

Estimating medical costs of work-related diseases in the Basque Country (2008)

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KEY WORDS

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SUMMARY

Objectives: To estimate the medical costs of work-attributable diseases (WAD) treated by the public health care system for one of the Spanish Autonomous Communities, the Basque Country, in 2008. **Methods:** We calculated the burden of disease attributable to work for each category of diseases according to ICD-9-CM by using estimates of attributable fractions. Hospital and specialized outpatient care cost data were derived from the Spanish National Health System analytical accountability system. Secondary sources of information were used to estimate primary health care and drug prescriptions. **Results:** Direct costs of work-attributable diseases borne by the Basque Regional Health Service totalled 106 million Euros in 2008, representing 3.3% of Basque public expenditures on health and 0.16% of Basque GDP in 2008. Specialized care, including hospitalizations, absorbed the highest proportion of costs (52%), followed by drug prescriptions and primary health care (27% and 21%, respectively). Diseases of the musculoskeletal system and connective tissues accounted for 47.3% of total costs, followed by cardiovascular diseases (19.6%) and cancer (15%). **Conclusions:** Occupational diseases and accidents are costly in the Basque Region of Spain, generating a severe deviation of public expenditures and overburdening of the Public Health System because they should really be the responsibility of the Social Security System. Proper identification and assignment of costs of work-related diseases would result in significant savings for the National Health System (Spanish and European), would provide an incentive for the prevention of these avoidable causes of illness and thus contribute to the sustainability of social systems.

RIASSUNTO

«Costi medici delle malattie attribuibili al lavoro nei Paesi Baschi (2008)». **Obiettivi:** Stimare i costi sanitari diretti delle malattie attribuibili al lavoro nei Paesi Baschi nel 2008. **Metodi:** Abbiamo calcolato le malattie attribuibili al lavoro per ciascuna categoria di malattie secondo ICD-9-CM e le frazioni attribuibili al lavoro nella let-

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teratura scientifica. I dati primari derivanti dal sistema di contabilità analitica del Servizio Sanitario Nazionale spagnolo sono stati usati per calcolare i costi relativi ai ricoveri e alle prestazioni ospedaliere. Fonti secondarie di informazione sono state utilizzate per stimare il costo dell'assistenza sanitaria primaria e le prescrizioni farmaceutiche. Risultati: I costi sanitari diretti delle malattie lavoro-correlate nel Servizio Sanitario Basco sono stati 106 milioni di euro nel 2008. Essi rappresentavano il 3,3% della spesa pubblica basca in materia di sanità e lo 0,16% del PIL nel 2008. L'assistenza specializzata, tra cui i ricoveri, assorbe la più alta percentuale dei costi (52%), seguita dalle prescrizioni di farmaci e dell'assistenza sanitaria di base (27% e 21%, rispettivamente). Le malattie del sistema muscolo-scheletrico e dei tessuti connettivi rappresentano il 47,3% dei costi totali, seguite dalle malattie cardiovascolari (19,6%) e dai tumori (15%). Conclusioni: Le malattie lavoro-correlate nei Paesi Baschi sono costose e rappresentano un importante aggravio per la spesa pubblica e per il Servizio Sanitario Nazionale, anche perché questa spesa dovrebbe essere più correttamente attribuita al Sistema di Previdenza Sociale. La corretta identificazione e assegnazione dei costi delle malattie lavoro-correlate può tradursi in un notevole risparmio per il Sistema Sanitario, e può costituire un incentivo per la prevenzione delle malattie lavoro-correlate e perciò una maggiore sostenibilità dei sistemi sociali.

INTRODUCTION

Working conditions have a great impact on people's health. However, despite the overwhelming scientific evidence of the burden of disease attributable to employment and working conditions (4, 8, 14, 15, 20-23, 33), the current workplace-oriented system of prevention is mainly focused on traumatic events and neglects occupational diseases (12).

Under-reporting of occupational diseases (OD) is frequent in Spain and elsewhere (3, 11) and undermines efforts to promote disease prevention and provide adequate health care coverage. In Spain, there are specific consequences of the failure to identify illnesses as work-related in terms of employment benefits. Pharmacological treatment is covered 100% for professional diseases, unlike common illnesses, for which patients have a co-pay. Paid sick leave is 75% of the base salary and is provided from the first day of missed work if an illness is recognized as professional, whereas it is reduced to 60% and only starts on the fourth day of missed work for non-occupational illnesses. From a macro-financial perspective, proper recording and notification of occupational diseases is also important for the National Health System (NHS). Costs of occupational diseases should be funded by social contributions from employers and employees and thus be borne by the Social Security system rather than by

the National Health System, which is tax-financed (12). Underreporting of occupational diseases results in medical and drug treatment of occupational illnesses under the National Health System without any financial compensation. This problem is acute at present due to the financial crisis in Spain and throughout Europe. Public sectors in all European nations, and particularly in Spain, are heavily cutting resources devoted to social welfare policies – including health care – in order to deal with general budget deficits. As a consequence, the debate on sustainability of the Spanish NHS has intensified (7). Thus, the proper delimitation of financial responsibility between the Social Security system (including Work Accidents and Occupational Diseases Insurance Institutes) and the National Health System is a highly relevant issue.

Only two studies have attempted to estimate the economic impact of work-attributable diseases (WAD) in Spain (5, 9). The first study, conducted by the European Agency for Safety and Health at Work, consisted of a survey made among the Member States of the European Union in which the Spanish authorities reported that total costs of occupational accidents and diseases were slightly less than 3% of GNP (5). Direct costs of occupational accidents and diseases were estimated by analyzing the social security accounts, and included costs of disability, health care/drugs and survivors'

pensions. Indirect costs were assessed by estimating data of working days lost as a result of occupational accidents and diseases. However, the methodology used to develop this estimate was not detailed. The second study estimated total costs only for cancer, cardiovascular, respiratory and nervous system WADs. Medical care data were based on a U.S. study instead of Spanish data sources, and estimated total costs came to 4.7% of GDP (9, 17).

The aim of our study was to estimate the burden of diseases attributable to work, as well as their medical costs in the Public Health Service of the Basque Region (SVS-O), one of the 17 Spanish Autonomous Communities, in 2008. This paper reports the results divided according to large groups of diseases (International Classification of Diseases, 9th Revision, Clinical Modification, ICD-9-CM).

METHODS

The number of WADs was based on the estimates of the fractions of common diseases attributable to workplace factors in previous studies in in-

dustrialized countries. Table 1 provides a matrix of disease categories, attributable fractions (AF), and relevant sex and age ranges. These data were combined with health care and associated costs data obtained from the different health care levels in the SVS-O. We used an AF prevalence approach to estimate the overall burden.

The AF were drawn for most ICD-9 disease and injury categories from Nurminen and Karjalainen (2001) (23); for skin diseases from the Queensland Government (2010) (28); and for musculoskeletal and connective tissue diseases from Castejón in Spain (2002) (2), French Government (2005) (29), WHO (22) and Queensland Government (2010).

Public medical costs were estimated by using both primary and secondary sources of information. Hospital and specialized outpatient care cost data were obtained directly from the NHS statistical information system. Since primary data were not available for primary health care and drug prescriptions, estimates from another nearby Spanish region – Catalonia – were used to estimate these costs (27).

Table 1 - Matrix of disease, ICD-9 codes, attributable fractions due to work (AF) from different studies and age range used for each fraction

ICD-9	Diagnosis	Nurminen et al., Finland, 2001		France 2005, 2008		Castejón Spain, 2006		Queensland Australia, 2010		W.H.O. 2005, 2009, 2011	
		AF (%)	Age	AF (%)	Age	AF (%)	Age	AF (%)	Age	FA (%)	Age
001-139	Infectious diseases	8.8	25-64	-	-	3	16-65	-	-	-	-
140-208	Malignant neoplasms	8.4	≥ 25	-	-	-	-	11 Males 2 Females	-	-	-
290-319	Mental disorders	3.5	≥ 25	-	-	9.1	16-65	4	-	-	-
320-389	Nervous system diseases	3.1	≥ 25	-	-	3	16-65	-	-	-	-
390-459	Cardiovascular system diseases	12.4	25-74 ¹	-	-	-	-	-	-	-	-
460-519	Respiratory system diseases	4.1	≥ 25	-	-	-	-	-	-	-	-
520-579	Digestive system diseases	2.1	25-64	-	-	-	-	-	-	-	-
580-629	Genitourinary system diseases	1.3	≥ 25	-	-	-	-	-	-	-	-
680-709	Skin diseases	-	-	-	-	-	-	14	-	-	-
723-729 (except 725)	Musculoskeletal disorders	-	-	46 Males 31 Females	20-59	60.6	16-65	37	-	37	-
800-999	Accidents and violent incidents	3.1	15-61	-	-	9.1	16-65	-	-	8	-

¹ Work-related fraction changes by age: 12.4% of those aged 25 to 59 years; 12.4% x 0.75 of those aged 60 to 64 years; 12.4% x 0.5 of those aged 65 to 69 years; and 12.4% x 0.25 of those aged 70 to 74 years

Primary data were provided by the NHS Information System (<http://pestadistico.msc.es/PEMSC25/> and <https://repositorio.msc.es/risns>) through the Hospital Discharge Records (CMBD-H) (22) and the Specialized Outpatient Care Records (CMBD-AAE) (30). From the CMBD-H, we selected the discharges for individuals in the relevant age groups by disease categories (table 1). Undated discharges, duplicate records, and patients receiving care at hospitals without being admitted (same date of admission and discharge unless the latter was due to death, hospital transfer or voluntary discharge) were excluded.

Hospital care costs by disease category were calculated as the product of the number of hospital discharges and the average cost per hospitalization estimated on a representative sample of NHS hospitals for the corresponding year. Costs linked to specialized outpatient services were calculated by multiplying the number of clinical episodes recorded in the CMBD-AAE (undated examinations and duplicate records were excluded) by the unit cost. According to the Spanish Health Information Institute, unit cost for specialized outpatient services can be estimated at 75% of the 'Weighted Activity Unit' – in Spanish, UPA – (19), which represents the average cost per hospital day by disease category (1).

In order to estimate costs associated with primary health care and drug prescription, we used the

distribution of health care costs by ICD-9 disease and injury categories documented for the health care expenditures of Catalonia for the year 2008 by Pastor and Gisbert (27). Separate data were provided for specialized care (SC), primary care (PC) and pharmaceutical care (PhC). Public expenditure on specialized care included inpatient care and specialized outpatient services, while pharmaceutical treatment included expenditures on prescription drugs and expenditure for pharmaceutical treatment supplied by hospitals during outpatient care. We calculated the ratios of primary care and pharmaceutical care costs to specialized care costs.

RESULTS

The total number of hospital discharges for the relevant age groups and disease categories in the Basque Region during 2008 was 109,368. Of this total, 10,578 of patient hospitalizations (9.7%) were estimated to have been caused by diseases or injuries attributable to work (table 2). Musculoskeletal disorders, cardiovascular diseases and malignant neoplasms accounted for 80% of these hospitalizations. The specialized outpatient examinations for occupational diseases and injuries numbered 2,471 (6.7% of total number of examinations). Musculoskeletal disorders accounted for the greatest part of specialized outpatient care (45.6%),

Table 2 - Distribution of public health care budget across disease categories and types of service in Catalonia (2008, thousand euros) and cost factors (relative weights) for primary health care and drug prescriptions (PH).

	ICD-9	Specialized Attention	Primary Health Care (PC)	Pharmacy (PH)	Cost factor for PC	Cost factor for PH
I	Infectious diseases	48,462	51,817	108,603	1.069	2.241
II	Malignant neoplasms	488,882	17,745	255,409	0.036	0.522
V	Mental disorders	249,750	269,658	249,814	1.080	1.000
VI	Nervous system diseases	408,828	114,589	127,841	0.280	0.313
VII	Cardiovascular system diseases	556,396	183,153	393,416	0.329	0.707
VIII	Respiratory system diseases	351,402	176,849	167,270	0.503	0.476
IX	Digestive system diseases	355,528	84,183	99,006	0.237	0.278
X	Genitourinary system diseases	343,523	69,194	102,777	0.201	0.299
XII	Skin diseases	58,402	43,592	23,789	0.746	0.546
XIII	Musculoskeletal disorders	211,172	120,380	90,180	0.570	0.427
XVII	Accidents and violent incidents	434,235	78,698	99,346	0.181	0.229

Source: Modified from Pastor and Gisbert (2010)

followed by nervous system diseases (27.3%) and malignant neoplasms (10.4%). Table 3 shows public expenditures on hospitalization and specialized care for work-related diseases and accidents in the Basque Country in 2008.

Table 4 shows estimated total direct health costs borne by the Basque Health Service in 2008 due to WAD, including hospitalizations, specialized outpatient care, primary care, and drug treatment. The total amount was 106 million Euros. Specialized

Table 3 - Number of hospital discharges and specialized outpatient care attributable to occupational exposures per Group of diseases. Basque Country, 2008.

ICD-9	AF(%)	Hospital admissions		Specialized outpatient care		
		Total discharges	Work-attributable discharges	Total Examinations	Work-attributable examinations	
I	Infectious diseases	8.8	1,596	140	90	8
II	Malignant neoplasms	8.4	17,743	1,490	3,058	257
V	Mental disorders	3.5	4,438	155	202	7
VI	Nervous system diseases	3.1	4,302	133	21,728	674
VII	Cardiovascular system diseases	12.4	14,435	1,790	1,441	179
VIII	Respiratory system diseases	4.1	22,728	932	1,538	63
IX	Digestive system diseases	2.1	11,154	234	1,985	42
X	Genitourinary system diseases	1.3	10,409	135	3,032	39
XII	Skin diseases	14.0	1,029	144	412	58
XIII	Musculoskeletal disorders	37	14,027	5,190	3,046	1,127
XVII	Accidents and violent incidents	3.1	7,507	233	576	18
	Total		109,368	10,578	37,108	2,471

Source: Modified from National Health System Database, Institute of Sanitary Information, Ministry of Health, Social Policy and Equity [Access April 2011]. Available at: <http://repositorio.msc.es/risns/>

Table 4 - Cost of specialized outpatient care cases attributable to occupational exposure per group of disease (Euros). Basque Country, 2008

CIE-9	Work-attributable discharges (this study)	Cost per discharge	Hospital expenditure	Attributable specialized outpatient care (this study)	Cost UPA-PV 2008	Outpatients care expenditure	Total cost specialized care	
I	Infectious diseases	140	5,490.9	768,719.9	8	379.7	3,037.4	771,757.3
II	Malignant neoplasms	1,490	6,773.7	10,092,757.7	257	509.5	130,942.6	10,223,700.4
V	Mental disorders	155	4,333.2	671,653.8	7	238.4	1,668.8	673,322.5
VI	Nervous system diseases	133	3,996.1	531,479.5	674	436.2	293,999.1	825,478.6
VII	Cardiovascular system diseases	1,790	5,651.2	10,115,592.3	179	599.4	107,294.2	10,222,886.5
VIII	Respiratory system diseases	932	3,829.3	3,568,927.2	63	378.7	23,856.2	3,592,783.4
IX	Digestive system diseases	234	4,197.4	982,201.8	42	635.5	26,690.0	1,008,891.8
X	Genitourinary system diseases	135	3,609.8	487,327.0	39	494.9	19,301.9	506,628.9
XII	Skin diseases	144	3,721.5	535,890.5	58	432.4	25,079.7	560,970.1
XIII	Musculoskeletal disorders	5,190	4,708.0	24,434,438.6	1,127	625.4	704,870.4	25,139,309.1
XVII	Accidents and violent incidents	233	5,749.4	1,339,599.9	18	543.9	9,789.9	1,349,389.8

Source: Modified from National Health System Database, Institute of Sanitary Information, Ministry of Health, Social Policy and Equity [Access April 2011]. Available at: <http://repositorio.msc.es/risns/>

care (including hospitalizations and specialized outpatient care) represented the highest proportion of costs (52%), followed by drugs and primary health care (27% and 21%, respectively).

Diseases of the musculoskeletal system and connective tissue accounted for 50 million Euros, or nearly one-half (47.3%) of total costs. Disorders of the cervical region (ICD-9 723), other and unspecified disorders of the back (ICD-9 724), peripheral enthetic disorders and allied syndromes (ICD-9 726), other synovial, tendon and bursa disorders (ICD-9 727), muscle ligament and fascia disorders (ICD-9 728), and other soft tissue disorders (ICD-9 729) were included in this disease group. Of these, back pain was responsible for 38.6% of costs. For back pain, six times more funds were spent treating men than women. One-half of the estimated costs due to diseases of the musculoskeletal system (over 25 million Euros) were associated with specialized health care, while primary health care and drugs represented 28.5% and 21.5% of costs, respectively,

Diseases of the cardiovascular system accounted for approximately 21 million Euros (19.6% of total) of health care costs. Note that a decreasing proportion of cardiovascular system disorders were considered work-related with advancing age: 12.4% of those aged 25 to 59; 12.4% x 0.75 of those aged 60 to 64 years; 12.4% x 0.5 of those aged 65 to 69 years; and 12.4% x 0.25 of those aged 70 to 74

years. Ischaemic heart disease (ICD-9 410-414) accounted for 60.6% of the costs of cardiovascular diseases, and cerebro-vascular disease (ICD-9 430-438) accounted for an additional 33%. Specialized care represented 49% of total WAD-related costs. The remainder was distributed between drugs (35%) and primary care (16%).

We estimated that the costs due to occupational cancer in people aged over 25 years was 16 million Euros 2008. Malignant neoplasms had a high average cost per hospitalization (€6,772) (table 3). As a consequence, specialized care accounted for 64.2% of the cost. Drug costs were also significant (33.5%), while primary health care represented only 2.3%. In this disease group, cancer of the lung and bronchi - mainly among men - accounted for the highest proportion of cost (27%), followed by bladder cancer (12.6%), mesothelioma (8.6%), colon neoplasms (7.3%) and stomach cancer (6.7%). Malignant neoplasms accounted for 15% of direct costs of WADs borne by the Basque public health system.

Respiratory diseases attributed to work cost over 7 million Euros (6.7% of total) in 2008. This disease group included asthma (ICD-9 493), chronic obstructive pulmonary disease and allied conditions -COPD- (ICD-9 490-496) and pneumoconiosis (ICD-9 500-505). COPD accounted for 80.6% of the health care costs classified in this group.

Table 5 - Total direct costs from work-related diseases (Euros). Basque Country, 2008

ICD-9	Specialized care	Primary care	Pharmaceuticals	Total expenditure
I Infectious diseases	771,757.3	825,008.6	1,616,831.6	3,213,597.4
II Malignant neoplasms	10,223,700.4	368,053.2	5,336,771.6	15,928,525.2
V Mental disorders	673,322.5	727,188.4	673,322.5	2,073,833.5
VI Nervous system diseases	825,478.6	231,134.0	258,374.8	1,314,987.4
VII Cardiovascular system diseases	10,222,886.5	3,363,329.7	7,227,580.7	20,813,796.9
VIII Respiratory system diseases	3,592,783.4	1,807,170.0	1,710,164.9	7,110,118.3
IX Digestive system diseases	1,008,891.8	239,107.4	280,471.9	1,528,471.1
X Genitourinary system diseases	506,628.9	101,832.4	151,482.0	759,943.4
XII Skin diseases	560,970.1	418,483.7	228,314.9	1,207,768.7
XIII Musculoskeletal disorders	25,139,309.1	14,329,406.2	10,734,485.0	50,203,200.2
XVII Accidents and violent incidents	1,349,389.8	244,239.5	309,010.3	1,902,639.6
Total	54,875,118.4	22,654,953.0	28,526,810.2	106,056,881.6

Source: Modified from National Health System Database, Institute of Sanitary Information, Ministry of Health, Social Policy and Equity [Access April 2011]. Available at: <http://repositorio.msc.es/risns/> and Table 2

Table 2 shows the number of inpatient hospitalizations and specialized outpatient medical examinations for the other major disease groups, including infectious diseases, mental disorders, diseases of the nervous system, digestive system, genital-urinary system, and skin, and injuries and violent incidents, which together accounted for 11% of admissions attributable to work. It should be noted that mental disorders had the highest average duration of hospitalization (13.6 days), followed by infectious diseases, 10.8 days, although the process cost was smaller. Lastly, we noted the significant proportion that drug treatment represented in the total costs of treatment of infectious diseases (50.3%) and the equal distribution of costs across the three types of health care associated with mental disorders (table 4).

DISCUSSION

We estimated that medical costs of work-related diseases treated by the Basque Regional Health Service in 2008 were 106.1 million Euros. This sum represents 3.3% of Basque public expenditure on health (3,200 million Euros) and 0.16% of the Basque GDP (67,924.5 million Euros) in 2008.

Other national and international studies estimated the cost of accidents and diseases due to occupation (5,6,9,15,34). They concluded that cost of diseases attributable to work was significant, ranging from 1% to 4.7% of GDP. This range is considerably higher than the results of the current study. Our study was, in fact, a partial estimate of the costs of occupational diseases and accidents, because we included only direct costs, not indirect costs (i.e., wage loss, costs of lost services of ill or injured workers, etc.). A previous study that addressed direct health costs for occupational diseases in Spain (9), used data from a North American study (17), which showed average costs per patient that were much higher than those obtained in our study. However, due to important differences in the Spanish and U.S. health care systems, the differences in relative costs are likely to be quite substantial (12).

Two alternative methodological approaches may be used to compute direct costs of WAD: the

prevalence approach or incidence approach. The first approach measures the costs associated with diagnosis and treatment over a specified period of time, regardless of when they were diagnosed. Alternatively, the incidence approach includes only the new cases diagnosed during a specified time period, and estimates the future costs generated by such cases. The prevalence approach may overstate or understate the disease burden as it does not take account of time trends; it is merely a snapshot of a point in time. However, the incidence approach requires forecasting the future course, treatment and associated costs of disease and injury and therefore entails greater uncertainty. Most cost-of-illness studies (occupational or otherwise) chose the prevalence method, because it allows analysis of reliable and available data and requires fewer forecasting assumptions (13, 15, 16, 18, 24–26).

To our knowledge, this is the first study in Spain that uses data from analytical accounts of the National Health System and estimates the health care costs of diseases associated with work in the public health system. We analyzed only direct health care costs of diseases, but not their indirect costs which are linked to labour productivity losses caused by premature mortality and disability and temporary or permanent sick leave. Costs linked to expenses for non-health costs (paid and non-paid work of care providers) and those due to occupational accidents were not included either, which increase the global burden of disease and its associated costs. In addition, among the disease categories, we only included disease groups for which there is sufficient scientific evidence of an occupational origin. In conclusion, our estimates of global costs of occupationally related diseases for the national public health system are an underestimation.

There are several limitations in our study. First, we mainly used fractions of disease attributable to work that were developed in other countries. This limitation has been cited whenever extrapolating across national boundaries, as different countries show different exposure patterns (4, 8, 16, 21, 22). We attempted to minimize this problem by relying on AF estimates from Finland (23), Spain (2) and France (29).

Second, part of the costs associated with specialized outpatient care was excluded from our estimates of costs. While surgical treatment is completely included in available health data, only 46.7% of day-hospital care is officially recorded (19), ensuring an underestimate of costs for this item.

Third, we used secondary sources of information in order to calculate medical costs for primary health care and drugs, since primary data for these groups of expenditure are not available. Spanish studies usually combine primary and secondary databases as a consequence of this fact (24, 25). Particularly, we assume that expenditure distribution across disease groups and types of assistance in the Basque Country is the same as that in Catalonia, although some differences in treatment and cost patterns are expected between these two regions. These two areas of Spain are similar, so that the differences in costs are likely to be small. Unfortunately, the absence of accurate information in this area is not unique to Spain. For example, the Senate committee in charge of calculating the costs of WAD in France recognized in its report the lack of proper databases and highlighted the difficulty in obtaining reliable cost estimates (29).

As noted above, another limitation was that we did not estimate indirect costs, which were beyond the scope of our study. But direct medical costs, such as we have estimated, are less controversial than indirect costs (16). We believe our estimates of medical costs of the WAD in the public health system in Spain are unique in the literature. An advantage of our method is that estimates were derived from actual cost data and linear calculations, and that we attempted to be as transparent as possible. As a result, any estimate in our tables can be adjusted for a different region in Spain or for a different attributable fraction.

Important implications of our findings should be noted. Most of these costs were not likely to be borne by workers' compensation insurance institutes and enterprises responsible for occupational exposure leading to the disease. Many of these diseases do not manifest until retirement. As a result, most of these costs are shifted from the social security system to the public health system. Under

these conditions, enterprises responsible for the exposure do not pay for the true cost of such exposures. This cost shifting erroneously allocates costs and undermines incentives to prevent occupational diseases and accidents (12, 15, 16). In the United States, it has been proposed to tax the industries responsible for WADs as a way to reduce this 'negative externality' (16). Such action would provide an incentive to reduce workplace exposures and, at the same time, it would reduce the financial burden on the NHS. Other countries apply different policies. In France, the social security system covering occupational accidents and diseases has to transfer a certain amount to the health system every year in order to compensate the latter for all health expenditures that are not identified as due to occupational diseases and accidents. In 2008, the amount so transferred reached 410 million Euros (29). We propose that a similar policy be implemented in Spain.

For workers, there are specific consequences of the failure to identify diseases as work-related in terms of employment, social and health care benefits. Drug treatment is covered 100% for occupational diseases, unlike common illnesses, for which patients have to pay part of the cost. Paid sick leave is 75% of the base salary and is provided from the first day of missed work if a disease is recognized as occupational, whereas it is reduced to 60% and only starts on the fourth day of missed work for non-occupational diseases.

Although our estimates do not provide a complete picture of costs derived from WAD, they provide an ample basis to support public policies, in Spain and in other countries, that would take into account occupational risk prevention systems, research in occupational medicine, and sustainability of health and welfare systems.

For most Spanish Autonomous Communities, and for other European countries, the Public Health Service is the largest public enterprise, based on the number of workers and budget. Our findings show that the costs sustained by the Basque Country Health Service due to WAD represent 3.3% of public expenditure on health in the Region (106 million Euros). Occupational disease prevention policies can be extraordinarily prof-

itable, not only in gains in worker health and public health, but also in terms of public savings in health care expenditure.

NO POTENTIAL CONFLICT OF INTEREST RELEVANT TO THIS ARTICLE WAS REPORTED

REFERENCES

- Bestard, JJ, Sevilla F, Corella M, et al: La unidad ponderada asistencial (UPA): nueva herramienta para la presupuestación hospitalaria. *Gaceta Sanitaria* 1993; 39: 263-273
- Castejón J: *El papel de las condiciones de trabajo en la incapacidad temporal por enfermedad común y accidente no laboral*. Tesis doctoral. Barcelona: UAB, 2002
- Comisión Nacional de Seguridad y Salud en el Trabajo: *Enfermedades Profesionales*. Madrid: Comisión Nacional de Seguridad y Salud en el Trabajo, 1999
- Driscoll T, Takala J, Steenland K, et al: Review of estimates of the global burden of injury and illness due to occupational exposures. *Am J Ind Med* 2005; 48: 491-502
- European Agency for Safety and Health at Work: *Economic impact of occupational safety and health in the Member States of the European Union*. Bilbao: European Agency for Safety and Health at Work, 1997
- Eurostat: *Statistics in focus 63/2009*. Luxembourg: Publications Office of the European Union, 2009
- Federación de Asociaciones para la Defensa de la Sanidad Pública. (2011). La sostenibilidad del Sistema Nacional de Salud. Análisis de la situación y propuestas para asegurarla. Available on-line at: <http://www.fadsp.org/pdf/SostenSNS6.2011.doc> (last access 3-08-2011)
- Fingerhut M, Nelson DI, Driscoll T, et al: The contribution of occupational risks to the global burden of disease: summary and next steps. *Med Lav* 2006; 97: 313-321
- García AM, Gadea R, López V. (2007). Impacto de las enfermedades laborales en España. Instituto Sindical de Trabajo, Ambiente y Salud. Available on-line at: <http://www.istas.ccoo.es>. (last access 13-11-2011)
- García Gómez M, Castañeda López R: Enfermedades profesionales declaradas en hombres y mujeres en España en 2004. *Rev Esp Salud Pública* 2006; 80: 361-375
- García Gómez M, Castañeda López R: Desigualdades interterritoriales en la compensación de las enfermedades profesionales en España de 1990 a 2007. *Gac Sanit* 2009; 23: 373-379
- García Gómez M, Urbanos R, Castañeda R, et al. (2010). Coste sanitario del asma, cáncer de vejiga, túnel carpiano y otra patología osteoarticular atribuible al trabajo en España en 2008. Fundación Francisco Largo Caballero. UGT. Available on-line at: http://www.ugt.es/fflc/estudios/2011-06-14-EDT_costes_asociados.pdf (last access 21-06-2011)
- Gisbert R, Brosa M, Figueras M, et al: *El coste de la enfermedad en España: el coste de las enfermedades cardiovasculares*. Madrid: Merck & Co, Soikos, S.L. 1997
- Kraut A: Estimates of the extent of morbidity and mortality due to occupational diseases in Canada. *Am J Ind Med* 1994; 25: 267-278
- Leigh P, Markowitz S, Fahs M, et al: *Burden and Costs of Occupational Injuries and Diseases in the United States*. Michigan: University of Michigan Press, Ann Arbor, 2000
- Leigh JP, Yasmeeen S, Miller TR: Medical costs of fourteen occupational illnesses in the United States in 1999. *Scand J Work Environ Health* 2003; 29: 304-313
- Leigh JP, Robbins JA: Occupational disease and workers' compensation: coverage, costs and consequences. *Milbank Quarterly* 2004; 82: 689-721
- Lobo F, Oliva J, López Bastida J, et al: Costes no sanitarios ocasionados por las enfermedades isquémicas del corazón en España. *Cuadernos económicos de ICE* 2004; 67: 263-298
- Ministerio de Sanidad, Política Social e Igualdad. Instituto de Información Sanitaria. Estadística de establecimientos sanitarios con régimen de internado. Evolución 2000-2008. Available on-line at: <http://www.mspsi.gob.es/estadEstudios/estadisticas/estHospiInternado/inforAnual/homeESCRI.htm>. (last access 20-04-2011)
- Morrell S, Kerr C, Driscoll T, et al: Best estimate of the magnitude of mortality due to occupational exposure to hazardous substances. *Occup Environ Med* 1998; 55: 634-641
- Murray CJL, Lopez AD: *The global burden of disease*. Geneva: World Health Organization, 1996
- Nelson DI, Concha-Barrientos M, Driscoll T, et al: The global burden of selected occupational diseases and injury risks: Methodology and summary. *Am J Ind Med* 2005; 48: 400-418
- Nurminen M, Karjalainen A: Epidemiologic estimate of the proportion of fatalities related to occupational fraction in Finland. *Scand J Work, Environ Health* 2001; 27: 161-213
- Oliva J, Lobo F, Molina B, et al: Direct health care costs of diabetes patients in Spain. *Diabetes Care* 2004; 27: 2616-2621
- Oliva-Moreno J, et al: The Economic Costs of Anxiety in Spain. *Estudios de Economía Aplicada* 2006; 24: 821-836

26. Oliva J. Pérdidas laborales ocasionadas por las enfermedades y problemas de salud en España en el año 2005. Papeles de Trabajo del Instituto de Estudios Fiscales, 2010; 5/10
27. Pastor M, Gisbert R: *Evolució de la participació dels plans directors en la despesa i en el pressupost sanitari del Cat-Salut. Any 2008*. Barcelona: Generalitat de Catalunya, Departament de Salut, Estudis d'Economia de la Salut, 2010 (Volum III): 9-39
28. Queensland Government. Occupational disease strategy 2007-2010. Available on-line at: <http://www.deir.qld.gov.au/workplace/publications/strategies/occupational-disease2007-10/issues/index.htm> (last access 7-04-2011)
29. Rapport de la Commission instituée par l'article L.176-2 du code de la Sécurité Sociale (2005), Rapport de la Commission. Paris, France. Informe Diricq. Available on-line at: <http://www.securite-sociale.fr/communications/rapports/2006/diricq/diricq.pdf>. (last access 5-04-2011)
30. Registro de altas de Atención Ambulatoria Especializada (CMBD-AAE). Consulta Interactiva del Sistema Nacional de Salud. Instituto de Información Sanitaria. MSPSI. Available on-line at: <http://pestadistico.msc.es>. (last access 8-04-2011)
31. Registro de altas de hospitalización (CMBD-H). Repositorio de Información del Sistema Nacional de Salud. Instituto de Información Sanitaria. MSPSI. Available on-line at: <http://repositorio.msc.es/risns/>. (last access 28-04-2011)
32. Serra-Batlles J, Plaza V, Morejón E, et al: (1998), Costs of asthma according to the degree of severity. *Eur Respir J* 1998; 12: 1322-1326
33. Steenland K, Burnett C, Lalich N, et al: Dying for work: The magnitude of US Mortality from selected causes of death associated with occupation. *Am J Ind Med* 2003; 43: 461-482
34. WHO. Global burden of disease (GBD) 2004 Estimates. Available on-line at: http://www.who.int/healthinfo/global_burden_disease/GBD_report_2004update_full.pdf. (last access 23-08-2011)