of doubled direct costs and of indirect costs increased by one-third.

#### Discussion

##### Direct costs

Direct costs consisting of medical and non-medical costs, came to € 934 per patient per year in our study, a value not matched in former Italian studies. On the contrary, the medical costs are comparable (€ 589 per patient per year). This value is higher than that formerly calculated as a result of different periods of observation, different measurement techniques and, most of all, different features of the samples. Contrary to the other studies carried out on

people with polyarticular OA, our patients were suffering from OA of the knee which, together with OA of the hip, is the most disabling form of the disease (10-12). In addition, the medical costs of OA of the knee estimated by Mazzucca in the United States were much higher, referring to 1996; but the value of € 1600 per patient per year could be explained by the fact that this cohort was formed by patients affected by a long lasting disease (6). Lanes (14) obtained results similar to ours; he calculated medical costs of € 580 per patient per year and, like us, considered hospitalization the most expensive item. That is shared by MacLean (12), who considered that hospitalization was two-third of the medical costs, even though in a sample of people over 65.

In our study, hospitalization formed 40% of the medical costs and it is interesting to observe that among different admissions, those in rehabilitative care were the most expensive (€ 7925 per user per year equivalent to € 62 per patient per year) due to a stay in hospital prolonged up to 50 days in patients operated for arthroprosthesis. As in other studies, diagnostics was the second item among medical costs. As much as 44% of the expenditure for diagnostics

**Table II.** Social costs according to Kellgren-Lawrence criteria (€ per patient per year).

	Hospitalization	Diagnosis	Therapy	Non-medical costs	Direct costs	Loss of labor product	Informal care	Indirect costs	Social costs
Grade 1: doubtful narrowing of joint space and possible osteophytes	111	183	104	224	622	626	144	771	1393
Grade 2: definite osteophytes and possible narrowing of joint space	216	199	129	481	1025	412	501	913	1938
Grade 3: moderate multiple osteophytes, definite narrowing of joint space, and some sclerosis and possible deformity of bone ends	270	207	137	207	821	411	887	1298	2119
Grade 4: large osteophytes, marked narrowing of joint space, severe sclerosis, and definite deformity of bone ends	225	274	268	651	1418	608	1758	2366	3784
Mean costs	253	209	146	346	934	451	785	1236	2170

**Table III.** Costs according to socio-demographic and clinical features (€ per patient year).

	Direct costs (mean of sample € 934)	Indirect costs (mean of sample € 1236)	Social costs (mean of sample € 2170)
Sex			
Males	655	1044	1699
Females	1024	1298	2322
Age classes (years)			
38–49	768	2020	2788
50–59	575	1199	1774
60–69	1021	1138	2159
70–79	1044	1241	2285
80–89	1358	1119	2477
Comorbidity			
No	621	1071	1692
Yes	1193	1373	2566

was invested in instrumental tests and in particular this is mostly due to frequent use of MRI (25% of cases). This expenditure is probably not justified, as MRI is not a diagnostic criterion according to ACR. With respect to visits, the first expenditure was due to requests for specialists' visits, even if GPs' visits were more frequent; on this basis, from the perspective of economizing on costs, it could be desirable to allot the management of the patients affected by OA to GPs. Therapy was the cheapest item among direct costs: 58% was allocated to physiotherapy and 42% to drugs. As regards the drugs prescribed and taken, NSAIDs were the

first choice for relieving pain in Italy; chondroprotective drugs were the second choice, while analgesics played a marginal role. Guidelines in the treatment of OA for control of pain, as well as for the method of administration of chondroprotective drugs, were not considered as these drugs were given only for a period of 53 days (30-34). Our study was the first to estimate non-medical costs by the bottom-up technique, using an instrument that provides quality of data at the expense of ease of calculation. Therefore it becomes very important that non-medical costs represented 37% of direct costs and that they were borne by a small share of the pa-

tients. These patients, paying by themselves, de facto bore most of the social costs of OA.

*Indirect costs*

Indirect costs, evaluated at € 1236 per patient per year in our study, were higher than the direct costs; this disagrees with the results of Levy in France, but it is in agreement with the data appraised by authors from the United States (8,9,35). However, losses caused by the disease were high and mainly due to the informal care provided by caregivers. Undoubtedly, that was the first item of expenditure at more than 50% of the indirect costs and by themselves about one-third of the social costs. Taking into account that informal care was provided by relatives in the majority of cases, it is plain that OA is a disease that incurs costs not only to patients and society, but also, and most of all, to families. Another important item was working day losses caused by the disease; our study confirms data reported from other studies that estimated rheumatic diseases as the first cause of temporary disability (36). Evaluating this fact according to the geographic distribution of the patients, we observed that day working loss was more frequent in the areas where the patients had difficulty in accessing health services as well as places of work.

### Social costs

Social costs of OA of the knee came to € 2170 per patient per year and varied according to severity of the disease and socio-demographic and clinical features of the patients.

According to worsening of the disease, categorized on the basis of K/L radiological classification, the social costs increased mainly due to the changes of indirect costs, which increased linearly. On the contrary, the trend of direct costs fell slightly in the 3rd grade of K/L radiological classification due to the reduction in non-medical costs, which are borne by the patient. At this stage of the disease, the patient was suffering from a severe, but not at all disabling disease, so that he demanded, through hospitalization, the greatest medical care from SSN. When we evaluated the social costs according to age classes, the indirect costs were the first cause of the peak observed from 38 to 49 years, the period of life when people are most busy and fruitful and the risk of losing productivity is highest.

The estimated incremental costs of illness can be biased by including or excluding comorbid conditions (37). Several studies, using data from the National Health Interview Survey Supplement on Aging (38-40) and Longitudinal Supplement on Aging (41), the Framingham Study (11), the Ontario Health Survey (42), and the Women's Health and Aging Study (43) have demonstrated the role of comorbidity in the relationship between OA and physical disability.

In this field, two studies estimated the cost without controlling for comorbid conditions. Gabriel (15) estimated that the annual cost of treating OA patients was approximately 1.92 times the annual cost of treating non-OA patients using 1987 data from Olmsted County, Minnesota. MacLean (12) estimated that OA patients cost approximately 2.15 times more annually than non-OA patient in 1993 using managed care claims data. In contrast, Fishman (44) estimated the cost of arthritis in a model that controlled for all comorbid conditions, including gastrointestinal disease, which is related to the cost of

OA (45). As predicted, they found a smaller annual cost for arthritis. Specifically, they estimated that arthritis patients costs about 1.50 times more annually than non-arthritis patients using 1992 managed care data. The results of our work suggest that comorbidity was very expensive, mainly as a result of the doubling of direct costs following higher demand for medical care.

We are aware of some limitations of this study. First, this is a cohort study, and the weight and the amount of different costs could vary in other cohorts. Secondly, the criteria used for valorization of cost are mostly subjective and country-specific, so that comparison with data from other countries may be difficult. Moreover, the estimated cost presented here incorporates possible limitations (i.e. erroneously classifying conditions as unrelated to the disease of interest, medical and epidemiological data not clearly defined, etc.).

However, we can assert that the burden of OA of the knee is very big, especially given the high prevalence of the disease. Dimensions of COI are the result of both high direct and indirect costs, so that strategies to limit expenditure are dependent on the point of view of the payers (46).

From the point of view of SSN, which is concerned about reducing medical costs, the policy should aim to reduce hospitalization and reorganize therapeutic plans to provide tested and efficacious cures. From the point of view of society, which has a wider outlook taking into account the impact of the disease on the working world, the policy should aim to limit loss of productivity that would increase according to worsening of articular damage.

From the point of view of patients, who pay non-medical costs and bear a large share of COI, it could be important to rely on an organization to provide voluntary informal care, so that relatives could be free from the duty of giving care.

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### Appendix: Members of the Italian Group of Study of the Costs of Arthritis (GISCA)

The list of other GISCA investigators, in alphabetical order, is as follows:

Bianchi G. (U.O. di Reumatologia, Ospedale La Colletta di Arenano - GE), Bucci R. (U.O. di Reumatologia, OO. RR. Azienda Mista Ospedale Università di Foggia), Cimmino MA. (DIMI, Università di Genova), Ciocci A. (Casa di cura "Villa Domelia", U.O. di Reumatologia, Roma), Colombo F. (U.O. di Reumatologia, Ospedale Niguarda di Milano), Fioravanti A. (Cattedra di reumatologia, Università di Siena), Franceschini M. (U.O. di Reumatologia, OCR di Venezia), Frizziero L. (U.O. di Reumatologia, Ospedale Maggiore, Bologna), Fumagalli M. (Servizio di Reumatologia, ICT-CTO, Milano), Grattagliano V. (Cattedra e Divisione di Reumatologia, Azienda Ospedaliera Policlinico di Bari), Macchioni P.I. (U.O. di Reumatologia, Ospedale S.M. Nuova, Reggio Emilia), Magarò M. (Istituto di Medicina Interna e Geriatria, Policlinico Gemelli, Università di Roma), Mannoni A. (U.O. di Reumatologia, Azienda Sanitaria di Firenze), Mascia M.T. (Cattedra di reumatologica, Policlinico di Modena), Minisola G. (U.O. di Reumatologia, Ospedale San Camillo di Roma), Modena V. (U.O. di Reumatologia, Azienda Ospedaliera S. Giovanni Battista di Torino), Muratore M. (U.O. di Reumatologia, Ospedale G. Cascione, Lecce), Nervetti A. (U.O. di Reumatologia, Ospedale, Azienda di Parma), Olivieri I. (U.O. di Reumatologia, Ospedale S. Carlo, Potenza), Paresce E. (Cattedra di Reumatologia, Ospedale G.Pini, Milano), Perotti L. (U.O. di Medicina, Ospedale S. Croce, Cuneo), Perpignano G. (I Cattedra di Reumatologia, Policlinico Universitario, Cagliari), Rossi S. (IRCCS Policlinico S. Matteo, Cattedra di Reumatologia, Università di Pavia), Sabadini L. (Servizio di Reumatologia, Azienda (2) USL 8, Arezzo), Sarzi Puttini P. (U.O. di Reumatologia, Ospedale Sacco, Milano), Schiavon F. (Cattedra e Divisione di Reumatologia, Università di Padova), Spanò A. (Cattedra e Divisione di Reumatologia, Università Federico II di Napoli), Stancati A. (Clinica Reu-

matologica, Università di Ancona), Tirri G. (Cattedra di Reumatologia, II Università degli Studi di Napoli).

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