PhD Dissertation; Departament de Pediatria, d'Obstetrícia i Ginecologia i de Medicina Preventiva, Facultat de Medicina, Universitat Autònoma de Barcelona, 2008

Essays on health capital and the efficiency of health care

Anna García-Altés

Vicente Ortún Rubio, Universitat Pompeu Fabra, director
Miquel Porta, Universitat Autònoma de Barcelona, tutor

Contents

Abstract

The introduction of innovations is one of the determinants of the increase in healthcare expenditure. Economic evaluation is the most direct approximation of a health economist to the measure of costs and health consequences of healthcare services. Paper 3 presents a direct application of cost-effectiveness analysis to measure the efficiency of the treatment of a clinical condition. Annex 3 presents a review of economic evaluation studies done in Spain from 1980 to 1999, focusing on the methods used, future research areas, and health policy implications.

The studies that have applied new economic perspectives to this problem, such as generalized cost-benefit analysis, make it possible to assess, in economic terms, the global impact of innovations on the treatment of a certain disease in real conditions and through time. The paper on Annex 1 carries out a thorough revision of those concepts, and describes some methodologies and results obtained in some recent research applications.

The revision of the economic value of healthcare expenditure has entailed the description and analysis of new indicators of welfare level attributable to healthcare, using measures uncommon on traditional national accounting. Those new measures, like health capital, are a reference to assess the increase of healthcare expenditure. Paper 1 applies a recently developed methodology to construct quality of life weights for Spain using the National Health Survey. Annex 2 goes further in this methodology, and measures the evolution of health capital in Barcelona from 1994 to 2006, taking into account changes in self-assessed quality of life, prevalence of diseases, and limitations in usual activities due to chronic conditions.

Finally, the increasing interest in gaining a more in-depth knowledge of the productivity and value of healthcare systems has been a stimulus for a diversity of initiatives. Paper 2 presents the results of such an experience, comparing the performance of Barcelona and Montreal healthcare services.

Resum

La introducció d'innovacions és un dels determinants de l'augment de la despesa en serveis sanitaris. L'avaluació econòmica és l'aproximació més directa per un economista de la salut a la mesura dels costos i les conseqüències en salut dels serveis sanitaris. El Paper 3 presenta una aplicació directa de l'anàlisi cost-efectivitat a la mesura de l'eficiència del tractament d'una condició clínica. L'Annex 3 presenta una revisió d'estudis d'avaluació econòmica fets a l'Estat espanyol entre 1980 i el 1999, enfocada cap els mètodes utilitzats, àrees de recerca futura i implicacions en política sanitària.

Els estudis que han aplicat noves perspectives econòmiques a aquest problema, com l'anàlisi cost-benefici generalitzat, permeten avaluar en termes econòmics l'impacte global en condicions reals de les innovacions aplicades al tractament d'una determinada malaltia al llarg del temps. L'article de l'Annex 1 fa una revisió exhaustiva d'aquests conceptes, i descriu algunes metodologies i resultats obtinguts en algunes recerques aplicades recentment.

La revisió del valor econòmic de la despesa en serveis sanitaris ha comportat la descripció i anàlisi d'indicadors nous del nivell de benestar atribuïble als serveis sanitaris, utilitzant mesures poc comunes en la comptabilitat nacional tradicional. Aquestes mesures noves, com el capital salut, són una referència per avaluar l'increment en la despesa en serveis sanitaris. El Paper 1 aplica una metodologia recentment desenvolupada per construir pesos de qualitat de vida per l'Estat espanyol utilitzant la *Encuesta Nacional de Salud*. L'Annex 2 va una mica més lluny en aquesta metodologia, i mesura l'avaluació del capital salut a Barcelona de 1994 a 2006, tenint en compte els canvis en l'estat de salut percebut, la prevalença de malalties, i les limitacions en les activitats habituals degudes a condicions cròniques.

Finalment, l'increment d'un coneixement més aprofundit de la productivitat i el valor dels sistemes sanitaris ha estat un estímul per iniciatives diverses. El Paper 2 presenta els resultats d'una d'aquestes experiències, comparant l'acompliment dels serveis sanitaris de Barcelona i Montreal.

Introduction

The concept of efficiency and the approach of extra-welfarism

The definition of efficiency refers to the relationship between used inputs and obtained outputs from a specific activity. In economics, people usually distinguish between three different concepts of efficiency: technical efficiency –when the production is organized to minimize the inputs required for a given output-, cost-effectiveness efficiency –when the cost of producing a given output is minimised-, and allocative efficiency –this later is obtained when resources are produced and allocated so as to produce the optimal level of each output according to the values that society places on them[1].

Welfare economics states that life standards, efficiency and justice in the allocation of services should be valued in terms of individual satisfaction -utility- by means of the consumption of goods and services. Among the principles of welfare economics is welfarism, meaning that the goodness of a situation can only be assessed by the utility level that individuals attained in that situation.

The specificity of healthcare services is known since health economics studies the healthcare services[2]. Some economists state that welfare economics principles do not hold in healthcare[3]. As a consequence, techniques such as the ability to pay represented by the area under the demand curve, loss their normative meaning; others criticise the fact that the value of a healthcare service to an individual is represented by the person's willingness to pay for the service, a measure closely related to the person's income and wealth[4].

More importantly, the approach of extra-welfarism argues that utility is not the only relevant factor in the societal welfare function, stating that health, not utility, is the most relevant outcome of social welfare in the healthcare sector[5,6]. In health economics, extra-welfarism takes health as the value to maximize. The absence of health involves the need to consume healthcare services that restore the health of the individuals, and those services are considered intermediate products. People demand healthcare services because of their impact on health, in terms of both the quantity and quality of life that they provide, but they include health, and not healthcare services, in their utility function. Cost-effectiveness studies apply the extra-welfarist approach when they look for the least costly method to obtain an improvement in health status.

More generally, rejection of the welfarist individualistic social welfare function has led to the development of a "decision-maker" approach to cost-benefit analysis, and a call for a more communitarian approach to evaluation. Extra-

welfarists have argued that decision-makers have declared that producing health is the primary objective of the healthcare system[7].

This dissertation adopts the extra-welfarist approach to the analysis of the healthcare sector, from a decision-maker point of view.

Healthcare services and their impact on population health

The introduction of innovations is one of the determinants of the increase in healthcare expenditure[8,9]. This effect is due to the introduction of new or modified technologies over the existing ones, the increase in their use, and the expansion of their applications[10]. The incentives behind these changes are many, and go from medical specialization to the competition between specialities, the uncertainty of results, the learning economies of scale, and the pressure of patients, payers and regulators.

In the last two centuries, the possibility frontier of treatment of diseases has been continuously increasing. As determinants of the evolution of population health, the improvement in nutrition, hygiene, birth control, socioeconomic variables, and health-related behaviours have been set against the marginal contribution of healthcare[11-14]. Despite their impact on the population's health and expenditure, recent developments in healthcare services have not been analysed. Conventional wisdom in health economics states that rich countries are in the flat part of the health production function (flat-of-the-curve medicine): the additional costs of innovations adds an increasingly small marginal improvement on population's health. This has been the argument for healthcare expenditure contention policies.

Based on the previous work in human capital theory developed in the 60's, Grossman was the first to describe demand for health and healthcare. According to the theory of the human capital, the increase in the stock of health increases the productivity of individuals in the productive (labour) and non-productive (other goods that enter in their utility function) market, and decreases lost productivity due to illness. Improvements in health status through time represent an increase in individuals' capital. In a similar way as human capital theory, health capital could be the present value of a person's lifetime health, in terms of health expectancy and quality of life[15].

It seems reasonable to identify the contribution of modern medicine to population's health, and determine if the obtained benefits compensate the costs. Nowadays, when measuring benefits, it is necessary to take into account the additional contributions of healthcare services, which go far beyond simply

curing diseases to include symptoms palliation, and improvement in quality of life. Efforts in health policy and healthcare management should be focused on financing those innovations where the impact on societal welfare is bigger than their costs, and reducing those with a small or negative net impact, instead of reducing healthcare expenditure, which could even be harmful for those healthcare services with bigger marginal benefits than marginal costs. To do so, it is necessary to value the contribution of healthcare services, and the other determinants of health, to population's health.

Economic evaluation is the most direct approximation of a health economist to the measure of costs and health consequences of healthcare services. Paper 3 presents a direct application of cost-effectiveness analysis to measure the efficiency of the treatment of a clinical condition. Annex 4 presents a review of economic evaluation studies done in Spain from 1980 to 1999, focusing on the methods used, future research areas, and policy implications.

The studies that have applied new economic perspectives to this problem, such as generalized cost-benefit analysis, make it possible to assess, in economic terms, the global impact of innovations on the treatment of a certain disease in real conditions and through time. The paper in Annex 1 carries out a thorough revision of those concepts, and describes some methodologies and results obtained in some recent research applications.

The revision of the economic value of healthcare expenditure has entailed the description and analysis of new indicators of welfare level attributable to healthcare, using measures uncommon on traditional national accounting. These new measures, like health capital, are a reference to assess the increase of healthcare expenditure. Paper 1 applies a recently developed methodology to construct quality of life weights for Spain using the National Health Survey. Annex 2 goes further in this methodology, and measures the evolution of health capital in Barcelona from 1994 to 2006, taking into account changes in self-assessed quality of life, prevalence of diseases, and limitations in usual activities due to chronic conditions.

Finally, the increasing interest in gaining a more in-depth knowledge of the productivity and value of healthcare systems has been a stimulus for a diversity of initiatives. Paper 2 presents the results of such an experience, comparing the performance of Barcelona and Montreal healthcare services.

Objectives

The objective of this dissertation is to add knowledge to health economics on the interpretation of the value of healthcare services expenditure.

Specific objectives are:

- To review the recent literature on the value of healthcare expenditure, and present the concepts of generalised cost-benefit analysis and health capital.

- To test "the paradox of health" in Barcelona from 1994 to 2006, analysing the evolution of self-assessed health status from 1994 to 2006, and estimating net self-assessed health status gains, for women and men, taking into account changes in cohort characteristics such as the age group, and the prevalence of chronic conditions and limitations in usual activities due to chronic conditions.

- To present an example of a cost-effectiveness analysis to analyse the efficiency of a healthcare treatment: alternative management strategies of dyspepsia.

- To review economic evaluation studies done in Spain from 1980 to 1999, focusing on the methods used, future research areas, and policy implications.

- To present the results of an initiative to measure the performance of the Barcelona and Montreal healthcare services.

Discussion

The improvement in life expectancy has been spectacular during the 20th century. However, the contribution of healthcare services to the improvement in survival is not well established. Studies using health production functions have found positive but small contributions of healthcare services to health status[16,17]. Given the amount of resources devoted to this health determinant, there is an increasing interest in knowing its efficiency.

The increase in healthcare expenditures is not necessarily negative for society. But to be useful for decision making and inform about productivity, the measure of the value of healthcare services should take into account the change in the value of costs and benefits. Costs of technological change correspond to changes in present and future costs; benefits are represented by the value of the improvements in health status.

The calculation of the difference between the actual value in the increase in costs and the value of the improvements in health status as a consequence of healthcare services needs to use some data that is not known with certainty. One of these parameters is the part of the improvement in health status that is the result of improvements in healthcare services. As has been shown in Annex 1, some studies done in the United States showed that if 27% of the improvement in health capital could be attributable to healthcare services, the net benefit of healthcare expenditure would be non negative.

Another uncertain parameter is the monetary value or the ability to pay for a QALY. The most common reference to that value are the works on the value of a statistical life using data from the labour market establishing an average value of $100.000 per QALY[16]. A more recent review suggested a reasonable value would be in the range between $70.000 and $175.000[17]. A part from other existing methods to estimate this value, there are limitations to this estimation, such as the varying value of a life year according to the age of the individual, and her or his quality of life[18]. These are areas for future epidemiological and economical research.

Annex 1 shows some direct applications of generalised cost-benefit analysis, in monetary terms and real conditions, to the to the measurement of the effectiveness of healthcare services on the treatment of a certain condition through time in relation to the spending on that condition. In the US, this approach has been used to study heart attacks, low-birth weight infants, depression, cataracts, breast cancer, and lung cancer and coronary heart disease in the elderly[19-21]; in Spain, it has been used to study perinatal

affections[22]. A similar kind of analysis could be done to measure the effect of a single technology on a specific condition, or even for medical spending as a whole[23-25].

The results of generalised cost-benefit analyses done showed that, also for the United States, there is a big heterogeneity in the efficiency of the treatment of different health problems. However, the mean positive productivity of healthcare expenditure, and the fact that the social value is bigger than the cost, is not a reason for the indiscriminate increase in healthcare services and medical innovations. Actually, in clinical practice, the extension of any innovation to marginal patients, i.e. those that obtain a small benefit from the treatment, could result in very small additional benefits derived from healthcare expenditure, although the innovation is efficient in mean terms. On the contrary, economic evaluation of health interventions should be encouraged, using proper methods and broad perspectives as discussed in Annex 3, to take into account all effects on society, in terms of extended life and quality of life improvement, and in relation to existing and alternative interventions, including health technologies, public health interventions, and lifestyle behaviours, such as in the example shown in Paper 3. A continuing challenge for health care economic analysis in Spain is to follow methodological guidelines and reporting conventions, to improve the dissemination of research, as well as to use more sophisticated economic analysis techniques, and to publish in international journals.

Furthermore, and given the importance of research and development processes, and the importance of improving the efficiency of healthcare expenditure, there is a need to eliminate the inefficient use of existing medical treatment and redirect medical innovations to the development of more productive technologies. It would be recommendable to consider the redistribution of research funding, and include the potential improvement in efficiency as a variable in research prioritization processes.

The extension of generalized cost-benefit analysis to all healthcare services has led to the definition and estimation of new economical concepts such as health capital. Paper 1 shows an analytical exercise to derive quality of life weights –one of the steps in the estimation of health capital-, and Annex 2 presents the results of a paper on the evolution of health capital in Barcelona from 1994 to 2006. The results of this analysis corroborate the paradox of health hypothesis for the population of Barcelona: despite the increase in the prevalence of chronic conditions, HSW tend to increase over the 1994-2006 period for women and men, especially for the youngest age groups. Moreover, self-assessed health status would have been better if the prevalence of chronic conditions and the characteristics of the cohort in 2006 had been maintained in

1994. This fact could suggest the positive contribution of health services, and the influence of the improvement of living conditions, individual behaviours and social determinants in the quality of life of the population of Barcelona.

Following the same reasoning, some authors have pointed out that national accounts have never included the value of the improvement in health status, and they are a poor approximation to population welfare. However, taking into account both income and the value of improvements in life expectancy, it could be possible to recalculate the convergence level of the welfare level of countries. Results of this kind of analyses done for 1962-1995 and 1849-1960 show that, in opposition to changes in income level, the improvements in life expectancy have reduced the differences in welfare level among different countries of the world[26,27]. Changes in mortality by infectious diseases, respiratory diseases, digestive diseases, and congenital and perinatal conditions have been the most influent in this convergence[28]. When taking into account changes in morbidity, these results could be even more striking. These kinds of measures –called full income measures- have been suggested instead of the Human Development Index[29].

The increasing interest in gaining in-depth knowledge about the productivity and value of healthcare systems has been a stimulus for a diversity of initiatives. Performance assessment of healthcare systems is one of these, with a diversity of international applications, country and citywide[30]. Their common characteristic is to define the main objectives of the healthcare system, and define indicators to measure them, in such a way that it is possible to measure the relationship between the design and performance of a health system, providing policy makers with tools to develop effective, efficient, and equitable systems, and to help determine priorities for health care interventions. Paper 2 presents the results of such an experience, comparing the performance of Barcelona and Montreal healthcare services. This initiative has proven to fit in an urban context, and to be a useful tool in designing and monitoring the accomplishment of programmes in both cities, to assess the services delivered, and for use in policy development. Along the same lines, greater attention is being paid to the measurement of health system output, and more accurate measures are being developed[31,32].

All the concepts, methodologies and results presented offer clear perspectives of future development, especially in the area of healthcare services research, and with immediate applications in priority setting, the provision of healthcare services, the design of financing methods and, in general, to inform policy making on the sustainability of public healthcare systems.

Conclusions

Given the increasing resources invested in healthcare services, it seems necessary to value their efficiency comparing them to the benefits obtained in terms of life expectancy and quality of life.

Generalized cost-benefit analysis measures, in monetary terms and real conditions, the effectiveness of healthcare services on the treatment of a certain condition through time in relation to the spending on that condition. It could also be applied to measure the effect of a single technology on a specific condition, or even for all medical spending as a whole.

The results of generalized cost-benefit analyses done in Spain and abroad showed that there is a big heterogeneity in the efficiency of the treatment of different health problems.

Economic evaluation of health interventions should be encouraged, using proper methods and broad perspectives, to take into account all effects on society, in terms of extended life and quality of life improvement, and in relation to existing and alternative interventions, including health technologies, public health interventions, and lifestyle behaviours.

The extension of generalized cost-benefit analysis to all healthcare services has brought to the definition and estimation of new economical concepts such as health capital.

The paradox of health hypothesis is corroborated for the population of Barcelona: despite the increase in the prevalence of chronic conditions, self-assessed health status tend to improve over the 1994-2006 period for women and men, especially for the youngest age groups. Moreover, self-assessed health status would have been better if the prevalence of chronic conditions and the characteristics of the cohort in 2006 had been maintained in 1994. This fact could suggest the positive contribution of health services, and the influence of the improvement of living conditions, individual behaviours and social determinants in the quality of life of the population of Barcelona.

The interest in the productivity and value of healthcare systems has been a stimulus for a diversity of initiatives, such as the performance assessment initiative comparing the performance of Barcelona and Montreal healthcare services. This initiative has proven to fit in an urban context, and to be a useful tool in designing and monitoring the accomplishment of programmes in both cities, to assess the services delivered, and for use in policy development.

Paper 1. García-Altés A, Pinilla J, Peiró S. [An approach to "quality-adjusted life years" quality of life weights from self-assessed health status] Gac Sanit 2006;20(6):457-64.

Aproximación a los pesos de calidad de vida de los «años de vida ajustados por calidad» mediante el estado de salud autopercibido

Anna García-Altés[a,b,c] / Jaime Pinilla[d] / Salvador Peiró[a]

[a]Fundación Instituto de Investigación en Servicios de Salud, Valencia, España; [b]Agència de Salut Pública de Barcelona, Barcelona, España; [c]Departament de Pediatria, d´Obstetrícia i Ginecologia i de Medicina Preventiva, Universitat Autònoma de Barcelona, España; [d]Departamento de Métodos Cuantitativos en Economía y Gestión, Universidad de Las Palmas de Gran Canaria, España.

(An approach to «quality-adjusted life years» quality of life weights from self-assessed health status)

Resumen

Objetivos: Estimar los pesos de calidad de vida para España, para los años 1987, 1993 y 2001, a partir del estado de salud autopercibido declarado en la Encuesta Nacional de Salud.

Material y métodos: Los pesos de calidad se han estimado mediante un modelo *probit* ordenado en el que el estado de salud autopercibido se relacionaba con la presencia de enfermedades crónicas, características demográficas y un error aleatorio, y normalizado a partir de una transformación de los estimadores obtenidos en el modelo.

Resultados: La calidad de vida asociada con las enfermedades crónicas difiere según cuáles sean éstas. Las dolencias, las limitaciones y las enfermedades en los últimos 12 meses reducen más la calidad de vida que las enfermedades crónicas. La calidad de vida disminuye a medida que aumenta la edad y se incrementa a medida que aumenta el nivel de estudios. Para una misma enfermedad, y tras ajustar por edad, sexo y nivel de estudios, los pesos de calidad de vida en los años 1993 y 2001 son mayores que en el año 1987.

Conclusiones: La metodología propuesta permite calcular los pesos de calidad de vida a partir de los datos de las encuestas de salud, con una aplicación directa en la evaluación económica, el análisis de las desigualdades socioeconómicas en el estado de salud de las poblaciones y el cálculo del capital de salud.

Palabras clave: Años de vida ajustados por calidad. Encuesta Nacional de Salud. Modelo *probit* ordenado. Capital de salud.

Abstract

Objectives: To estimate quality of life weights in Spain for 1987, 1993 and 2001, based on self-assessed health status reported in the National Health Survey.

Material and methods: Quality of life weights were estimated using an ordered probit model. In this model, self-assessed health status was related to the presence of chronic diseases, demographic characteristics, and a random error. Quality of life weights were derived by normalizing the regressors obtained.

Results: Quality of life values related to chronic diseases varied depending on the diseases. Pain, limitations, and diseases in the previous 12 months had a greater negative impact on quality of life than did chronic diseases. Quality of life decreased as age increased, and increased as educational level increased. For the same disease and adjusted for age, sex, and educational level, quality of life weights were greater for 1993 and 2001 than for 1987.

Conclusions: The proposed methodology allows quality of life weights to be calculated from health survey data, which has direct application in economic assessment, analysis of socioeconomic health inequalities, and health capital estimation.

Key words: Quality-adjusted life years. Health survey. Ordered probit model. Health capital.

Introducción

La valoración del estado de salud tiene connotaciones importantes en política sanitaria. Por ejemplo, la argumentación de que la productividad marginal del sistema sanitario es baja y que limitar el gasto sanitario mejoraría el bienestar de la sociedad en su conjunto carece de sentido si no se contrapone al gasto la valoración de los beneficios que pro-

Correspondencia: Dra. Anna García-Altés.
Fundación Instituto de Investigación en Servicios de Salud.
Pere Serafí, 38, 5.º 2.ª. 08012 Barcelona. España.
Correo electrónico: agarcia@aspb.es

Recibido: 17 de octubre de 2005.
Aceptado: 13 de marzo de 2006.

duce, es decir, la mejora del estado de salud de la población. La valoración de los beneficios obtenidos, en términos de mejora del estado de salud, en cada uso alternativo también puede ser útil a la hora de asignar recursos y, por otra parte, muchas decisiones de comportamiento (permanencia en el mercado laboral, preferencias distributivas, etc.) también tienen que ver con la valoración que hacen los individuos de su salud[1].

Las mejoras en el estado de salud conseguidas con el tiempo constituyen un aumento del capital o de los activos de los que disponen los individuos y, de forma paralela a como hace la teoría del capital humano, se puede hablar de capital de salud como el valor que tiene la salud (esperanza de vida y calidad de vida relacionada con la salud) que podrá disfrutar un individuo. Siguiendo esta teoría, el capital de salud de un individuo sería la utilidad resultante de su *stock* de años de vida ajustados por calidad (AVAC) presente y futuro[2]. El interés de la investigación económica por el capital de salud y su impacto en el crecimiento económico es muy reciente, a pesar de ser seguramente el activo que más se ha transformado a lo largo del siglo xx, y uno de los que puede haber contribuido, tanto o más que el capital monetario y humano, al bienestar y al crecimiento económico de muchos países[3]. En particular, las estimaciones pioneras de la magnitud del capital de salud para la economía de los Estados Unidos son las de Cutler y Richardson[1,4,5], Nordhaus[6] y Becker et al[7].

En España, a pesar de la importante contribución de los servicios sanitarios a la salud de la población[8] y del volumen de recursos que el sector sanitario representa, no hay ninguna estimación del capital de salud. La obtención de los pesos de calidad de vida de los AVAC permite, multiplicando estos pesos por los años de vida ganados y dando un valor monetario a los AVAC, estimar el capital de salud. La estimación de los pesos de calidad de vida se realiza tradicionalmente mediante encuestas que piden (a la población general, enfermos o médicos) que se asigne un peso a un determinado estado de salud. La explicitación de estos valores suele hacerse a través de escalas analógicas o de instrumentos como el *time-tradeoff* o el *standard gamble*[9]. Un enfoque alternativo sería obtener estos pesos mediante la comparación del estado de salud autopercibido de personas con y sin enfermedad. En esta opción se pregunta por el estado de salud a personas con y sin una determinada enfermedad, y la diferencia entre el estado de salud de ambos grupos, tras controlar por otras variables, se asume atribuible a la enfermedad. El objetivo de este trabajo es estimar los pesos de calidad de vida de los AVAC a partir del estado de salud autopercibido declarado en la Encuesta Nacional de Salud (ENS) y analizar su evolución en los años 1987, 1993 y 2001.

Material y métodos

Se realizó un estudio transversal con 3 cortes correspondientes a las ENS de los años 1987, 1993 y 2001. La población de estudio corresponde a la población muestral de la ENS (adultos no institucionalizados de toda España) y la unidad de análisis a los individuos que componían las ENS en los años 1987 (n = 29.191), 1993 (n = 21.061) y 2001 (n = 21.120). La ENS se ha realizado también en los años 1995 y 1997, pero los años seleccionados, debido a su tamaño muestral y estratificación, resultaban más comparables.

El análisis se ha realizado asumiendo que las personas tienen una medida latente de su estado de salud (y_i^*) de la que sólo se conoce en qué categoría (entre las 5 posibles: estado de salud autopercibido muy bueno, bueno, regular, malo y muy malo) se encuentra el individuo. Estar en una u otra categoría dependerá de ciertos factores medibles *x*, como pueden ser las enfermedades que tiene el individuo, características sociodemográficas como la edad, el sexo y el nivel de estudios, y de ciertos factores no observables *u*. Formalizando:

$$y_i^* = x_i'\beta + u_i,$$
$$\text{donde } ui = yi^* - E\,(y_i^*/x_i).$$

Las 5 categorías de la variable dependiente discreta y_i se hacen corresponder con 5 intervalos dentro de los que toma valores y_i^*, de forma que $y = 0 \text{ si } y^* \leq c_1$, $y = 1 \text{ si } c_1 < y^* \leq c_2$, …, $y = 4 \text{ si } y^* > c_4$. Si los valores que presenta la variable endógena están ordenados, como ocurre en este caso, la estimación de las probabilidades se plantea como $p(y \leq i/x) = F(c_j + x\beta)$, donde *j* es cada una de las clases ordenadas definidas (0, 1, …, 4). Las expresiones anteriores son una forma de censura de los datos. Los coeficientes c_j son parámetros que se han de estimar al tiempo que β, vector de coeficientes de las variables explicativas, una vez impuesta una distribución a la estructura de los errores. Para la estimación de este modelo se asume que *u* sigue una distribución normal, modelo *probit*[10]. El modelo final se construye a partir de la estimación de las variables definidas anteriormente, así como de los productos entre ellas que estudian el efecto de la interacción entre variables (p. ej., hipercolesterolemia y diabetes). Los pesos de calidad de vida (PCV) se pueden calcular normalizando a partir de una transformación de los estimadores obtenidos mediante el modelo ordenado. En este caso, los regresores obtenidos (β) para cada variable independiente se han normalizado mediante la utilización de los puntos de corte mínimo (c_1) y máximo (c_4) obtenidos en el modelo: $PCV = 1 - (\beta/c1 - c4)$[1].

La ENS recoge, a través de entrevista personal directa, variables demográficas, estado de salud percibido, enfermedades crónicas, morbilidad percibida, uti-

Tabla 1. Descripción de las variables de la Encuesta Nacional de Salud incluidas en el estudio

Variables		Categorización
Variable dependiente	Estado de salud autopercibido	1 = muy malo; 2 = malo; 3 = regular; 4 = bueno; 5 = muy bueno
Variables independientes	Enfermedades crónicas	Hipertensión, hipercolesterolemia, diabetes, enfermedades crónicas del corazón, asma, úlcera de estómago, alergias, depresión: 1 = sí; 0 = no
	Dolencias, limitaciones y enfermedades en los últimos 12 meses	Artrosis, fracturas, enfermedades neurológicas, enfermedades psíquicas, enfermedades de la sangre: 1 = sí; 0 = no
	Problemas de oído	1 = sí; 0 = no
	Problemas de visión	1 = sí; 0 = no
	Sexo	Hombre = 1; Mujer = 0
	Edad	Continua
	Estudios primarios	1 = sí; 0 = no
	Estudios secundarios	1 = sí; 0 = no
	Estudios universitarios	1 = sí; 0 = no

lización de servicios sanitarios y medicamentos, hábitos de salud, actividades preventivas y cobertura sanitaria. Así, por una parte, y para analizar la evolución de la calidad de vida, se ha construido un mismo modelo para los 3 años con las variables comunes a los 3: autopercepción del estado de salud, sexo, edad, enfermedades crónicas, educación primaria, educación secundaria y educación universitaria. Posteriormente, y dado que la ENS de 2001 incluye variables que no fueron incluidas en las ENS previas, se ha construido un modelo ampliado para 2001 en el que se ha incluido el máximo de variables disponibles: autopercepción del estado de salud, sexo, edad, enfermedades crónicas, dolencias, limitaciones y enfermedades en los últimos 12 meses, problemas de oído y de visión, educación primaria, educación secundaria y educación universitaria. Las variables incluidas en los modelos, las preguntas correspondientes en la ENS y su categorización se describen en la tabla 1.

Se exploraron algunos modelos alternativos y, en particular, se valoró la especificación *logit.* También se exploraron modelos mediante una recategorización de la variable «autopercepción del estado de salud» en 3 categorías –mala, regular, buena– en lugar de 5. Dado que se realizaron numerosas pruebas estadísticas, se fijó el valor de significación de p en 0,001. Todos los análisis se realizaron mediante el programa Stata 8.0.

Resultados

En la tabla 2 se describen las frecuencias de las diversas variables utilizadas. La distribución por edad y sexo fue muy parecida en las ENS de los 3 años empleados. En general, el número de personas que declaran tener alguna enfermedad crónica tiende a incrementarse con el tiempo, pero no en los casos de asma o úlcera de estómago. Respecto al estado de salud, se produce un ligero incremento de las personas que declaran tener un estado de salud bueno o muy bueno (el 67,3% en 1987, el 68,6% en 1993 y el 69,9% en 2001).

En la tabla 3 se muestran los resultados de los modelos con los datos de las ENS de 1987, 1993 y 2001. Por lo que se refiere al modelo con datos de 1987, y en relación con las variables demográficas, el estado de salud empeora en función de la edad (PCV = 0,996). La interacción entre las variables sexo y edad da un valor igual a la unidad (PCV = 1,000). Las enfermedades crónicas, la hipertensión, la hipercolesterolemia y la alergia empeoran poco el estado de salud de la población (PCV entre 0,908 y 0,924); en cambio, la diabetes, las enfermedades crónicas del corazón y el asma la disminuyen más (PCV entre 0,802 y 0,846). La calidad de vida aumenta a medida que se incrementa el nivel de estudios. En lo esencial, los resultados del modelo con los datos de la ENS de 1993 repiten los de 1987: la calidad de vida disminuye en función de la edad (PCV = 0,997); la hipertensión, la hipercolesterolemia y la alergia disminuyen poco la calidad de vida (PCV entre 0,928 y 0,938) y la diabetes, las enfermedades crónicas del corazón, el asma y la úlcera de estómago la disminuyen más (PCV entre 0,821 y 0,870) y la calidad de vida aumenta a medida que se incrementa el nivel de estudios. Los resultados del modelo con datos de la ENS de 2001 son consistentes con los anteriores. De nuevo, la calidad de vida disminuye en función de la edad

Tabla 2. Frecuencia y parámetros de las variables incluidas en los modelos

Variable	ENS 1987	ENS 1993	ENS 2001
Número de casos	29.191	21.061	21.120
Estado de salud autopercibido			
Muy malo	1,32%	1,04%	1,63%
Malo	6,89%	5,80%	5,54%
Regular	24,47%	24,28%	22,38%
Bueno	53,64%	57,80%	54,77%
Muy bueno	13,69%	10,80%	15,15%
Edad media [años (DT)]	43,62 (18,59)	43,55 (18,48)	45,32 (18,79)
Hombres	47,91%	48,41%	48,35%
Mujeres	52,02%	51,41%	51,40%
Hipertensión crónica	9,78%	10,99%	14,26%
Hipercolesterolemia crónica	6,15%	8,25%	10,82%
Diabetes crónica	3,95%	4,12%	5,44%
Enfermedad crónica del corazón	4,41%	3,83%	5,11%
Diabetes y enfermedad crónica del corazón	0,66%	0,65%	1,04%
Asma crónica	6,18%	4,52%	4,83%
Úlcera de estómago crónica	ND	3,80%	3,30%
Alergia crónica	5,61%	6,26%	7,64%
Depresión crónica	ND	ND	6,28%
Artrosis	ND	ND	4,81%
Fractura	ND	ND	3,40%
Enfermedades neurológicas	ND	ND	0,18%
Problemas psíquicos	ND	ND	0,97%
Enfermedades de la sangre	ND	ND	0,13%
Problemas de oído	14,29%	ND	8,35%
Problemas de visión	50,35%	ND	6,59%
Sin estudios	4,20%	15,50%	7,59%
Estudios primarios	63,55%	50,29%	59,84%
Estudios secundarios	27,05%	18,40%	19,35%
Estudios universitarios	5,20%	15,81%	13,21%

DT: desviación típica; ENS: Encuesta Nacional de Salud; ND: variable no disponible en la ENS del año correspondiente.

(PCV = 0,995); la hipertensión, la hipercolesterolemia y la alergia disminuyen discretamente la calidad de vida (PCV entre 0,920 y 0,946) y la diabetes, las enfermedades del corazón, el asma, la úlcera de estómago y la depresión la reducen de un modo más importante (PCV entre 0,824 y 0,870). De nuevo, la calidad de vida aumenta a medida que se incrementa el nivel de estudios.

Los resultados del modelo ampliado con datos de la ENS de 2001 (tabla 4) son consistentes también con los anteriores y dan información sobre dolencias, limitaciones y enfermedades en los últimos 12 meses. De nuevo, la calidad de vida disminuye en función de la edad (PCV = 0,996); la hipertensión, la hipercolesterolemia y la alergia disminuyen discretamente la calidad de vida (PCV entre 0,933 y 0,956) y la diabetes, las enfermedades del corazón, el asma, la úlcera de estómago y la depresión la reducen de un modo más importante (PCV entre 0,838 y 0,870). Las dolencias, las limitaciones y las enfermedades en los últimos 12 meses, variables disponibles sólo para este año, diminuyen de manera considerable la calidad de vida. Destacan especialmente las enfermedades neurológicas, los problemas psíquicos y las enfermedades de la sangre, con PCV alrededor de 0,600. En lo referente a los problemas de vista y oído, también disminuyen la calidad de vida, aunque de forma discreta (PCV alrededor de 0,950).

Al comparar longitudinalmente el modelo para los 3 años mediante el conjunto de variables comunes (tabla 3), para una misma enfermedad crónica, los valores de PCV con datos de 1993 y 2001 son superiores a los obtenidos con datos de 1987, lo que indica que las personas con la misma enfermedad (y tras ajustar por edad, sexo y nivel de estudios) tienen una calidad de vida superior en los últimos años analizados que en el primero. En particular, para la diabetes crónica, la enfermedad crónica del corazón y la alergia crónica, los valores de PCV son mayores en 2001 que en 1987 y 1993. Por otra parte, a medida que aumenta el nivel de estudios se incrementa la calidad de vida, aunque las diferencias de calidad de vida entre niveles de estudios han ido disminuyendo con el tiempo, hasta pasar a ser en el año 2001 un parámetro significativo sólo para los que tienen estudios universitarios. Los modelos predicen correctamente entre el 57,3 y el 60,8% de los casos. Ninguno de los modelos alternativos probados (*logit* ordenado, recategorización de la variable dependiente) mejoraba el ajuste ni predecía correctamente un número mayor de casos. A partir de la muestra inicial, el número de observaciones se redujo en 392, 411 y 142 para 1987, 1993 y 2001, respectivamente, debido sobre todo a la diferencia de valores perdidos entre los 3 años.

Discusión

Las estimaciones pioneras de la magnitud del capital de salud para la economía de Estados Unidos[1,4,5] calcularon el capital de salud a través de la información sobre la esperanza de vida de una determinada población de cada edad, la prevalencia de problemas de salud para los que sobreviven en cada estado, la calidad de vida asociada a la supervivencia con un determinado problema de salud, y el valor monetario de un año de vida en buena salud. El trabajo actual es una réplica parcial de estos trabajos, refiriéndose sólo a la estimación de los PCV en los años 1987, 1993 y 2001 a partir del estado de salud autopercibido. Esta metodología permite calcular estos pesos a partir de los datos disponibles en las encuestas de salud, proceder que

Tabla 3. Comparación de los modelos para 1987, 1993 y 2001

	1987			1993			2001		
	Coeficiente β	Error estándar	PCV 1987	Coeficiente β	Error estándar	PCV 1993	Coeficiente β	Error estándar	PCV 2001
Hombre	0,103*	0,036	1,027	0,101*	0,037	1,025	0,147*	0,036	1,040
Edad	–0,015*	0,001	0,996	–0,014*	0,001	0,997	–0,018*	0,001	0,995
Hombre × edad	0,001*	0,001	1,000	0,001*	0,001	1,000	0,001*	0,001	1,000
Hipertensión crónica	–0,345*	0,022	0,911	–0,294*	0,034	0,928	–0,276*	0,023	0,925
Hipercolesterolemia crónica	–0,356*	0,033	0,908	–0,266*	0,035	0,935	–0,295*	0,028	0,920
Diabetes crónica	–0,598*	0,036	0,846	–0,530*	0,045	0,870	–0,475*	0,035	0,870
Enfermedad crónica del corazón	–0,771*	0,038	0,802	–0,729*	0,038	0,821	–0,629*	0,038	0,828
Diabetes × enfermedad crónica del corazón	0,404*	0,094	1,104	0,487*	0,088	1,120	0,267*	0,077	1,073
Asma crónica	–0,603*	0,029	0,845	–0,639*	0,044	0,843	–0,644*	0,038	0,824
Alergia crónica	–0,295*	0,031	0,924	–0,253*	0,040	0,938	–0,199*	0,036	0,946
Sin estudios	–	–	–	–	–	–	–	–	–
Estudios primarios	0,210*	0,037	1,054	0,187*	0,027	1,046	0,053	0,034	1,015
Estudios secundarios	0,458*	0,045	1,118	0,341*	0,034	1,084	0,074	0,040	1,020
Estudios universitarios	0,571*	0,059	1,147	0,483*	0,039	1,119	0,141*	0,039	1,038
c1	–3,082	0,072	–	–3,121	0,092	–	–3,309	0,076	–
c2	–2,106	0,067	–	–2,164	0,073	–	–2,533	0,054	–
c3	–0,961	0,062	–	–0,982	0,066	–	–1,417	0,050	–
c4	0,802	0,067	–	0,950	0,075	–	0,357	0,052	–
N.º de observaciones	28.799			20.650			20.978		
% casos correctamente clasificados	57,36			60,82		5	7,72		
Seudo-R^2	0,1045			0,0966			0,0993		
Log pseudo-likelihood	–30.692,381			–20.792,118			–22.272,208		

PCV: peso de calidad de vida. Errores estándares consistentes por provincias.
*p < 0,001.

tiene varias ventajas: evita la realización de estudios *ad-hoc* para conocer el estado de salud y, por extensión, la calidad de vida de la población, lo que supone un importante ahorro de recursos a la hora de hacer estudios que requieran esta información; además, el hecho de trabajar con una muestra poblacional representativa resulta útil a la hora de extrapolar resultados. Estas ventajas han sido señaladas por otros investigadores que han trabajado en medidas de calidad de vida a partir de encuestas de salud[11]. Su aplicación es inmediata en los estudios de evaluación económica y tiene una utilidad directa en el análisis de las desigualdades socioeconómicas en el estado de salud de las poblaciones, como ya se ha hecho por parte de investigadores del norte de Europa[12,13] y españoles[14-16].

Entre los resultados obtenidos cabe destacar, en primer lugar, el hecho de que la calidad de vida asociada a las enfermedades crónicas difiere según cuales sean éstas: enfermedades como la diabetes, la enfermedad crónica del corazón, el asma, la úlcera de estómago y la depresión están asociadas con una calidad de vida inferior que enfermedades como la hipertensión, la hipercolesterolemia y la alergia. Además, las dolencias, las limitaciones y las enfermedades en los últimos 12 meses disminuyen más la calidad de vida que las enfermedades crónicas, probablemente porque en ese período las personas todavía no se han adaptado a sus expectativas. Destacan especialmente las enfermedades neurológicas, los problemas psíquicos y las enfermedades de la sangre, que son mucho más graves. En segundo lugar, los resultados muestran que la calidad de vida disminuye a medida que aumenta la edad, hecho presumiblemente relacionado con la mayor prevalencia de enfermedades en las edades más avanzadas.

Los resultados también muestran que la calidad de vida se incrementa a medida que aumenta el nivel de estudios, tal vez por el mayor uso de servicios sanitarios preventivos y de los excluidos de la cobertura sanitaria pública que realiza la población con mayor nivel socioeconómico[17], aunque más probablemente se deba al impacto de sus mejores condiciones de vida generales. En cualquier caso, las diferencias entre niveles de estudios son cada vez menores y en 2001 el parámetro pasa a significativo sólo para los que tienen estudios universitarios, lo cual indicaría una disminución de las desigualdades de salud entre clases sociales, dato que hasta la fecha no se había documentado[17-19].

Tabla 4. Resultados del modelo para 2001

Variables	Coeficiente β	Error estándar	PCV 2001
Hombre	0,214*	0,042	1,054
Edad	–0,015*	0,001	0,996
Hombre × edad	–0,001	0,001	1,000
Hipertensión crónica	–0,263*	0,025	0,933
Hipercolesterolemia crónica	–0,249*	0,027	0,937
Diabetes crónica	–0,511*	0,036	0,870
Enfermedad crónica del corazón	–0,637*	0,046	0,838
Diabetes × enfermedad crónica del corazón	0,303*	0,098	1,077
Asma crónica	–0,611*	0,039	0,845
Úlcera crónica	–0,527*	0,061	0,866
Alergia crónica	–0,172*	0,035	0,956
Problemas de oído	–0,156*	0,023	0,960
Problemas de visión	–0,220*	0,032	0,944
Artrosis	–1,074*	0,032	0,727
Fractura	–0,809*	0,058	0,794
Enfermedades de la sangre	–1,544*	0,189	0,607
Problemas psíquicos	–1,580*	0,066	0,598
Enfermedades neurológicas	–1,555*	0,174	0,605
Sin estudios	–	–	–
Estudios primarios	0,046	0,034	1,019
Estudios secundarios	0,075	0,042	1,019
Estudios universitarios	0,145*	0,040	1,037
c1	–3,549	0,078	–
c2	–2,693	0,056	–
c3	–1,464	0,042	–
c4	0,383	0,001	–

PCV: peso de calidad de vida.
*$p < 0,001$; n = 20.978. Porcentaje de casos correctamente clasificados = 59,13%; Seudo-R^2 = 0,1388; *Log pseudo-likelihood* = –21296,081. Errores estándar robustos en el ámbito provincial.

Finalmente, para una misma enfermedad, y tras ajustar por edad, sexo y nivel de estudios, la calidad de vida en los años 1993 y 2001 es mayor que en el año 1987; en particular, para la diabetes crónica, la enfermedad crónica del corazón y la alergia crónica, los valores de PCV son mayores en 2001 que en 1987 y 1993. Este aspecto sugiere la contribución positiva de los servicios sanitarios y la influencia de las mejoras en las condiciones de vida y sociales en la calidad de vida de la población, y que vendría reforzado por el aumento, en los años estudiados, del porcentaje de población que declara tener un estado de salud bueno o muy bueno. No obstante, también es posible que este cambio se deba a un incremento del diagnóstico de enfermedades crónicas y la consiguiente incorporación de pacientes más leves en las cohortes más recientes. Estos resultados, en términos generales, son consistentes con los encontrados por Cutler y Richardson para la población de Estados Unidos, a partir del análisis del estado de salud autopercibido de esa población en los años 1979-1981 y 1989-1991[1].

Como puede observarse en las tablas de resultados, algunos pesos son superiores a la unidad, en particular, los correspondientes a: *a)* la interacción de 2 variables, ya sean 2 enfermedades o edad y sexo; *b)* el nivel de estudios, y *c)* ser hombre. Por una parte, la normalización no acota de ninguna manera los valores de los regresores, por lo que pueden obtenerse valores superiores o inferiores a la unidad. Por otra parte, los valores mayores que uno en el caso de las interacciones entre variables (2 enfermedades; sexo y edad) muestran que la calidad de vida disminuye menos que proporcionalmente al hecho de tener las 2 enfermedades o el sexo y la edad. En el caso del nivel de estudios, los valores superiores a la unidad indican que para una persona con determinado sexo, edad y enfermedad, su calidad de vida es mayor si tiene estudios universitarios que si tiene estudios primarios. Por último, los valores superiores a la unidad en el caso de ser hombre indican que éstos declaran tener una calidad de vida superior que las mujeres ante una misma enfermedad, edad y nivel de estudios, lo que coincide con los datos de la literatura científica[20].

La principal limitación de este análisis es que los pesos de calidad de vida derivados no son estrictamente equiparables a los pesos de calidad de vida que se obtendrían con una escala analógica o con medidas de elicitación como el *time trade-off* o el *standard gamble*. Para satisfacer el concepto de AVAC, los pesos de calidad de vida deberían estar basados en preferencias, anclados en la salud perfecta y la muerte, y medidos en una escala de intervalo[9]. Estas características no se cumplen en el caso de los pesos derivados a partir del estado de salud autopercibido y su relación con las enfermedades; sin embargo, los resultados obtenidos son coherentes con lo que se conoce sobre calidad de vida relacionada con la salud y coinciden con resultados anteriores de los investigadores que propusieron esta metodología[1]. Así, y siendo consciente de sus limitaciones, los PCV obtenidos en encuestas como la ENS de 2001, que incluye enfermedades bien especificadas, podrían utilizarse como *proxy* de los pesos de calidad de vida para construir los AVAC en los estudios de evaluación económica. Hay que señalar también que en la estimación de los PCV puede haber un sesgo de selección ocasionado por la muerte de los individuos antes de la entrevista. La probabilidad de que el individuo declare tener un buen o mal estado de salud es condicional a que esté vivo, por lo que habría un truncamiento selectivo en la función de distribución[21]. Una posibilidad de corregir por dicho sesgo sería estimar por máxima verosimilitud con información completa el modelo de salud autopercibido y la ecuación de supervivencia[22], solución no factible en este trabajo al no incorporar información sobre mortalidad. Finalmente, otra limitación que puede señalarse se deriva del hecho de trabajar con datos autodeclarados, tanto de estado de salud

como de prevalencia de enfermedades, si bien se conoce la buena correlación de estos indicadores subjetivos con indicadores de resultados finales[23].

Este estudio se enmarca en un contexto más general referido a la interpretación del valor del gasto en servicios sanitarios. A la hora de hacer valoraciones sobre la asignación adecuada de recursos y la eficiencia del sistema sanitario en su conjunto, el crecimiento del gasto sanitario debe ponerse en relación con el valor económico de las mejoras en la supervivencia y en la calidad de vida que las innovaciones introducidas hayan aportado. Los estudios que han aplicado nuevos enfoques económicos a este problema, como el análisis coste-beneficio generalizado, permiten evaluar en términos monetarios el impacto global en condiciones reales de las innovaciones en el tratamiento de una enfermedad a lo largo del tiempo[24]. En Estados Unidos se han estudiado los casos del infarto de miocardio, recién nacidos de bajo peso, depresión, cataratas y cáncer de mama[25], y en España se ha estudiado el caso de las afecciones perinatales[26]. La extensión del análisis coste-beneficio a todo el gasto sanitario ha llevado a la definición y la estimación de conceptos económicos novedosos, como son el capital de salud y la renta de salud. La idea subyacente es que la inversión en innovaciones médicas y el gasto sanitario a lo largo del tiempo son una inversión en la mejora de la salud de los individuos, es decir, en su capital de salud. Algunos trabajos para Estados Unidos muestran que sería suficiente que el 27% de las mejoras en el capital de salud fueran atribuibles al sistema de salud para que el beneficio neto del gasto sanitario no fuese negativo, si bien hay una fuerte heterogeneidad en la eficiencia en el tratamiento de diferentes problemas de salud, por ejemplo, en el tratamiento de las enfermedades cardiovasculares (con más beneficios que costes) y el cáncer (con más costes que beneficios)[5]. La única estimación disponible en Europa del valor de los cambios en el capital de salud hasta este momento corresponde a Suecia[27].

Por último, investigadores españoles han iniciado líneas de trabajo interesantes en torno al concepto de potencial de calidad de vida[28] y al del valor estadístico de la vida humana[29]. El potencial de calidad de vida es una medida de bienestar social que combina las rentas estimadas por encima de la línea de pobreza con esperanzas de vida a la edad actual a partir de una función de calidad de vida. Para España, y con los datos estadísticos disponibles, es posible construir una serie completa de potenciales de vida a partir de 1975, en la que se está trabajando en la actualidad. Las implicaciones de estos estudios para las políticas sanitarias son relevantes porque al permitir estimar, en términos monetarios, los costes y los beneficios, y a pesar de diversas limitaciones, permiten orientar la toma de decisiones en función de las variaciones en el beneficio neto, antes que en argumentos exclusivos de gasto.

Agradecimientos

Este trabajo ha sido parcialmente financiado con una ayuda de investigación del Instituto de Estudios Fiscales y forma parte de un proyecto de investigación más amplio titulado «Impacto de la atención sanitaria en la salud» financiado por una ayuda de la Fundación BBVA.

A Vicente Ortún por sus comentarios a varias revisiones previas de este texto. Los errores son responsabilidad de los autores.

Bibliografía

1. Cutler DM, Richardson E. Measuring the health of the US population. Washington: Brooking Papers Microeconomics; 1997. p. 217-71.
2. Grossman M. The human capital model of the demand for health. NBER Working paper series. Working Paper 7078. Cambridge: National Bureau of Economic Research; 1999.
3. McDonald S, Roberts J. Growth and multiple forms of human capital in an augmented Solow Model: a panel data investigation. Econ Letters. 2002;74:271-6.
4. Cutler DM, Richardson E. The value of health: 1970-1990. Amer Econ Rev. 1998; AEA Papers and Proceedings: 97-100.
5. Cutler DM, Richardson E. Your money and your life: The value of health and what affects it. Frontiers Health Policy Res. 1999;2:99-132.
6. Nordhaus WD. The health of nations: the contribution of improved health to living standards. En: Murphy KM, Topel R, editors. Measuring the gains from medical research. Chicago: University of Chicago Press; 2003.
7. Becker G, Philipson T, Soares RR. Growth and mortality in less developed nations. Chicago: University of Chicago; 2001.
8. Meneu R, Peiró S. Eficiencia y despilfarro en la atención sanitaria. A propósito del infarto de miocardio. Cuad Econ Inform Comercial Esp. 2004;67:9-25.
9. Drummond MF, O'Brien B, Stoddart GL, Torrance GW. Methods for the economic evaluation of health care programmes. 2nd. ed. Oxford: Oxford University Press; 1997.
10. Maddala GS. Limited dependent and qualitative variables in econometrics. Cambridge: Cambridge University Press; 1983.
11. Gold MR, Franks P, McCoy KI, Fryback DG. Toward consistency in cost-utility analyses: using national measures to create condition-specific values. Med Care. 1998;36:778-92.
12. Van Doorslaer E, Jones AM. Inequalities in self-reported health: validation of a new approach to measurement. J Health Econ. 2003;22:61-87.
13. Lauridsen J, Christiansen T, Häkkinen U. Measuring inequality in self-reproted health: discussion of a recently suggested approach using Finish data. Health Econ. 2004;13:725-32.
14. García P, López A. Socio-Economic Inequalities in Health in Catalonia. Working paper #758. Barcelona: Department of Economics and Business, Universitat Pompeu Fabra; 2004.
15. García P, López A. Regional differences in socio-economic health inequalities in Spain. Working paper #757. Barcelona: Department of Economics and Business, Universitat Pompeu Fabra; 2004.
16. García P, López A. The Evolution of Inequity in the Access to Health Care in Spain: 1987-2001. Working paper #756. Barcelona: Department of Economics and Business, Universitat Pompeu Fabra; 2004.
17. Lostao L, Regidor E, Calle ME, Navarro P, Domínguez V. Evolución de las diferencias socioeconómicas en la utilización y

accesibilidad de los servicios sanitarios en España entre 1987 y 1995/97. Rev Esp Salud Pública. 2001;75:115-27.
18. Regidor E, Gutiérrez-Fisac JL, Domínguez V, Calle ME, Navarro P. Comparing social inequalities in health in Spain: 1987 and 1995/97. Soc Sci Med. 2002;54:1323-32.
19. Borrell C, Plasencia A, Pasarín I, Ortún V. Widening social inequalities in mortality: the case of Barcelona, a southern European city. J Epidemiol Community Health. 1997;51:659-67.
20. Artazcoz L, Borrell C, Benach J, Cortes I, Rohlfs I. Women, family demands and health: the importance of employment status and socio-economic position. Soc Sci Med. 2004; 59:263-74.
21. Heckman J. Sample selection bias as a specification error. Econometrica. 1979. 47:153-61.
22. Salas C. On the empirical association between poor health and low socio-economic status at old age. Health Econ. 2002;11:207-20.
23. Idler EL, Benyamini Y. Self-rated health and mortality: a review of twenty-seven community studies. J Health Soc Behav. 1997;38:21-37.
24. García-Altés A, Puig Junoy J. Una reconsideración del valor del gasto sanitario agregado. Nuevos enfoques económicos e implicaciones para la adopción de políticas públicas en España. En: Puig Junoy J, López-Casasnovas G, Ortún V, editores. ¿Más recursos para la salud? Barcelona: Masson; 2004.
25. Cutler DM, McClellan M. Is technological change in medicine worth it? Health Aff (Millwood). 2001;20:11-29.
26. Pinilla J. Comparación entre costes y beneficios a largo plazo en el proceso tecnológico en sanidad: caso de las afecciones con origen en el período perinatal. En: González López-Varcárcel B, editores. Difusión de nuevas tecnologías sanitarias y políticas públicas. Barcelona: Masson; 2005.
27. Burström K, Johannesson M, Direrichsen F. The value of the change in health in Sweden 1980/81 to 1996/97. Health Econ. 2003;12:637-54.
28. Pinilla R, Goerlich J. Potencial de vida, población, esperanza de vida y envejecimiento como factores fundamentales en la teoría del capital humano. Estimación empírica para España (1900-1998). Valencia: Instituto Valenciano de Insvestigaciones Económicas. Revista de Demografía Histórica, 2.
29. Martínez JE, Pinto JL, Abellán JM. El valor estadístico de la vida humana en España. XXIV Jornadas de Economía de la Salud: Respuestas individuales y sociales ante los riesgos para la salud. El Escorial, mayo de 2004.

Paper 2. García-Altés A, Borrell C, Coté L, Plaza A, Benet J, Guarga A. Measuring the performance of urban healthcare services: results of an international experience. J Epidemiol Community Health 2007;61(9):791-6.

EVIDENCE-BASED PUBLIC HEALTH POLICY AND PRACTICE

Measuring the performance of urban healthcare services: results of an international experience

Anna García-Altés, Carme Borrell, Louis Coté, Aina Plaza, Josep Benet, Alex Guarga, for the Montreal and Barcelona group on performance of healthcare services

J Epidemiol Community Health 2007;**61**:791–796. doi: 10.1136/jech.2006.051789

The objective of this paper is to apply a framework for country-level performance assessment to the cities of Montreal, Canada, and Barcelona, Spain, and to use this framework to explore and understand the differences in their health systems. The UK National Health Service Performance Assessment Framework was chosen. Its indicators went through a process of selection, adaptation and prioritisation. Most of them were calculated for the period 2001–3, with data obtained from epidemiological, activity and economic registries. Montreal has a higher number of old people living alone and with limitations on performing one or more activities of daily life, as well as longer hospital stays for several conditions, especially in the case of elderly patients. This highlights a lack of mid-term, long-term and home care services. Diabetes-avoidable hospitalisation rates are also significant in Montreal, and are likely to improve following reforms in primary care. Efficient health policies such as generic drug prescription and major ambulatory surgery are lower in Barcelona. Rates of caesarean deliveries are higher in Barcelona, owing to demographics and clinical practice. Waiting times for knee arthroplasty are longer in Barcelona, which has triggered a plan to reduce them. In both cities, avoidable mortality and the prevalence of smoking have been identified as areas for improvement through preventive services. In conclusion, performance assessment fits perfectly in an urban context, as it has been shown to be a useful tool in designing and monitoring the accomplishment of programmes in both cities, to assess the performance of the services delivered, and for use in policy development.

See end of article for authors' affiliations

Correspondence to: A García-Altés, Agència de Salut Pública de Barcelona, Pl Lesseps, 1, 08023 Barcelona, Spain; agarcia@aspb.es

Accepted 27 November 2006

The objective of performance assessment is to provide governments, health authorities and populations with appropriate information about the state of their healthcare systems.[1] Some of the aims of any relevant performance assessment are to build an evidence base on the relationship between a health-system design and its performance, providing policy makers with crucial tools to develop effective, efficient and equitable systems, and to help determine priorities for healthcare interventions, contributing to their design and management.[2]

In recent years, an increasing amount of work and attention has been devoted to the measurement of performance within health systems at the country level, with an aim to improve them. The drivers of this trend are rooted in the current characteristics of the environment where healthcare is provided, and the concerns of governments and populations.[3] Resource spending constraints, growing public expectations and concerns about safety, quality and equity are increasing the pressure on accountable healthcare systems.

Urban contexts have the elements to develop such an initiative. Big cities have several social problems, inherent to their development: low-income families, unemployment, immigration, inequalities, an ageing population, small social networks and so on. In particular, the existing health problems in Montreal, Canada and Barcelona, Spain are among the consequences of these particular social conditions: higher HIV/AIDS rates, higher illegal drug consumption, lower birth rates, stronger social class inequalities in health status, higher prevalence of mental health problems and so on.[4] Moreover, in many big cities, the available public health and healthcare services try to address these issues with specific policies and programmes, as local governments tend to have an active role in policy development and service delivery assurance as well as public health functions.[5] As a result, urban contexts could be seen as a microenvironment in which to develop a performance assessment initiative, much more focused than a country-level initiative, making it possible to measure the achievement of health goals and the effectiveness of the programmes in place.[6]

The objective of this paper was to apply a framework for country-level performance assessment to the cities of Montreal and Barcelona, and to use this framework to explore and understand differences in their health systems. The present initiative is the first one at the city level, which is an indication of the uniqueness of this project, and could be an incentive for other cities interested in this kind of framework.

METHODS

The project on performance assessment began in 2002, as one of the agreements between the Montreal Health Authority (Régie Régionale) and the Health Consortium of Barcelona, under the auspices of the declaration of cooperation between the governments of Quebec and Catalunya. Its objective was to develop a set of indicators that would allow Barcelona and Montreal to assess the performance of their healthcare services.

Abbreviation: NHS, National Health Service

Table 1 UK National Health Service performance indicators, 2002*

Dimension	Indicator
Health improvement	Deaths from all causes (15–64 years)
	Deaths from all causes (64–74 years)
	Deaths from cancer
	Deaths from all circulatory diseases
	Suicide rates
	Deaths from accidents
	Serious injury from accidents
Fair access	Access to elective surgery (surgery rates for hip, knee, cataract replacements and coronary heart disease)
	Access to family planning and services (conception rates for teenage girls)
	Access to dentists (number of people registered with a dentist)
	Access to health promotion (early detection of cancer)
	Access to community services (number of general practitioners, practice availability)
Effective delivery of appropriate healthcare	Health promotion/disease prevention (childhood immunisations, early detection of cancer)
	Appropriateness of surgery (surgery rates, inappropriate surgery)
	Primary care management (acute care, chronic care, mental healthcare, cost-effective prescribing)
	Compliance with standards of care (returning home after a stroke, returning home after a hip fracture)
Efficiency	Maximising the use of resources (day case rate, length of stay, unit costs, generic prescribing)
Patient—care giver experience	Accessibility (patients who wait <2 h for emergency admissions, cancellations of operations for non-medical reasons)
	Cooperation/communication (delayed discharge, first outpatient appointment that the patient did not attend)
	Waiting times (outpatients seen within 13 weeks of referral, number of people on the waiting list for ⩾18 months)
	Satisfaction (patients' complaints)
Health outcomes	Reducing the level of risk (conception rates for teenage girls)
	Reducing the level of disease or impairment (adverse events or complications of treatment, decayed, missing or filled teeth for 5-year-old children)
	Improving the quality of life for users and care givers (hospital admissions for older people, psychiatric readmissions)
	Reducing premature deaths (infant deaths, survival rates for cancer, avoidable deaths, hospital premature deaths)

* Indicators are grouped in the table, to avoid overwhelming the reader with too much detailed information.

First, a systematic search in PubMed was carried out, looking for performance assessment initiatives that have actually been put in place in different countries. [7] Such initiatives were identified in the UK, Canada, Australia, New Zealand and Sweden.[8–13] Afterwards, the applicability of each of the five initiatives to an urban context was assessed, valuing their capability to reflect the nuances of that setting, assessing the health status of the inhabitants of big cities, and the public health and healthcare services available. From the revised initiatives, the indicators contained in the UK initiative —UK National Health Service (NHS) Performance Assessment Framework—were seen as the most suitable for Montreal and Barcelona, as they take into account general dimensions of health, while also focusing on areas more specific to those cities (ie, HIV/AIDS, health of immigrants, concerns about community care, particular types of cancer and geographical inequities).[8] Additionally, most of the indicators could be obtained from epidemiological, activity and economic information regularly available. Finally, the UK healthcare system is quite similar to the Canadian and Spanish systems, and hence one could expect that the UK NHS Performance Assessment Framework would be applicable.

The UK NHS Performance Assessment Framework, in its 2002 version, defines a set of 51 indicators (table 1) grouped in dimensions.[8] The application of the framework to an urban context would be as follows:

- *Health improvement*: To reflect the overarching aims of improving the general health of urban populations and reducing health inequalities within the cities.
- *Fair access*: To assert that the city must offer fair access to health services in relation to people's needs, irrespective of neighbourhood or district of residence, socio-economic group, ethnicity, age or sex.
- *Effective delivery of appropriate healthcare*: To acknowledge that there must be effective, appropriate and timely services that comply with agreed-upon standards.
- *Efficiency*: To ensure that healthcare services are delivered with the minimum of waste, and that the city uses its resources to achieve value for money.
- *Patient/care giver experience*: To assess the way in which patients and their care givers experience and view the quality of the care they receive.
- *Health outcomes*: To assess the direct contribution of the city healthcare services to improvements in overall health.

The Barcelona city officials invited a multidisciplinary group of experts (10 people) to join the project. These experts were outstanding professionals working in the Barcelona healthcare system in the areas of primary care, long-term care, mental health, public health, health policy and planning, hospital management and healthcare services research. The multidisciplinary group of experts held three meetings to review the UK NHS Performance Assessment Framework indicators. During these meetings, indicators were selected and adapted and new indicators were added, finally arriving at a set of 107 indicators. To prioritise the indicators obtained, the multidisciplinary group of experts, together with Montreal and Barcelona officials, then assessed four dimensions for each indicator—importance, reliability, information readily available and comparability—on a scale from 1 to 5. Indicators with worse scores, and those that could not be obtained at least in the short term, were dropped, leaving a final set of 76 indicators. Afterwards, three video conferences were carried out in which the Montreal and Barcelona officials discussed the specifications of the indicators, and developed and agreed upon specific technical definitions for each of them. Information for the last year available was collected.

This was an observational cross-sectional study. For each indicator, counts, percentages or rates were calculated, in accordance with the definitions made. When comparing percentages and rates, they were age standardised using the world standard population 2000–25, so that the values of both cities would be directly comparable. Additionally, information was collected on a set of descriptive indicators related to basic demographic information of both cities and the main characteristics of their healthcare systems.

RESULTS

Populations in both cities are comparable in terms of size, demographic structure and literacy level (table 2). In Barcelona, there is a bigger proportion of people aged >64 years, especially women (24.9% vs 17.9%); however, in Montreal there is a higher number of people aged >64 years living alone (35.6% vs 25.8%). Montreal has a larger foreign-born population, as massive immigration is a recent phenomenon in Barcelona; in 2003, foreigners represented 12.8% of the population of the city,

Table 2 Description of the population and healthcare services

Indicator	Sex	Barcelona	Montreal
Population			
Inhabitants (n)	—	1503884 (2001)	1812740 (2001)
Population aged >64 years (%)	Men	15.1 (2001)	12.4 (2001)
	Women	24.9 (2001)	17.9 (2001)
Population aged >74 years (%)	Men	4.5 (2001)	4.9 (2001)
	Women	12.5 (2001)	8.9 (2001)
Population aged >64 years living alone (%)	—	25.8 (2001)	35.6 (2001)
Population with university degree (%)	—	21.2 (2001)	23.1 (2001)
Foreign population (%)	—	12.8 (2003)	27.6 (2003)
Structure			
Inhabitants per public primary care doctor (n)	—	1829 (2003)	1657 (2002)
Inhabitants per nurse (n)	—	1885 (2003)	1733 (2002)
Public acute beds per 1000 inhabitants (n)	—	3.1 (2003)	2.8 (2002)
Public long-term care beds per 1000 inhabitants (n)	—	3.7 (2003)	51.9 (2002)
Costs			
Per capita healthcare spending (€)*	—	1035.5 (2001)	1584.3 (2001)

Sources: Census 2001, Departament d'Estadística, Ajuntament de Barcelona; Human Resources Registry, Consorci Sanitari de Barcelona; Recensement 2001, Statistique Canada; Éco-santé Québec 2002, Ministère de la Santé et des Services Sociaux du Québec.
*1Can$ = €0.6667 using 2002 Purchasing Power Parity conversion factors.

while in 1991 it was 1.4%. Regarding resources, Montreal and Barcelona are quite similar in terms of the number of inhabitants per primary care doctor, per nurse and the number of public acute beds. It was not possible to compare long-term care resources because the organisation and type of services available are different. Per capita public healthcare spending is higher in Montreal.

In the health improvement dimension, Montreal has a larger proportion of people reporting very good health status (91.6% vs 79.5% in men and 84.7% vs 70.9% in women; table 3). At the same time, Montreal has a larger proportion of men aged >65 years with limitations to perform one or more activities of daily living (35.3% vs 24.0%), whereas Barcelona has a larger proportion of women (42.3% vs 39.6%) in this situation. With regard to mortality, Montreal has higher rates of coronary diseases and suicide, especially for men. Barcelona, by contrast, has higher rates of cancer, cerebrovascular diseases and respiratory diseases (table 3). Traffic injuries, mortality and prevalence of smoking are similar in both cities. The percentage of smoking population is high in both cities.

With regard to access, Montreal has higher rates of myocardial infarction, angioplasty and hospitalisation due to bypass; hospitalisation rates due to knee replacement are higher in Barcelona; the number of emergencies per inhabitant is similar in both cities (table 3). In the effective delivery of appropriate services dimension, the number of patients aged >65 years with cerebrovascular accident or with femur fracture, with a hospital stay of >20 days, is higher in Montreal, as well as diabetes-avoidable hospitalisation rates. The percentage of emergency admissions is also higher in Montreal (58.1% vs 41.2%). Barcelona has a higher percentage of caesarean deliveries (22.2% vs 20.4%).

In the efficiency dimension, Barcelona has a lower substitution rate for major ambulatory surgery (57.9% vs 91.9%), and lower generic drug prescription (14.5% vs 36.5%; table 3). Gross length of stay of patients with cerebrovascular diseases is higher in Montreal. Regarding user experience, waiting times for knee arthroplasty are much longer in Barcelona (22.3 vs 7.8 months; table 3).

Finally, in the health outcomes dimension, Montreal has a higher inhospital mortality from femur fractures, whereas Barcelona has a higher inhospital mortality from bypass (table 3). Regarding avoidable mortality, Montreal has higher lung cancer rates for both sexes; Barcelona has higher cerebrovascular disease rates, especially for men.

DISCUSSION

The results of this project are an example of the applicability and usefulness of performance assessment initiatives to an urban context. This is the first effort in applying this kind of framework at the city level. The results made it possible to identify a few issues related to demographics, acute and preventive services available, clinical practice and management techniques in Montreal and Barcelona.

In terms of demographics, Montreal has a higher number of old people living alone and with limitations to perform one or more activities of daily living (table 2). Related to this is the fact that Montreal has a longer length of stay for several conditions, especially in the case of elderly patients (table 3). This highlights a lack of mid-term and long-term healthcare services, and a greater need for home-care services in Montreal. Taking action, in early 2005, a plan to improve post-acute care. Diabetes-avoidable hospitalisation was initiated in Montreal rates are also significant in Montreal (table 3). This is something that the Montreal local health authorities hope to see an improvement in for the coming years, following an important primary care reform that was started in mid-2004.

Generic drug prescription and major ambulatory surgery are lower in Barcelona, indicating the low expansion of efficient health policies. Rates of caesarean deliveries are higher in Barcelona, which is probably related to demographics and clinical practice. Waiting times for knee arthroplasty are longer and hospitalisation rates for this condition are higher in Barcelona, mainly because of the slow diffusion of this technique in the city hospitals. This fact led to the development of a plan to reduce them in 1999, mainly guaranteeing a certain annual number of interventions, and the development of clinical units for knee arthroplasty, among other measures. Both indicators should decrease in the future as the number of people waiting for this operation diminishes.

In both cities, avoidable mortality indicates an area for improvement: lung cancer and suicide in Montreal and cerebrovascular diseases in Barcelona give plenty of action to preventive services (table 3). This is also the case for the prevalence of smoking.

Table 3 Performance indicator values for Barcelona and Montreal

Indicator	Sex	Barcelona	Montreal
Health improvement			
Population aged >65 years with limitations to perform one or more activities of daily living (%)	Men	24.0 (2000)	35.3 (2001)
	Women	42.3 (2000)	39.6 (2001)
Population with good or very good health status (%)	Men	79.5 (2000)	91.6 (2001)
	Women	70.9 (2000)	84.7 (2001)
Mortality from cancer per 100 000 inhabitants aged <75 years	Men	198.8 (2002)	128.6 (1997–9)
	Women	100.6 (2002)	90.7 (1997–99)
Mortality from coronary diseases per 100 000 inhabitants aged <75 years	Men	67.4 (2002)	77.4 (1997–9)
	Women	23.5 (2002)	25.9 (1997–9)
Mortality from cerebrovascular diseases per 100 000 inhabitants aged <75 years	Men	40.6 (2002)	13.5 (1997–9)
	Women	29.0 (2002)	8.3 (1997–9)
Mortality from respiratory diseases per 100 000 inhabitants aged <75 years	Men	65.9 (2002)	20.6 (1997–9)
	Women	23.7 (2002)	11.6 (1997–9)
Mortality from suicide per 100 000 inhabitants aged 15–49 years	Men	15.6 (2002)	40.7 (1997–9)
	Women	3.9 (2002)	8.2 (1997–9)
Mortality from traffic injuries per 100 000 inhabitants aged 15–44 years	Men	9.9 (2002)	11.7 (1997–9)
	Women	3.3 (2002)	1.5 (1997–9)
Smoking population (%)	Men	35.3 (2000)	30.6 (2001)
	Women	22.9 (2000)	24.6 (2001)
Access			
Hospitalisation rate for femur fracture surgery per 1000 inhabitants	—	0.436 (2003)	0.449 (2001–3)
Hospitalisation rate for stroke per 1000 inhabitants	—	0.822 (2003)	0.740 (2001–3)
Hospitalisation rate for myocardial infarction per 1000 inhabitants	—	0.749 (2003)	1.107 (2001–3)
Hospitalisation rate for angioplasty per 1000 inhabitants	—	0.527 (2003)	0.941 (2001–3)
Hospitalisation rate for bypass per 1000 inhabitants	—	0.192 (2003)	0.425 (2001–3)
hospitalisation rate for knee replacement per 1000 inhabitants	—	0.491 (2003)	0.228 (2001–3)
Emergencies per 1000 inhabitants (n)	—	485.8 (2003)	463.2 (2002–3)
Effective delivery of appropriate services			
Diabetes-avoidable hospitalisation rate per 1000 inhabitants	—	0.012 (2003)	0.026 (2001–3)
Duodenal and gastric ulcer-avoidable hospitalisation rate per 1000 inhabitants	—	0.185 (2003)	0.126 (2001–3)
Cerebrovascular accident discharges of patients aged >65 years with >20 days of length of stay (%)	—	14.2 (2003)	35.2 (2001–3)
Discharges of patients with femur fracture aged >65 years with >20 days of length of stay (%)	—	14.9 (2003)	20.5 (2001–3)
Caesarean deliveries (%)	Women	22.2 (2003)	20.4 (2001–3)
Emergency admissions (%)	—	41.2% (2003)	58.1% (2002–3)
Efficiency			
Substitution for major ambulatory surgery (%)	—	57.9 (2003)	91.9 (2001–3)
Gross average length of stay for ischaemic diseases	—	8.04 (2003)	7.84 (2001–3)
Gross average length of stay for cerebrovascular diseases	—	11.06 (2003)	15.74 (2001–3)
Generic drug prescription (%)	—	14.5 (2003)	36.5 (2001–3)
User experience			
Waiting list for knee arthroplasty (months)	—	22.3 (2003)	7.8 (2004)
Waiting list for cataract surgery (months)	—	2.2 (2003)	2.3 (2004)
Health outcomes			
Inhospital mortality from bypass per 100 bypass discharges	—	5.17 (2003)	2.79 (2001–3)
Inhospital mortality from femur fractures per 100 femur fracture discharges	—	4.08 (2003)	7.71 (2001–3)
Inhospital mortality from myocardial infarction per 100 myocardial infarction discharges	—	12.87 (2003)	12.09 (2001–3)
Inhospital mortality from stroke per 100 000 inhabitants	—	18.54 (2003)	17.51 (2001–3)
Cerebrovascular disease-avoidable mortality per 100 000 inhabitants aged 35–64 years	Men	21.2 (2002)	15.4 (1997–9)
	Women	10.2 (2002)	9.9 (1997–9)
Lung cancer-avoidable mortality per 100 000 inhabitants aged 5–64 years	Men	26.8 (2002)	31.5 (1997–9)
	Women	6.6 (2002)	22.5 (1997–9)
Cirrhosis-avoidable mortality per 100 000 inhabitants aged 15–74 years	Men	12.1 (2002)	13.8 (1997–9)
	Women	3.6 (2002)	4.8 (1997–99)

Sources: Barcelona Health Survey 2000, Agència de Salut Pública de Barcelona; Mortality Registry, Agència de Salut Pública de Barcelona; Hospital Discharge Registry, Consorci Sanitari de Barcelona; Provider Contracts, Consorci Sanitari de Barcelona; Recensement 2001, Statistique Canada; Fichier des décès, Ministère de la Santé et des Services Sociaux du Québec; Med-Écho, Ministère de la Santé et des Services Sociaux du Québec; Éco-santé Québec 2002, Ministère de la Santé et des Services Sociaux du Québec.
Rates have been standardised using the world standard population 2000–25, hence they are directly comparable.

What this paper adds

- This paper presents the application of a framework for country-level performance assessment to the cities of Montreal and Barcelona, and explains how this framework was used to explore and understand differences in their health systems.
- The results show that performance assessment is applicable in an urban context and can be used as a tool for policy development, as it has allowed both cities to identify a few issues related to demographics, clinical practice and management techniques.
- The application of a performance framework to two cities, the collaboration between both cities and the extensions of the project make this a unique and successful project in the international arena.

Policy implications

- Performance assessment is a useful tool to design and monitor the accomplishment of policies and to assess the services delivered.
- This project is allowing decision makers in Montreal and Barcelona to identify the strengths and weaknesses of the healthcare services of both cities, in terms of available resources and quality of care.

All the performance assessment initiatives at the country level previously mentioned have actually been put in place, and are still being used and continuously improved, a testimony to the importance and usefulness of such initiatives for policy makers and populations. By drawing on other experiences, countries can adapt their frameworks to their own particular conditions, and learn from examples of good practice, thus avoiding errors made elsewhere.[14–17] In fact, some specific studies have been carried out comparing the performance of healthcare services among countries, and within countries, looking for the relationship between health results, health determinants and resources.[18–24] Additionally, this kind of approach could be used to assess health sector reforms and compare healthcare providers.[25 26] However, the present initiative is the first at the city level, which confirms the uniqueness of this project, and could be an incentive for other cities interested in this kind of framework.

The comparison of two cities made it possible to confirm previously identified problem areas in each city (eg high mortality from suicide in Montreal, long waiting times for knee artroplasty in Barcelona), and, more interestingly, made it possible to identify other areas in which there is room for improvement (eg, caesarean deliveries and generic drug prescription in Barcelona, emergency admissions in Montreal). In some sense, instead of looking for ''benchmarks'' for each indicator, each city acts as a benchmark for the other. Continuing this project by collecting annual data would make it possible to monitor any improvements. The international comparison of cities makes the project especially attractive, but even without an intercity comparison, this project is an example of how the application of a performance assessment framework to an urban context could be useful in any city setting, where there is an interest in health system assessment and improvement.

As in any initiative, some limitations could be found: in this study, these are mainly related to the process followed and the availability of information. First, the selection of indicators was based on a pre-existing set of indicators and carried out by a group of experts. The selection of the UK NHS Performance Assessment Framework was based on a careful assessment of the applicability of all the initiatives found to an urban context, and the similarities of the healthcare systems. The use of a group of experts to select, add and prioritise indicators has the limitations intrinsic to the participation of a particular group of people. Finally, some indicators that either the Barcelona or the Montreal officials thought would be interesting to include were dropped in the prioritisation process because they were not available in both cities. Although this is a limitation, the comparison of available data sources was useful to identify information gaps, and says a lot about the strengths and weaknesses of a system. Improving information systems on drug consumption, vaccines and primary care in Montreal, and on hospital activity information at the Barcelona district level would be a way to advance.

At present, we are working on the development of a strategy to disseminate the results of this project. It will include the presentation of the project in local, national, and international forums through scientific meetings and papers. We have also developed a web page for the project, based on geographical information systems, so that people can interactively see the performance of each indicator, together with its technical definition, and the comparison between cities (http://www.cmis.mtl.rtss.qc.ca/fr/performance/coop_mtl_barcelone/barcelone_presentation.html). We are already working on the continuation of this project, collecting annual data and extending the project to the metropolitan areas of both cities.

This project allows decision makers in Montreal and Barcelona to identify the strengths and weaknesses of the healthcare services of both cities, in terms of available resources and quality of care. The application of a performance assessment framework to an urban context, the collaboration between two cities and the extensions of the project make this a unique and successful project in the international arena.

ACKNOWLEDGEMENTS

We thank Agència de Salut Pública de Barcelona, Consorci Sanitari de Barcelona, Corporació Sanitària de Barcelona and Agence de la Santé et des Services Sociaux de Montréal, our partners in this project; and the Montreal and Barcelona group on performance of healthcare services: Josep Benet, Mike Benigeri, Carme Borrell, Marc Bourguignon, Xavier Castells, Louis Côté, Danièle Dorval, Jaume Estany, Gonçal Foz, Lluís Franch, Anna García-Altés, Josep Ma Giralt, Àlex Guarga, José Manuel Pérez-Castejón, Antoni Plasència, Alfonso Pozuelo, Aina Plaza, Elvira Torné, Corinne Zara and Lauriane Zonco.

Authors' affiliations

Anna García-Altés, Department de Pediatria, d'Obstetrícia i Ginecologia i de Medicina Preventiva, Universitat Autònoma de Barcelona
Anna García-Altés, Carme Borrell, Agència de Salut Pública de Barcelona, Pl Lesseps, Barcelona, Spain, Louis Coté, Agence de la Santé et des Services Sociaux de Montréal, Montréal, Québec, Canada
Aina Plaza, Josep Benet, Alex Guarga, Consorci Sanitari de Barcelona, Barcelona, Spain

Funding: No extra funding apart from the authors' institutions.

Competing interests: None.

REFERENCES

1 **Murray CJL**, Frenk J. A framework for assessing the performance of health systems. *Bull World Health Organ* 2000;**78**:811–20.
2 **Pan American Health Organization**. *Health system performance assessment and improvement in the region of the Americas*. Washington, DC: PAHO, 2001.

3 **Hurst J**. Performance measurement and performance management in OECD health systems: an overview of issues and challenges. ''Measuring up'' improving health systems performance in OECD countries. *OECD Health Conference on Performance Measurement and Reporting*. Ottawa, November, 2001.
4 **Borrell C**, Pasarín M. Inequalities in health and urban areas. *Gac Sanit* 2004;**18**(Suppl 2):1–4.
5 **Líndez P**, Villalbí JR, Vaqué J. Public health functions, activities and structures: the role of large and middle-sized municipalities. *Gac Sanit* 2001;**15**:164–71.
6 **Derose SF**, Schuster MA, Fielding JE, *et al*. Public health quality measurement: concepts and challenges. *Annu Rev Public Health* 2002;**23**:1–21.
7 **García-Altés A**, Zonco L, Borrell C, *et al*. Measuring the performance of health care services: a review of international experiences and their application to an urban context. *Gac Sanit* 2006;**20**:316–24.
8 **National Health Service**. *NHS performance indicators. National figures: February 2002*. London: NHS, 2003.
9 **Canadian Institute for Health Information**. *Health indicators*, Vol 2003, Number 2. Ottawa: Canadian Institute for Health Information, 2003 (Catalogue Number 82-221-XIE)).
10 **National Health Performance Committee**. *Fourth national report on health sector performance indicators. A report to the Australian Health Ministers' conference*. Sydney: NSW Health Department, 2000.
11 **Or Z**. *Improving the performance of health care systems: from measures to action (a review of experiences in four OECD countries)*. Paris: OECD, 2002 (Labour Market and Social Policy, Occasional Papers Number 57)).
12 **Hurst J**, Jee-Hugues M. *Performance measurement and performance management in OECD Health Systems*. Paris: OECD, 2000 (Labour Market and Social Policy, Occasional Paper Number 47)).
13 **McIntyre D**, Rogers L, Heier EJ. Overview, history and objectives of performance measurement. *Health Care Financ Rev* 2001;**22**:7–21.
14 **Evans DB**, Edejer TT, Lauer J, *et al*. Measuring quality: from the system to the provider. *Int J Qual Health Care* 2001;**13**:439–46.
15 **Upshaw V**. The National Public Health Performance Standards Program: would it strengthen governance of local public health? *J Public Health Pract* 2000;**6**:1–18.
16 **McPake B**, Mills A. What can we learn from international comparisons of health systems and health system reform? *Bull World Health Organ* 2000;**78**:811–20.
17 **Mannion R**, Goddard M. Performance measurement and improvement in health care. *Appl Health Econ Health Policy* 2002;**1**:13–23.
18 **Feachem RGA**, Sekhri NK, White KL. Getting more for their dollar: a comparison of the NHS with California's Kaiser Permanente. *BMJ* 2002;**324**:135–41.
19 **Evans DB**, Tandon A, Murray CJL, *et al*. Comparative efficiency of national health systems: cross national econometric analysis. *BMJ* 2001;**323**:307–10.
20 **The Conference Board of Canada**. *Challenging health care system sustainability: understanding health system performance of leading countries*. Ottawa: The Conference Board of Canada, 2004.
21 **Hussey PS**, Anderson GF, Osborn R, *et al*. How does the quality of care compare in five countries? *Health Aff (Millwood)* 2004;**23**:89–99.
22 **Organisation for Economic Cooperation and Development**. *Towards high-performing health systems*. Paris: OECD, 2004.
23 **Arah OA**, Westert GP. Correlates of health and healthcare performance: applying the Canadian health indicators framework at the provincial-territorial level. *BMC Health Serv Res*, 20051, **5**:76.
24 **Schoen C**, Davis K, How SK, *et al*. U.S. health system performance: a national scorecard, *Health Aff (Millwood)* 2006;**25**:w457–75.
25 **Knowles JC**, Leighton C, Stinson W. *Measuring results of health sector reform for system performance: a handbook of indicators*, Special Initiatives Report Number 1. Bethesda, MD: Partnerships for Health Reform, Abt Associates, 1997.
26 **Abdad P**, Rouse A, Mohamemed A, *et al*. Performance league tables: the NHS deserves better. *BMJ* 2002;**324**:95–8.

APHORISM OF THE MONTH

Testing the impact of public health interventions in response to the null hypothesis may help reduce avoidable hubris in expectations of benefits.

Lowell Levin

Paper 3. García-Altés A, Rota R, Barenys M, Abad A, Moreno V, Pons JMV, Piqué JM. Cost-effectiveness of a "score and scope" strategy for the management of dyspepsia. European Journal of Gastroenterology and Hepatology 2005;17(7):709-19.

Cost-effectiveness of a 'score and scope' strategy for the management of dyspepsia

Anna García-Altés[a,b,c], Rosa Rota[d], Mercè Barenys[d], Águeda Abad[d], Victor Moreno[e], Joan M.V. Pons[b] and Josep M. Piqué[f]

Objective **It is important to identify the best initial work-up in patients with uninvestigated dyspepsia because of its epidemiological and economical relevance. The objective of the study was to assess systematically the effectiveness and cost-effectiveness of invasive and non-invasive strategies for the management of dyspepsia.**

Methods **A decision analysis was performed to compare prompt endoscopy, score and scope, test and scope, test and treat, and empirical antisecretory treatment. Published and local data on the prevalence of different diagnoses, rates of *Helicobacter pylori* infection, accuracy values of diagnostic tests, and effectiveness of drug treatments were used. The perspective of analysis was that of the public healthcare payer, and only direct costs were included, with a one-year post-therapy time horizon. The main outcome measure was cost per asymptomatic patient, valued in 2003 Euros.**

Results **Endoscopy was found to be the most effective strategy for the management of dyspepsia (38.4% asymptomatic patients), followed by test and scope (35.5%), test and treat (35.3%), score and scope (34.7%), and empirical treatment (28.5%). Incremental cost-effectiveness ratios showed that score and scope was the most cost-effective alternative (483.17 Euros per asymptomatic patient), followed by prompt endoscopy (1396.85 Euros). Sensitivity analyses showed variations when varying the values of prevalence of duodenal ulcer, and the values of healing of functional dyspepsia with antisecretory and eradication drugs. There were no changes when varying the prevalence of *H. pylori* in dyspepsia.**

Conclusions **We would recommend stratifying patients by a score system, referring first to endoscopy those patients at higher risk of organic dyspepsia. *Eur J Gastroenterol Hepatol* 17:709–719 © 2005 Lippincott Williams & Wilkins.**

European Journal of Gastroenterology & Hepatology 2005, **17**:709–719

Keywords: cost-effectiveness, decision analysis, dyspepsia, score and scope

[a]Fundación Instituto de Investigación en Servicios de Salud, 08012 Barcelona, Spain, [b]Agència d'Avaluació de Tecnologia i Recerca Mèdiques, 08023 Barcelona, Spain, [c]Departament de Pediatria, Obstetricia i Ginecologia i de Medicina Preventiva, 08193 Bellaterra, Spain, [d]Unitat de Digestiu, Hospital de Viladecans, 08840 Viladecans, Barcelona, Spain, [e]Institut Català d'Oncologia, Hospital Duran Reynalds, 08097 L'Hospitalet de Llobregat, Spain and [f]Hospital Clinic i Provincial, 08036 Barcelona, Spain.

Part of this work was supported by a grant from Fondo de Investigación Sanitaria number FIS 99/1016 and a grant from the Catalan Society of Gastroenterology.

Correspondence to Anna García-Altés, Fundación Instituto de Investigación en Servicios de Salud, Pere Serafi 38, 5–2, 08012 Barcelona, Spain.
E-mail: annagarcia@post.harvard.edu

Received 25 January 2005 **Accepted** 11 March 2005

Introduction

Dyspepsia is a common disorder, with reported prevalences ranging from 13 to 40% [1]. An international working party defined dyspepsia as 'upper abdominal or retrosternal pain, discomfort, heartburn, nausea, vomiting, or other symptoms considered being referable to the proximal alimentary tract' [2]. This is a broad definition that has been adopted by most studies. However, one important aspect is to exclude from dyspepsia patients with isolated heartburn or regurgitation that should be considered as having gastro-esophageal reflux disease [3].

The impact of dyspepsia in terms of cost is also considerable. Drugs for dyspepsia represent a large percentage of the total cost of drugs in many healthcare systems, and the number of visits to primary care practitioners, investigation costs, especially endoscopies and testing for *Helicobacter pylori*, are increasing every year [4].

Because of its importance in terms of prevalence and costs, this is a field of abundant research, both epidemiological and economic. Many studies have tried to address the issue of identifying the best initial work-up in patients with uninvestigated dyspepsia. In the past two decades two different approaches have mainly been proposed: (i) non-invasive strategies: empirical treatment with antisecretory drugs, or eradication treatment either empirical or based on the results of an *H. pylori* test (test and treat); and (ii) invasive strategies: initial endoscopy to all patients, or after selecting the best-suited candidates either by scoring models based on dyspeptic symptoms and patients' characteristics (score and scope), or in the light of the results of an *H. pylori* test (test and scope).

Empirical treatment with antisecretory drugs was initially proposed by the American College of Physicians [5], but

0954-691X © 2005 Lippincott Williams & Wilkins

some studies have claimed low effectiveness [6] and low levels of satisfaction among patients submitted to this strategy [7], whereas others have claimed cost-effectiveness [8,9]. The non-invasive test and treat strategy has been shown to be effective [10] and cost-effective [11–14] in different studies, but there are many concerns about it, mainly the problem of increasing bacterial resistance [15], and the low benefits, if any, of eradicating *H. pylori* in non-ulcer dyspepsia [16]. Although eradication treatment in non-ulcer dyspepsia has been shown to be cost-effective under certain conditions [17], it is necessary to avoid unnecessary eradication, and to point out that deleterious rebound hypersecretion can appear in some patients after eradication treatment [18]. Moreover, recent data have again supported the use of empirical treatment with proton pump inhibitors for the initial management of dyspepsia [19].

With regard to invasive strategies, gastroscopy is the gold standard investigation for dyspepsia [20], and can reliably distinguish between patients with organic causes of dyspepsia such as peptic ulcer disease, reflux oesophagitis, or cancer, and patients with no underlying cause that are then labelled as functional dyspeptic individuals. Endoscopy can be normal in up to 60% of patients with dyspepsia, and a strategy based on initial endoscopy increases the workload for endoscopies without savings in medications or later visits according to some authors, but with benefits according to others [21]. If the cost of endoscopy is low, it could be a cost-effective alternative for the treatment of dyspeptic patients older than 45–50 years, because a precise diagnosis and an accurate treatment could give rise to a great reduction in dyspeptic symptoms [22]. The test and scope strategy has not been shown to be cost-effective [23] because it increases the number of endoscopies over usual practice in primary care, perhaps because of the low accuracy of the *H. pylori* rapid test used in primary care settings. Scoring systems aimed at selecting patients suitable for endoscopy, based on clinical symptoms and patients' characteristics, have shown higher predictive accuracy for the diagnosis of organic disease than *H. pylori* testing in environments with a high prevalence of infection [24]. Varying results have been reported, with sensitivities for the detection of major pathology from 86 to 97%, and savings in endoscopic workload varying between 23 and 33% [25,26].

Apart from all this information, no study has systematically compared the performance of all these strategies. The objective of this study was to assess the effectiveness and cost-effectiveness of several invasive and non-invasive strategies for the management of dyspepsia, i.e. prompt endoscopy, score and scope, test and scope, test and treat, and empirical antisecretory treatment. The results obtained in the present study would help to make recommendations about the optimal management strategy of dyspepsia from a cost-effectiveness point of view.

Methods

A decision analysis was performed to compare the effectiveness and cost-effectiveness of initial endoscopy, score and scope, test and scope, test and treat, and empirical antisecretory therapy for the management of dyspepsia. Figure 1 shows the decision tree used to perform the cost-effectiveness analysis (the complete tree is available from the authors upon request). The decision model considers patients that consult at primary care with uncomplicated dyspepsia, excluding patients with clinical suspicion of isolated reflux disease and patients with alarm clinical symptoms suggestive of malignant disease. At the first decision node, the primary care practitioner should decide between five different management strategies:

1. Endoscopy

The patient is referred for endoscopy. If the results of the endoscopy show a gastric ulcer or extensive erosive gastritis, a biopsy with histological examination is performed. If the results of the endoscopy show duodenal ulcer or erosive duodenitis, a rapid urease test is performed over an antral tissue sample. For positive results, an eradication treatment is prescribed (omeprazole, clarithromycin and amoxicillin for one week); for negative results, an antisecretory treatment is prescribed (omeprazole for 2 months). For oesophagitis and non-ulcer dyspepsia, normal endoscopy or minor lesions (less than five gastric erosions), an antisecretory treatment is also prescribed (omeprazole for 2 months). If the diagnosis is gastric cancer the patient is referred for surgical evaluation.

2. Score and scope

A previously locally validated scoring system [24] is performed on the patient. If the score shows a value equal to or greater than 7, the patient is at high risk of organic disease, and an endoscopy is performed, acting as previously stated. In the absence of alarm symptoms or a score value lower than 7, an antisecretory treatment is given to the patient (omeprazole for 2 months).

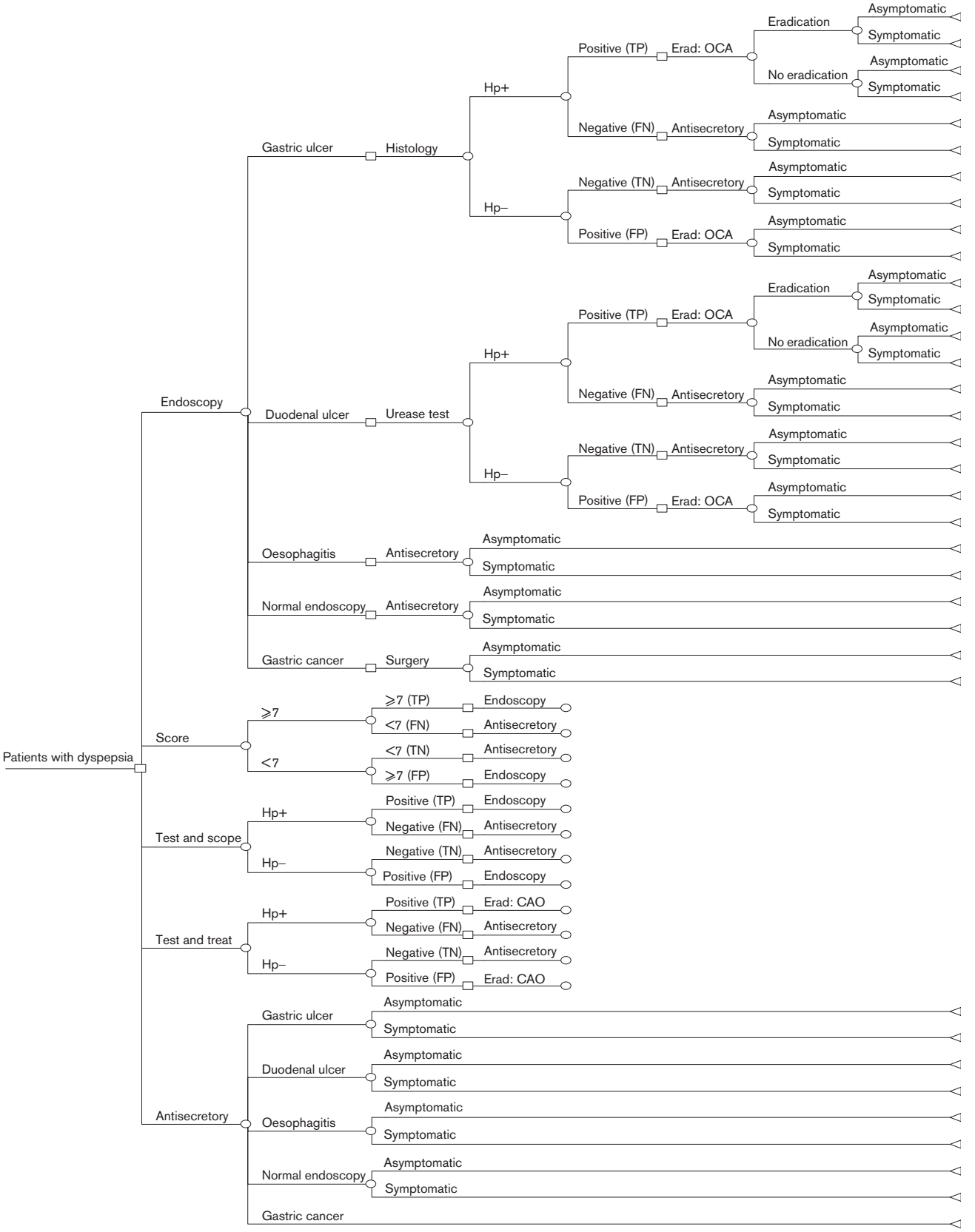
3. Test and scope

During the initial visit, a urea breath test is performed. If the result shows positive for *H. pylori* infection, the patient is referred for endoscopy. From now on, the patient goes through the same steps as in the endoscopy strategy. If the result of the breath test is negative, the primary care practitioner prescribes an antisecretory treatment (omeprazole for 2 months).

4. Test and treat

As in the previous strategy, during the initial visit, a urea breath test is performed. If the results show positive for

Fig. 1



Decision tree used in the analysis. TP, True Positive; FN, False Negative; TN, True Negative; FP, False Positive; CAO, clarithromycin, amoxicillin, and omeprazole.

H. pylori infection, an eradication treatment is prescribed (again omeprazole, clarithromycin and amoxicillin for one week). If the result is negative, an antisecretory treatment is prescribed (omeprazole for 2 months).

5. Empirical antisecretory treatment

During the initial visit, an antisecretory treatment is prescribed (omeprazole for 2 months) without performing any invasive or non-invasive diagnostic test.

Therapeutic effectiveness was measured as the rate of asymptomatic patients one year after the end of the treatment. The diagnostic accuracy values of the diagnostic tests considered in this study and their corresponding data sources, as well as the effectiveness data of the two drug treatments considered are listed in Table 1 [12,13,24,27–66]. Data on the prevalence of different diagnoses of dyspepsia in primary care populations, and rates of *H. pylori* infection are based on available scientific evidence, and on local data from a county hospital with primary care offices, located in an area of southern Europe (Hospital de Viladecans, Barcelona, Spain), which serves a population of 145 000 inhabitants. We also included local prevalence data and rates of infection from patients older and younger than 45 years coming from our sample. Values and references are listed in Table 1.

As the perspective of analysis used was that of the public healthcare payer, only direct costs were included in the analysis, which corresponded to the cost of visits to a primary care practitioner, the cost of diagnostic tests, and the cost of drug treatments. In the endoscopy strategy (and all the strategies including endoscopy), one clinical visit to a primary care practitioner, an endoscopy, and a second visit to the primary care practitioner to check the endoscopic results and prescribe treatment were included. In the score and scope strategy, only one visit was included, because at the first visit the score is performed and the treatment prescribed. In the case of performing an endoscopy, the costs are as previously described. In the test and scope and test and treat strategies, two visits were included, because two visits are necessary to perform a breath test and check the results. Once the results are known, the physician could prescribe the treatment during the second visit, or refer the patient for endoscopy if needed (again, as previously described). In the case of empirical treatment, only one visit to the primary care practitioner was included.

The cost of both diagnostic tests and medical visits were estimated through costs, looking them up in the accounting system of the Hospital de Viladecans for 2001. In the sensitivity analysis, however, we included a lower and an upper bound. The lower bound corresponded to cost data coming from the tariff system used to reimburse the activity of public hospitals in Catalonia, estimated from administrative data from the Catalan Health Service for 2001, actualized to 2003. The upper bound corresponded to schedule fees used to reimburse activity by private insurers for 1997, actualized to 2003. For gastric cancer we included an estimated cost of surgery, also coming from the accounting system of the same hospital. For the estimation of the cost of drug therapies an eradication therapy comprising clarithromycin (500 mg every 12 h, for one week), amoxicillin (1000 mg every 12 h, for one week), and omeprazole (20 mg every 12 h, for one week) was considered, as well as an antisecretory therapy comprising omeprazole (20 mg every 24 h, for 2 months). The reference list prices of these drugs were used as a measure of the cost of the different therapies in 2001. All costs were actualized and converted to 2003 Euros using a 3% inflation rate, and are shown in Table 1.

The measure of the economic analysis, the incremental cost-effectiveness ratio, was cost per asymptomatic patient, valued in 2003 Euros. The incremental cost-effectiveness ratio was calculated as the additional cost of each strategy over the previous least costly alternative, divided by its additional effectiveness; empirical treatment was used as the reference alternative to calculate incremental values. The time-horizon established was one year post-therapy, and no discount rate was used because costs and benefits occurred in a period shorter than one year. Different one-way and two-way sensitivity analyses were performed to test the robustness of both the model and the results obtained against variations in the baseline variables. The model was designed to be internally consistent, i.e. the prevalence of each condition is the same in each strategy; when performing sensitivity analyses, just one or two variables were varied at a time. Data analyses were performed using Microsoft Excel and Data 3.5 Windows software packages (see Fig. 2).

Results

Endoscopy was found to be the most effective strategy for the management of dyspepsia, followed by test and scope, test and treat, score and scope, and empirical treatment (Table 2). A total of 38.4% of the patients were asymptomatic within one year in the endoscopy group, followed by 35.5% in the test and scope group, 35.3% in the test and treat group, 34.7% in the score and scope group, and 28.5% in the empirical treatment group.

According to the age of the patients, endoscopy was also found to be the most effective strategy, although there were some changes in the relative order of the rest of the strategies. In particular, for patients older than 45 years, 39.8% were asymptomatic in the endoscopy group after one year, 37.0% in the test and treat group, 36.6% in the test and scope group, 35.4% in the score and scope group, and 28.5% in the empirical treatment group.

Table 1 **Data used in the analysis**

Data	Value[a]	<45	>45	Min–max values	References
Endoscopy					
% Gastric ulcer after endoscopy	6.7	4.9	8.8	2.2–13.0	24,27,28
% Duodenal ulcer after endoscopy	20.4	18.6	22.4	7.2–34.0	24,29–31
% Oesophagitis after endoscopy	10.2	8.3	12.4	12.1–28.0	24,28,29–32
% Functional dyspepsia after endoscopy	62.4	68.2	55.7	52.0–77.0	24,28,32,33
% Gastric cancer after endoscopy	0.3	0.0	0.6	0.05–2.0	24,28,31
Prevalence of Hp+ in gastric ulcer	70.0	57.0	80.0	65.4–85.0	24,34
% Eradication of Hp+ in gastric ulcer	80.0			70.0–91.0	35,36
% Healing after eradication in gastric ulcer	95.0			95.0–100.0	35–39
% Healing after no eradication in gastric ulcer	20.0			0.0–22.0	40
Prevalence of Hp+ in duodenal ulcer	91.0	93.0	89.0	72.8–95.0	24,34,41
% Eradication in duodenal ulcer	80.0			70.0–90.0	35,42,43
% Healing after eradication in duodenal ulcer	85.0			85.0–100.0	35,38,42–44
% Healing after no eradication of duodenal ulcer	20.0			10.0–22.0	40
% Healing of oesophagitis with antisecretory treatment	25.0			20.0–30.0	45,46
% Healing of functional dyspepsia with antisecretory treatment	30.0			7.0–38.0	12,40,47–49
% Healing of gastric cancer with surgery	17.0			–	50
Score					
% Dyspeptic patients with score $\geqslant 7$	43.4	39.2	48.5		24,51
% Dyspeptic patients with score $\geqslant 7$ with gastric ulcer	11.7	10.0	13.4		24,51
% Dyspeptic patients with score $\geqslant 7$ with duodenal ulcer	35.2	37.5	32.9		24,51
% Dyspeptic patients with score $\geqslant 7$ with oesophagitis	18.5	16.2	20.7		24,51
% Dyspeptic patients with score $\geqslant 7$ with functional dyspepsia	34.6	36.3	33.0		24,51
% Dyspeptic patients with score $\geqslant 7$ with gastric cancer	0.0	0.0	0.0		24,51
% Dyspeptic patients with score < 7	56.5	60.7	51.4		24,51
% Dyspeptic patients with score <7 with gastric ulcer if an endoscopy would be performed	2.8	1.6	4.6		24,51
% Dyspeptic patients with score <7 with duodenal ulcer if an endoscopy would be performed	9.0	6.4	12.6		24,51
% Dyspeptic patients with score <7 with oesophagitis if an endoscopy would be performed	3.8	3.2	4.6		24,51
% Dyspeptic patients with score <7 with functional dyspepsia if an endoscopy would be performed	83.9	88.8	77.1		24,51
% Dyspeptic patients with score <7 with gastric cancer if an endoscopy would be performed	0.5	0.0	1.1		24,51
Test and scope					
% Dyspeptic patients with Hp+	67.0	65.0	68.0	26.0–67.5	12,13,24,32,34,47,48
Prevalence of Hp+ in gastric ulcer	7.1	4.3	10.5	2.3–11.3	12,34
Prevalence of Hp+ in duodenal ulcer	31.3	30.1	32.9	5.0–47.0	12,13,24,52
Prevalence of Hp+ in oesophagitis	12.4	10.8	14.4	5.0–22.2	12,24,34,46
Prevalence of Hp+ in functional dyspepsia	48.5	54.8	40.7	34.0–57.0	12,24,34,46,52
Prevalence of Hp+ in gastric cancer	0.6	0.0	1.3	0.0–0.5	24,34,47
% Dyspeptic patients with Hp–	33	35	32	32.5–74.0	24,32,34,46,47
Prevalence of Hp+ in gastric ulcer	5.9	6.1	5.5	3.0–3.6	24,34,47
Prevalence of Hp+ in duodenal ulcer	5.9	4.1	8.3	2.0–19.2	24,34,47
Prevalence of Hp+ in oesophagitis	8.2	6.1	11.1	16.3–18.3	24,34,47
Prevalence of Hp+ in functional dyspepsia	80	83.6	75	53.2–73.0	24,34,47
Prevalence of Hp+ in gastric cancer	0.0	0.0	0.0	0.0–5.0	24,34,47
Test and treatment					
% Eradication in functional dyspepsia	85.0			85.0	52
% Healing of oesophagitis after eradication	5.0			0.0–10.0	Personal communication
% Healing of functional dyspepsia after eradication	20.0			17.0–58.0	12,46–48,53,54
% Healing of gastric cancer after eradication	0.0			–	Personal communication
Empirical treatment					
% Healing of gastric ulcer with antisecretory treatment	47.0			47.0–60.0	35,38,39
% Healing of duodenal ulcer with antisecretory treatment	20.0			20.0–45.0	38,39,54
% Healing of oesophagitis with antisecretory treatment	25.0			20.0–30.0	40,45
% Healing of gastric cancer with antisecretory treatment	0.001				40
Diagnostic accuracy					
Sensitivity urea breath test	95.0			90.0–100.0	53–58
Specificity urea breath test	90.0			85.0–100.0	56,58–62
Sensitivity urease test	85.0			80.0–95.0	56,60
Specificity urease test	90.0			85.0–100.0	56,60
Sensitivity histology	95.0			85.0–98.0	56,60,63
Specificity histology	95.0			90.0–100.0	63
Sensitivity score	74.0			76.0–85.0	24
Specificity score	70.0			60.0–76.0	24
Costs[b]					
Cost of eradication therapy	56.48				64
Cost of antisecretory therapy	50.16				64
Cost of digestive endoscopy and biopsy	45.00			26.67–121.76	65,66
Cost of urea breath test	46.86			41.61–76.51	65,66
Cost of urease test	3.41			3.69–50.51	65,66
Cost of histology	20.81			23.62–33.44	65,66
Cost of visit to general practitioner or specialist	25.73			35.64–44.63	65,66
Cost of surgery	2466.55				65,66

Hp+, *Helicobacter pylori* positive; Hp–, *H. pylori* negative.
[a]Values are expressed in percentages.
[b]Costs are in 2003 Euros.

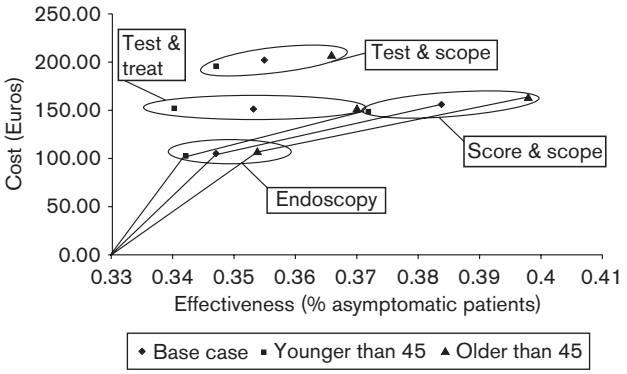
The sensitivity analyses showed variations in a few cases. For low values of prevalence of duodenal ulcer, test and treat is the most effective strategy (35.3%), followed by score and scope (34.7%); for high values of prevalence of gastric ulcer, endoscopy is the most effective strategy (40.9%), but is followed by score and scope (37.2%). For low values of healing of functional dyspepsia with antisecretory and eradication drugs, test and treat is the most effective strategy, followed by endoscopy. Finally, for low values of prevalence of *H. pylori* in dyspepsia, endoscopy is the most effective strategy (38.4%), followed by score and scope (34.7%), test and scope (32.7%), test and treat (31.9%), and empirical treatment (28.5%) (Table 2).

With regard to efficiency results and looking to incremental cost-effectiveness ratios, score and scope was the most cost-effective alternative. Score and scope provided additional clinical benefits over empirical treatment for 6.2% asymptomatic patients, and increased total costs by 29.96 Euros, resulting in an incremental cost-effectiveness ratio of 483.17 Euros per asymptomatic patient. Endoscopy increased effectiveness by 3.7% over score and scope, and total costs by 51.68 Euros, resulting in an incremental cost-effectiveness ratio of 1396.85 Euros per asymptomatic patient.

Although the absolute values of the incremental cost-effectiveness ratios vary according to the age of the patients, the relative order of the strategies do not vary for patients younger and older than 45 years (Table 3). Sensitivity analysis showed variations in a few cases. When using low prevalence values of duodenal ulcer, low values of healing of functional dyspepsia with antisecretory treatment, and high values of healing of functional dyspepsia with eradication treatment, score and scope was the most cost-effective alternative, followed in those cases by test and treat (Table 3).

The results do not change when varying the prevalence of *H. pylori* in dyspepsia, score and scope being the most cost-effective strategy, followed by endoscopy. No two-way sensitivity analyses showed variations with respect to the base case results.

Fig. 2



Incremental cost-effectiveness of the strategies (base case analysis, and age variations). The slope of the line indicates incremental cost-effectiveness. Strategies above and left are dominated (more expensive and/or less effective).

Discussion

The results of our analysis show that endoscopy was the most effective alternative, whereas score and scope was the most cost-effective strategy.

The score and scope strategy is the main novelty of this analysis. The strategy is based on the selection of candidates for endoscopy by using a predictive model constructed by our group [24]. This predictive model for organic dyspepsia is a simple diagnostic tool, based on clinical symptoms and patient characteristics. It has a global predictive accuracy of 79%, with a sensitivity of 74% and a specificity of 70%. The good predictive accuracy of this scoring model has recently been

Table 2 Effectiveness of the strategies[a]

Scenario	Endoscopy	Score & scope	Test & scope	Test & treat	Empirical therapy
Base case	0.384	0.347	0.355	0.353	0.285
Sensitivity analysis					
Patients <45 years old	0.372	0.342	0.347	0.340	0.285
Patients ⩾ 45 years old	0.398	0.354	0.366	0.370	0.285
Prevalence of duodenal ulcer 0.072	0.343	0.347	0.328	0.353	0.298
Prevalence of duodenal ulcer 0.34	0.426	0.347	0.383	0.353	0.271
Prevalence of gastric ulcer 0.022	0.366	0.347	0.343	0.353	0.277
Prevalence of gastric ulcer 0.13	0.409	0.347	0.372	0.353	0.296
Healing of functional dyspepsia with antisecretory treatment 0.07	0.240	0.203	0.201	0.294	0.141
Healing of functional dyspepsia with antisecretory treatment 0.38	0.433	0.397	0.409	0.373	0.335
Healing of functional dyspepsia with eradication treatment 0.17	0.384	0.347	0.355	0.343	0.285
Healing of functional dyspepsia with eradication treatment 0.58	0.384	0.347	0.355	0.480	0.285
Prevalence of Hp in dyspepsia 0.26	0.384	0.347	0.327	0.319	0.285
Prevalence of Hp in dyspepsia 0.675	0.384	0.347	0.355	0.353	0.285

Hp, *Helicobacter pylori*.
[a]Effectiveness is measured as proportion of asymptomatic patients.

Table 3 **Cost-effectiveness of the strategies**

Scenario	Cost-effectiveness	Cost	Effectiveness	Incremental cost-effectiveness
Base case – costs				
Empirical treatment	266.29	75.89	0.285	–
Score & scope	305.04	105.85	0.347	483.17
Test & treat	433.18	152.91	0.353	Dominated*
Endoscopy	410.24	157.53	0.384	1396.85
Test & scope	571.32	202.82	0.355	Dominated
Tariffs				
Empirical treatment	301.06	85.80	0.285	–
Score & scope	405.12	140.58	0.347	883.46
Endoscopy	414.80	159.28	0.384	505.58
Test & treat	475.32	167.79	0.353	Dominated
Test & scope	597.75	212.20	0.355	Dominated
Private fees				
Empirical treatment	488.51	139.23	0.285	–
Score & scope	655.93	227.61	0.347	1425.52
Test & treat	692.60	244.49	0.353	Dominated*
Endoscopy	834.18	320.33	0.384	2505.88
Test & scope	1073.14	380.96	0.355	Dominated
Patients <45 years				
Empirical treatment	265.74	75.74	0.285	–
Score & scope	299.83	102.54	0.342	470.28
Endoscopy	401.44	149.34	0.372	1462.31
Test & treat	449.36	152.78	0.340	Dominated
Test & scope	565.86	196.35	0.347	Dominated
Patients >45 years				
Empirical treatment	266.69	76.01	0.285	–
Score & scope	309.47	109.55	0.354	486.17
Test & treat	412.89	152.77	0.370	Dominated
Endoscopy	416.59	165.80	0.398	1278.42
Test & scope	571.99	209.35	0.366	Dominated
Prevalence of duodenal ulcer 0.072				
Empirical treatment	254.50	75.84	0.298	–
Score & scope	305.04	105.85	0.347	612.41
Test & treat	433.18	152.91	0.353	7843.94
Endoscopy	455.63	156.28	0.343	Dominated
Test & scope	616.49	202.21	0.328	Dominated
Prevalence of duodenal ulcer 0.34				
Empirical treatment	279.63	75.78	0.271	–
Score & scope	305.04	105.85	0.347	395.65
Test & treat	433.18	152.91	0.353	Dominated*
Endoscopy	372.55	158.71	0.426	669.08
Test & scope	531.50	203.56	0.383	Dominated
% Healing of functional dyspepsia with antisecretory treatment 0.07				
Empirical treatment	536.44	75.64	0.141	–
Score & scope	520.68	105.70	0.203	484.84
Test & treat	519.16	152.63	0.294	515.77
Endoscopy	655.14	157.23	0.240	Dominated
Test & scope	1010.83	203.18	0.201	Dominated
% Healing of functional dyspepsia with antisecretory treatment 0.38				
Empirical treatment	226.6	75.91	0.335	–
Score & scope	266.63	105.85	0.397	482.92
Test & treat	409.58	152.77	0.373	Dominated
Endoscopy	363.04	157.56	0.434	1397.49
Test & scope	496.27	202.97	0.409	Dominated
% Healing of functional dyspepsia with eradication treatment 0.17				
Empirical treatment	266.29	75.89	0.285	–
Score & scope	305.04	105.85	0.347	483.17
Test & treat	445.92	152.95	0.343	Dominated
Endoscopy	410.24	157.53	0.384	1396.85
Test & scope	571.32	202.82	0.355	Dominated
% Healing of functional dyspepsia with eradication treatment 0.58				
Empirical treatment	266.29	75.89	0.285	–
Score & scope	305.04	105.85	0.347	483.17
Test & treat	318.08	152.68	0.480	352.10
Endoscopy	410.24	157.53	0.384	Dominated
Test & scope	571.32	202.82	0.355	Dominated
Prevalence of Hp in dyspepsia 0.26				
Empirical treatment	266.29	75.89	0.285	–
Score & scope	305.04	105.85	0.347	483.17
Test & treat	472.45	150.71	0.319	Dominated
Endoscopy	410.24	157.53	0.384	1396.85
Test & scope	534.64	174.83	0.327	Dominated
Prevalence of Hp in dyspepsia 0.675				
Empirical treatment	266.29	75.89	0.285	–
Score & scope	305.04	105.85	0.347	483.17
Test & treat	432.75	152.76	0.353	Dominated*
Endoscopy	410.24	157.53	0.384	1396.85
Test & scope	571.73	203.54	0.356	Dominated

Hp, *Helicobacter pylori*. Dominated*, strategy dominated using the 'extended dominance' criteria. Strategies are listed in order of increasing cost.

evaluated prospectively, confirming a value of 75% for organic dyspepsia when applied by primary care doctors and of 82% when applied by gastroenterologists [51]. The higher discriminant power of the scoring system over the *H. pylori* test [24] can explain the higher efficiency of score-based strategies over *H. pylori* testing strategies. This scoring system has been shown to be very useful in the process of the referral of dyspeptic patients from primary care to endoscopy units [51,67], especially in cases of long waiting lists for endoscopy [68].

Other studies have analysed the cost-effectiveness of different strategies in dyspepsia by using decision analyses with different results [19,69–72]. Most of them suggest that test and treat, or empirical antisecretory treatment [9,23,73] are more cost-effective than endoscopy, whereas others have shown that endoscopy is the most cost-effective approach [21,22].

One important aspect to consider in the approach to dyspepsia is gastric cancer. Although an initial endoscopy strategy would detect all tumours, and some cancers can be missed if prompt endoscopy is not performed, a decrease in gastric cancer survival is not clearly demonstrated if an endoscopy is delayed a couple of months [74]. The incidence of cases of gastric cancer are negligible in younger patients in our population [24], and alarm symptoms are usually good predictors of the suspicion of gastric cancer [75], which will be detectable with a score and scope strategy. Test and scope cannot detect all gastric cancers because a small percentage of tumours are *H. pylori* negative. Neither test and treat nor empirical treatment could detect any gastric cancer case, although in some contexts eradication treatment has proved to be useful in reducing the development of some cases [76].

Several limitations should be pointed out in this analysis associated with the assumptions used, and in defining the baseline clinical-economic setting of care. First, local data come from an area of high prevalence of *H. pylori* infection (68–70%) [24,77] and a prevalence of ulcer disease among dyspeptic patients of 27% [24]. The high rate of ulcer disease is probably due to the fact that local data were obtained in a study on the relationship of symptoms of dyspepsia with endoscopic diagnosis, in which the delay between inclusion and the performance of endoscopy was less than 10 days. Recent studies have shown that the rate of ulcers among dyspeptic patients is decreasing [78,79], and other authors believe that lower rates of peptic ulcer among dyspeptic patients only reflect ulcer disease healed during the waiting list period for endoscopy [78]. However, it is very important to point out that the decision analysis model was robust in the face of changes in the prevalence of some organic diseases, the prevalence of *H. pylori*, the accuracy of diagnostic tests, and the age of the patients, score and scope being the most efficient strategy, followed by endoscopy. In particular, results did not change for higher and lower values of the prevalence of *H. pylori* in dyspepsia, ensuring the generalizability of the results to contexts with a lower *H. pylori* prevalence.

Second, the temporal horizon considered in the analysis was one year post-therapy, according to the effectiveness measure used and the costs included in the analysis (i.e. the number of asymptomatic patients in each branch one year after the initial treatment). This fact is relevant because it does not allow the inclusion of alternative or complementary diagnostic procedures and therapies after the first year of treatment, neither does it take into consideration relapses or the worsening of diseases, *H. pylori* infection, or resistance to the eradication treatment used. We abstained from constructing a longer time horizon model, to avoid the problems that assumptions about disease recurrence and alternative treatments would impose. In case there was good quality scientific evidence on these variables, a longer time horizon should be used in order to include all the consequences of the therapies. In addition, recent studies about quality of life of dyspeptic patients suggest lower cost-effectiveness ratios for those strategies that emphasize early eradication [80].

Third, because the analysis was carried out from the perspective of the public healthcare payer instead of the societal perspective, no indirect costs were included in the model. Productivity losses could be relevant in dyspepsia, a disease with high associated indirect costs as a result of the symptoms, tests, and medical visits [81]. However, one could say that productivity losses would be smaller in the case of score and scope, an alternative that involves the least number of medical visits, and the least delays in terms of, for example, waiting time for results of tests and invasive procedures.

Fourth and also related to costs, in the base case analysis we used costs obtained from the accounting system of the hospital. When using public tariffs in the sensitivity analysis, cost-effectiveness ratios are slightly higher, because tariffs are higher or lower than costs, depending on the procedure. Tariffs, as charges, do not usually reflect the real cost of procedures [82,83]. Using higher estimations of costs, the reimbursement fees of private insurers, the model yielded higher cost-effectiveness ratios, but maintained the same relative order of the compared alternatives (Table 3). Therefore, one could say that the same results would be obtained in other healthcare contexts in which, for example, endoscopy costs are much higher [84].

Finally, the decision analysis had implicitly adopted percentages of compliance with drug therapies and diagnostic test uptakes of 100%. The risks associated

with the performance of any of the specific diagnostic tests were not considered in the analysis, nor were the adverse effects of antisecretory and eradication therapies, or endoscopy. Dyspeptic symptoms cause significant disutility that should be incorporated into future cost-effectiveness analyses of management strategies [85]. In this sense, the inclusion of patient preferences regarding the different diagnostic tests may be an interesting research area, using the most recently published scientific evidence and applying cost–utility analysis. Although we are aware of the recommendations of the Panel on Cost-effectiveness Analysis about the use of QALYs [86], we did not use them because of the absence of validated data on quality of life about dyspepsia in our context [87].

In conclusion, the current analysis showed that a management strategy based on score and scope is the most cost-effective approach. According to these results, we would recommend stratifying patients by a score system, referring first to endoscopy patients at higher risk of organic dyspepsia. Further studies taking into account the limitations found in this study should be designed, both with regard to the quality of scientific evidence on effectiveness data, the validity of the assumptions of the baseline analysis, and the measured costs, considering always its applicability in primary care [87,88]. In the meantime, the results of this study could be included in clinical practice guidelines, once validated in each particular setting, contributing to decrease the existing variations, and to higher standards of care.

Acknowledgements

The authors are gratefully indebted to Xavier Calvet for his wise and always helpful comments, to Francesc Gudiol for his help in the evaluation of the clinical aspects of *H. pylori* infection, to Josep Lluis Nin for calculation of the costs in our hospital, and to Margarida Admetlla for her encouraging attitude in our work.

Conflict of interest

None declared.

Authors' contributions

All authors have contributed to the design, analysis, discussion, writing, and critical review of the paper. AGA designed the decision tree, performed the analysis, and wrote the paper. RR, MB, and AA provided clinical data, performed the literature review, and reviewed the paper. VM, JMVP, and JMP provided statistical and clinical insights, and reviewed the paper.

References

1 Drossman DA, Li Z, Andruzzi E, Temple RD, Talley NJ, Thompson WG, *et al.* US Householder survey of functional gastrointestinal disorders. Prevalence, sociodemography, and health impact. *Dig Dis Sci* 1993; **38**:1569–1580.
2 Collin Jones DG, Bloom B, Bodemar G, Crean G, Freston J, Gugler R, *et al.* Management of dyspepsia: report of a working party. *Lancet* 1988; **i**:576–579.
3 Talley NJ, Stanghellini V, Heading RC, Kock KL, Malagelada JR, Tytgat GNF. Functional gastrointestinal disorders. *Gut* 1999; **45 (suppl 2)**:II37–II42.
4 Moayyedi P, Mason J. Clinical and economic consequences of dyspepsia in the community. *Gut* 2002; **50 (suppl 4)**:iv10–iv12.
5 American College of Physicians. Endoscopy in the evaluation of dyspepsia. *Ann Intern Med* 1985; **102**:226–229.
6 Delaney BC, Innes MA, Deeks J, Wilson S, Oakes R, Moayyedi P, *et al.* Initial management strategies for dyspepsia. *Cochrane Database Syst Rev* 2000; **2**:CD001961.
7 Delaney BC. Why do dyspeptic patients over the age of 50 consult their general practitioner? A qualitative investigation of health beliefs relating to dyspepsia. *Br J Gen Pract* 1998; **48**:1481–1485.
8 Laheij RJ, Severens JL, Jansen JB, van de Lisdonk EH, Verbeek AL. Management in general practice of patients with persistent dyspepsia. A decision analysis. *J Clin Gastroenterol* 1997; **25**:563–567.
9 Laheij RJ, Severens JL, van de Lisdonk EH, Verbeek AL, Jansen JB. Randomised controlled trial of omeprazole or endoscopy in patients with persistent dyspepsia; a cost-effective analysis. *Aliment Pharmacol Ther* 1998; **12**:1249–1256.
10 Moayyedi P, Soo S, Deeks J, Delaney B, Harris A, Innes M, *et al.* Eradication of *Helicobacter pylori* for non-ulcer dyspepsia (Cochrane Review). *Cochrane Database Syst Rev* 2001; **1**:CD002096.
11 Manes G, Menchise A, de Nucci C, Balzano A. Empirical prescribing for dyspepsia: randomised controlled trial of test and treat versus omeprazole treatment. *BMJ* 2003; **326**:1118–1121.
12 Patel P, Khulusi S, Mendall MA, Lloyd R, Jazrawwi R, Maxweel JD, *et al.* Prospective screening of dyspeptic patients by *Helicobacter pylori* serology. *Lancet* 1995; **346**:1315–1318.
13 Mendall MA, Jazrawi RP, Marrero JM, Molineaux N, Levi J, Maxwell JD, *et al.* Serology for *Helicobacter pylori* compared with symptom questionnaires in screening before direct access endoscopy. *Gut* 1995; **36**:330–333.
14 Heaney A, Collins JS, Watson RG, McFarland RJ, Bamford KB, Tham TC. A prospective randomised trial of a ''test and treat'' policy versus endoscopy based management in young *Helicobacter pylori* positive patients with ulcer-like dyspepsia, referred to a hospital clinic. *Gut* 1999; **45**: 186–190.
15 Formoso G, Maestri E, Magrini N, Koch M, Capurso L, Liberati A. Eradicating *Helicobacter pylori* in non-ulcer dyspepsia may not be cost effective [Letter]. *BMJ* 2001; **322**:557.
16 Blum AL, Talley NJ, O'Morain C, van Zanten SV, Labenz J, Stolte M, *et al.* Lack of effect of treating *Helicobacter pylori* infection in patients with nonulcer dyspepsia. Omeprazole plus Clarithromycin and Amoxicillin Effect One Year after Treatment (OCAY) Study Group. *N Engl J Med* 1998; **339**:1875–1881.
17 Moayyedi P, Soo S, Deeks J, Forman D, Mason J, Innes M, *et al.* Systematic review and economic evaluation of *Helicobacter pylori* eradication treatment for non-ulcer dyspepsia. Dyspepsia Review Group. *BMJ* 2000; **321**:659–664.
18 Gillen D, Wirz AA, Ardill JE, McColl KE. Rebound hypersecretion after omeprazole and its relation to on-treatment acid suppression and *Helicobacter pylori* status. *Gastroenterology* 1999; **116**:239–247.
19 Spiegel BMR, Vakil NB, Ofman JJ. Dyspepsia management in primary care: a decision analysis of competing strategies. *Gastroenterology* 2002; **122**:1270–1285.
20 Dooley CP, Larson AW, Stace NH, Renner IG, Valenzuela JE, Eliasoph J, *et al.* Double-contrast barium meal and upper gastrointestinal endoscopy. A comparative study. *Ann Intern Med* 1984; **101**:538–545.
21 Bytzer P, Hansen J. Empirical H2-blocker therapy or prompt endoscopy in management of dyspepsia. *Lancet* 1994; **343**:811–816.
22 Delaney BC, Wilson S, Roalfe A, Roberts L, Redman V, Wearn A, *et al.* Cost-effectiveness of initial endoscopy for dyspepsia in patients over age 50 years: a randomised controlled trial in primary care. *Lancet* 2000; **356**:1965–1969.
23 Delaney BC, Wilson S, Roalfe A, Roberts L, Redman V, Wearn A, *et al.* Randomised controlled trial of *Helicobacter pylori* testing and endoscopy for dyspepsia in primary care. *BMJ* 2001; **322**:898–901.
24 Barenys M, Abad A, Pons JMV, Moreno V, Rota R, Granados A, *et al.* Scoring system has better discriminative value than *Helicobacter pylori* testing in patients with dyspepsia in a setting with high prevalence of infection. *Eur J Gastroenterol Hepatol* 2000; **12**:1275–1282.
25 Davenport PM, Morgan AG, Darnborough A. Can preliminary screening of dyspeptic patients allow more effective use of investigational techniques? *BMJ* 1985; **290**:217–219.
26 Holdstock G, Harman M, Machin D, Patel C, Lloyd RS. Prospective testing of a scoring system designed to improve case selection for upper gastrointestinal investigation. *Gastroenterology* 1986; **90**:1164–1169.
27 Kiill J, Anderson D. X-ray examination and or endoscopy in the diagnosis of gastroduodenal ulcer and cancer. *Scand J Gastroenterol* 1979; **15**:39–43.
28 Mollman KM, Bonnevie O, Gudbrand-Hayer E. A diagnostic study in patients with upper abdominal pain. *Scand J Gastroenterol* 1975; **10**: 105–109.

29 Johnsen R, Bernersen B, Straume B, Forde OH, Bostad L, Burhol PG. Prevalences of endoscopic and histological findings in subjects with and without dyspepsia. *BMJ* 1991; **302**:749–752.

30 Bytzer P, Schaffalitzky de Muckadell OB. Prediction of major pathologic conditions in dyspeptic patients referred for endoscopy. A prospective evaluation of a scoring system. *Scand J Gastroenterol* 1992; **27**: 987–992.

31 Bianchi Porro G, Parente F, Imbesi V, Montrone F, Caruso L. Role of *Helicobacter pylori* in ulcer healing and recurrence of gastric and duodenal ulcers in longterm NSAID users. Response to omeprazole dual therapy. *Gut* 1996; **39**:22–26.

32 Lassen AT, Pedersen FM, Bytzer P, Shaffalitzky de Muckadell OB. *Helicobacter pylori* test and eradicate versus prompt endoscopy for management of dyspeptic patients: a randomised trial. *Lancet* 2000; **356**:455–460.

33 Capurso L, Koch M, Dezi A, Koch G, di Ciocco U. Towards a quantitative diagnosis of dyspepsia: the value of clinical symptoms. *Ital J Gastroenterol* 1988; **20**:191–202.

34 Pilotto A, Franceschi M, Concetta Costa M, Mario FD, Valerio G. *Helicobacter pylori* test and eradication strategy. *Lancet* 2000; **356**: 1683–1684.

35 Van der Hulst RWM, Raws EAJ, Köycu B, Keller JJ, Bruno MJ, Tijssen JGP, *et al.* Prevention of ulcer recurrence after eradication of *Helicobacter pylori*: a prospective long-term follow-up study. *Gastroenterology* 1997; **113**:1082–1086.

36 Sung JJ, Chung SC, Ling TK, Yung MY, Leung VK, Ng EK, *et al.* Antibacterial treatment of gastric ulcers associated with *Helicobacter pylori*. *N Engl J Med* 1995; **332**:139–142.

37 Bermejo F, Boixeda D, Gisbert JP, Defarges V, Martin de Argila C, Sanz JM, *et al.* Effects of *Helicobacter pylori* eradication on the recurrence of gastric ulcer during a 12-month follow up [in Spanish]. *Med Clin (Barc)* 2000; **115**:201–204.

38 Hopkins RJ, Giraldi LS, Turney EA. Relationship between *Helicobacter pylori* eradication and duodenal and gastric ulcer recurrence: a review. *Gastroenterology* 1996; **110**:1244–1252.

39 Van der Hulst RW, Tytgat GN. *Helicobacter pylori* and peptic ulcer disease. *Scand J Gastroenterol Suppl* 1996; **220**:10–18.

40 Silverstein MD, Petterson T, Talley NJ. Initial endoscopy or empirical therapy with or without testing for *Helicobacter pylori* for dyspepsia: a decision analysis. *Gastroenterology* 1996; **110**:72–83.

41 Marshall BJ. *Helicobacter pylori*. *Am J Gastroenterol* 1994; **89 (8 suppl)**:S116–S128.

42 Gené E, Calvet X, Azagra R. Diagnosis of *Helicobacter pylori* after triple therapy in uncomplicated duodenal ulcers – a cost-effectiveness analysis. *Aliment Pharmacol Ther* 2000; **14**:433–442.

43 Gisbert JP, Mur M, Boixeda D, Cena G, Martin de Argila C, Alvarez Baleriola I, *et al.* One-week treatment with omeprazole, clarithromycin and amoxicillin: high efficacy in the eradication of *Helicobacter pylori* and cicatrization of duodenal ulcer [in Spanish]. *Med Clin (Barc)* 1997; **108**:524–529.

44 O'Brien B, Goeree R, Mohamed AH, Hunt R. Cost-effectiveness of *Helicobacter pylori* eradication for the long term management of duodenal ulcer in Canada. *Arch Intern Med* 1995; **155**:1958–1964.

45 Sontag SJ, Hirschowitz BI, Holt S, Robinson MG, Behar J, Malcolm M, *et al.* Two doses of omeprazole versus placebo in symptomatic erosive esophagitis: the US multicenter study. *Gastroenterology* 1992; **102**: 109–118.

46 Tytgat G, Hungin APS, Malfertheiner P, Talley N, Hongo M, Mc Coll K, *et al.* Decision-making dyspepsia in primary and secondary care. *Eur J Gastroenterol Hepatol* 1999; **11**:223–229.

47 McColl K, Murray L, el-Omar E, Dickson A, el-Nujumi A, Wirz A, *et al.* Symptomatic benefit from eradicating *Helicobacter pylori* in patients with non ulcer dyspepsia. *N Engl J Med* 1998; **339**:1869–1874.

48 Blum AL, Arnold R, Stolte M, Fischer M, Koetz HR. Short-course acid suppression treatment for patients with functional dyspepsia: results depend on *Helicobacter pylori* status. *Gut* 2000; **47**:473–480.

49 Talley NJ, Meineche-Schmidt V, Pare P, Duckworth M, Raisanen P, Pap A, *et al.* Efficacy of omeprazole in functional dyspepsia: double-blind, randomized, placebo-controlled trials (the Bond and Opera studies). *Aliment Pharmacol Ther* 1998; **12**:1055–1065.

50 Adshek K, Sanger J, Longmire WP. Cancer of the stomach: review of consecutive ten year intervals. *Ann Surg* 1978; **189**:6–9.

51 Barenys M, Rota R, Moreno V, Villafafila R, García-Bayo I, Abad A, *et al.* Prospective validation of a clinical scoring system for the diagnosis of organic dyspepsia [in Spanish]. *Med Clin (Barc)* 2003; **121**: 766–771.

52 Gisbert JP, Cruzado LM, Benito D, Perez-Poveda L, Gonzalez A, de Pedro M, *et al.* The test and treat strategy in dyspeptic patients. Is it useful? [in Spanish]. *Gastroenterol Hepatol* 2001; **24**:66.

53 Talley NJ, Janssens J, Lauritsen K, Racz I, Bolling-Sternevald E. Eradication of *Helicobacter pylori* in functional dyspepsia: randomised double-blind placebo controlled trial with 12 months of follow-up. The Optimal Regimen Cures Helicobacter Induced Dyspepsia (ORCHID) Study Group. *BMJ* 1999; **318**:833–837.

54 Talley NJ, Vakil N, Ballard ED, Fennerty MB. Absence of benefit of eradicating *Helicobacter pylori* in patients with nonulcer dyspepsia. *N Engl J Med* 1999; **341**:1106–1111.

55 Imperiale TF, Speroff T, Cebul RD, Mc Cullough AJ. A cost analysis of alternative treatments for duodenal ulcer. *Ann Intern Med* 1995; **123**: 665–672.

56 Logan RP. Urea breath tests in the management of *Helicobacter pylori* infections. *Gut* 1998; **43 (suppl 1)**:S47–S50.

57 Scottish Intercollegiate Guidelines Network. Helicobacter pylori. *Eradication in dyspeptic disease*. Edinburgh, Scotland: SIGN; August 1996.

58 Thijs JC, van Zwet AA, Thijs WJ, Oey HB, Karrenbeld A, Stellaard F, *et al.* Diagnostic tests for *Helicobacter pylori*: a prospective evaluation of their accuracy, without selecting a single test as the gold standard. *Am J Gastroenterol* 1996; **91**:2125–2129.

59 Dill S, Payne-James JJ, Misiewicz JJ, Grimble GK, McSwiggan D, Pathak K, *et al.* Evaluation of ^{13}C-urea breath test in the detection of *Helicobacter pylori* and in monitoring the effect of tripotassium dicitrato bismuthate in non-ulcer dyspepsia. *Gut* 1990; **31**:1237–1241.

60 Veldhuyzen van Zanten SJO. A systematic overview (meta-analysis) of outcome measures in *Helicobacter pylori* gastritis trials and functional dyspepsia. *Scand J Gastroenterol* 1993; **28 (suppl)** 199:40–43.

61 García-Altés A, Jovell AJ, Serra-Prat M, Aymerich M. Management of *Helicobacter pylori* in duodenal ulcer: a cost-effectiveness analysis. *Aliment Pharmacol Ther* 2000; **14**:1631–1638.

62 Marshall BJ, Plankey MW, Hoffman SR, Boyd CL, Dye KR, Frierson HF, *et al.* A 20 minutes breath test for *Helicobacter pylori*. *Am J Gastroenterol* 1991; **86**:438–445.

63 Henze E, Malfertheiner P, Clausen M, Burkhardt H, Adam WE. Validation of a simplified carbon-14-urea breath test for routine use for detecting *Helicobacter pylori* noninvasively. *J Nucl Med* 1990; **31**:1940–1944.

64 Thillainayagam AV, Arvind AS, Cook RS, Harrison IG, Tabaqchali S, Farthing MJ. Diagnostic efficiency of an ultrarapid endoscopy room test for *Helicobacter pylori*. *Gut* 1991; **32**:467–469.

65 V-I Vademecum Internacional 2001. *40ª Edición*. Madrid: Medicom, S.A.; 2001.

66 *Catàleg de prestacions de suport diagnòstic i terapèutic de l'ICS: Gabinets d'atenció especialitzada ambulatoria*. 2a edición. Barcelona: Institut Català de la Salut; 2001.

67 Borda F, Echarri A, Martinez A, Elizalde I, Jiménez J, Rodríguez C. Economic study up to a year of two strategies in front of a patient with ulcer clinical symptoms [in Spanish]. *Rev Esp Enf Digest* 1997; **87 (suppl)**:43.

68 Martínez-Sánchez G, Saperas E, Benavent J, Mearin F, Piñol JL, Barenys M, *et al.* Practices of primary care doctors of Barcelona in front of the diagnostic and treatment of *Helicobacter pylori* infection in gastro-duodenal diseases [in Spanish]. *Gastroenterología y Hepatología* 1998; **21**:473–478.

69 Ebell MH, Warbasse L, Brenner C. Evaluation of the dyspeptic patient: a cost–utility study. *J Family Pract* 1997; **44**:545–555.

70 Fendrick AM, Chernew ME, Hirth RA, Bloom BS. Alternative management strategies for patients with suspected peptic ulcer disease. *Ann Intern Med* 1995; **123**:260–268.

71 Moayyedi P, Zilles A, Clough M, Heminbrough E, Chalmers DM, Axon AT. The effectiveness of screening and treating *Helicobacter pylori* in the management of dyspepsia. *Eur J Gastroenterol Hepatol* 1999; **11**:1245–1250.

72 Delaney B, Moayyedi P, Deeks J, Innes M, Soo S, Barton P, *et al.* The management of dyspepsia: a systematic review. *Health Technol Assess* 2000; **4:iii–v**: 1–189.

73 Ladabaum U, Chey WD, Scheiman JM, Fendrick AM. Reappraisal of non-invasive management strategies for uninvestigated dyspepsia: a cost-minimization analysis. *Aliment Pharmacol Ther* 2002; **16**:1491–1501.

74 Gillen D, Mc Coll KE. Does concern about missing malignancy justify endoscopy in uncomplicated dyspepsia in patients aged less than 55 years? *Am J Gastroenterol* 1999; **94**:75–79.

75 Fransen AJ, Fransen GA, Janssen MJ, Muris JW, Laheij RJ, Jansen JB. Meta-analysis: the diagnostic value of alarm symptoms for upper gastrointestinal malignancy. *Aliment Pharmacol Ther* 2004; **20**:1045–1052.

76 Uemara N, Okamoto S, Yamamoto, Matsamura N, Yamaguchi S, Yamakido M, *et al. Helicobacter pylori* infection and the development of gastric cancer. *N Engl J Med* 2001; **345**:784–789.

77 Boixeda D, Gisbert JP, Martín de Argila C, Cantón R, Bermejo F, García Plaza A. Is there any relationship between digestive symptomatology and *Helicobacter pylori* infection? [in Spanish]. *Rev Esp Enferm Dig* 1995; **87**:8–14.

78 Smith T, Verzola E, Mertz H. Low yield of endoscopy in patients with persistent dyspepsia taking proton pump inhibitors. *Gastrointest Endosc* 2003; **58**:9–13.

79 Xia HH, Phung N, Aliparamark E, Berry A, Matheson M, Talley NJ. Reduction of peptic ulcer disease and *Helicobacter pylori* infection but increase of reflux esophagitis in Western Sydney between 1990 and 1998. *Dig Dis Sci* 2001; **46**:2716–2723.

80 Groeneveld PW, Lieu TA, Fendrick AM, Hurley LB, Ackerson LM, Levin TR, Allison JE. Quality of life measurement clarifies the cost-effectiveness of *Helicobacter pylori* eradication in peptic ulcer disease and uninvestigated dyspepsia. *Am J Gastroenterol* 2001; **96**:338–347.

81 Severens JL, Laheij RJ, Jansen JB, Van der Lisdonk EH, Verbeek AL. Estimating the cost of lost productivity in dyspepsia. *Aliment Pharmacol Ther* 1998; **12**:919–923.

82 Finkler SA. The distinction between cost and charges. *Ann Intern Med* 1982; **96**:102–109.

83 Talley NJ. Dyspepsia management in the millennium: the death of test and treat? *Gastroenterology* 2002; **122**:1521–1525.

84 García-Altés A, Jovell AJ, Aymerich M, Serra-Prat M. Thinking globally, analysing locally: cross national comparison of the efficiency of duodenal ulcer treatment. In: 16th Annual Meeting of the International Society of Technology Assessment in Health Care (ISTAHC). The Hague, June 2000.

85 Groenveld PW, Lieu TA, Fendrick AM, Hurley LB, Ackerson LM, Levin TR, *et al.* Quality of life measurement clarifies the cost-effectiveness of *Helicobacter pylori* eradication in peptic ulcer disease and uninvestigated dyspepsia. *Am J Gastroenterol* 2001; **96**:338–347.

86 Gold MR, Siegel JE, Russell LB, Weinstein MC, editors. *Cost-effectiveness in health care and medicine*. New York: Oxford University Press; 1996.

87 Veldhuyzen van Zanten SJ. Assessment of outcome in dyspepsia: has progress been made? *Gut* 2002; **50 (suppl 4)**:v23–v25.

88 Meinecke-Schmidt V, Rubin G, de Wit NJ. *Helicobacter pylori* infection: a comparative review of existing management guidelines. *Family Pract* 2000; **17 (suppl 2)**:S2–S5.

Annex 1. García-Altés A, Puig Junoy J. [A reconsideration of the value of health care spending. New economic approaches and implications for the establishment of public policies in Spain]. In: Puig Junoy J, López-Casasnovas G, Ortún V, eds. [More resources for health?]. Madrid: Masson, 2004.

¿MÁS RECURSOS PARA LA SALUD?

JAUME PUIG-JUNOY *(director)*

Vocal del Consejo de Gobierno e Investigador permanente
del Centro de Investigación en Economía y Salud (CRES);
Catedrático de Escuela Universitaria,
Departamento de Economía y Empresa,
Universitat Pompeu Fabra, Barcelona

GUILLEM LÓPEZ-CASASNOVAS

Director del Centro de Investigación en Economía y Salud (CRES);
Catedrático de Universidad, Departamento de Economía y Empresa,
Universitat Pompeu Fabra, Barcelona

VICENTE ORTÚN RUBIO

Codirector del Centro de Investigación en Economía y Salud (CRES);
Profesor Titular de Universidad, Departamento de Economía y Empresa,
Universitat Pompeu Fabra, Barcelona

MASSON

MASSON, S.A.
Travessera de Gràcia, 17-21 - 08021 Barcelona (España)
Teléfono: (34) 93 241 88 00
www.masson.es

MASSON, S.A.
21, rue Camille Desmoulins - 92789 Issy-les-Moulineaux Cedex 9 - Paris (Francia)
www. masson.fr

MASSON S.P.A.
Via Muzio Attendolo detto Sforza, 7/9 - 20141 Milano (Italia)
www.masson.it

MASSON DOYMA MÉXICO, S.A.
Santander, 93 - Colonia Insurgentes Mixcoac - 03920 México DF (México)

CENTRE DE RECERCA EN ECONOMIA I SALUT-CRES

Colección *Economía de la salud y gestión sanitaria*
Director *Vicente Ortún, CoDirector del CRES*

Para la realización de este trabajo, los autores han contado con la colaboración no condicionada de Farmaindustria, en el marco de un acuerdo con el Centre de Recerca en Economia i Salut (CRES).

El contenido de esta información refleja las conclusiones y hallazgos propios de los autores y no son necesariamente los de Farmaindustria.

ISBN: 84-458-1432-X
Depósito Legal: B. 30.168 - 2004
Composición y compaginación: Fotoletra, S.A. - Paseo de San Juan, 198 - Barcelona (2004)
Impresión: Domingraf, S.L. - Pol. Industrial Can Magarola - Mollet del Vallès (Barcelona) (2004)
Printed in Spain

Colaboradores

Albert Castellanos Maduell	Investigador Asociado, Centro de Investigación en Economía y Salud (CRES); Profesor Asociado, Departamento de Economía y Empresa, Universitat Pompeu Fabra, Barcelona
Anna García-Altés	Agencia de Salud Pública de Barcelona; Investigadora Asociada de la Fundación Instituto de Investigación en Servicios de Salud (IISS), Valencia
Pilar García Gómez	Investigadora Asociada, Centro de Investigación en Economía y Salud (CRES); Profesora Asociada, Departamento de Economía y Empresa, Universitat Pompeu Fabra, Barcelona
Guillem López-Casasnovas	Director del Centro de Investigación en Economía y Salud (CRES); Catedrático de Universidad, Departamento de Economía y Empresa, Universitat Pompeu Fabra, Barcelona
Ricard Meneu de Guillerna	Vicepresidente de la Fundación Instituto de Investigación en Servicios de Salud (IISS), Dirección Territorial de Valencia, Conselleria de Sanitat, Valencia
Anna Merino Castelló	Investigadora Asociada, Centro de Investigación en Economía y Salud (CRES); Profesora Asociada, Departamento de Economía y Empresa, Universitat Pompeu Fabra, Barcelona

Vicente Ortún Rubio — Codirector del Centro de Investigación en Economía y Salud (CRES); Profesor Titular de la Universidad, Departamento de Economía y Empresa, Universitat Pompeu Fabra, Barcelona

Salvador Peiró Moreno — Presidente de la Fundación Instituto de Investigación en Servicios de Salud (IISS), Escuela Valenciana de Estudios de la Salud, Valencia

Ivan Planas Miret — Investigador Asociado, Centro de Investigación en Economía y Salud (CRES); Profesor Asociado, Departamento de Economía y Empresa, Universitat Pompeu Fabra, Barcelona

Jaume Puig-Junoy — Vocal del Consejo de Gobierno e Investigador permanente del Centro de Investigación en Economía y Salud (CRES); Catedrático de Escuela Universitaria, Departamento de Economía y Empresa, Universitat Pompeu Fabra, Barcelona

Índice de capítulos

CAPÍTULO 5

Una reconsideración del valor del gasto sanitario agregado. Nuevos enfoques económicos e implicaciones para la adopción de políticas públicas en España

A. García-Altés y J. Puig-Junoy

Introducción

El objetivo de este capítulo es describir y analizar las aportaciones recientes de la economía de la salud a la interpretación del valor del gasto en servicios sanitarios.

Existe confusión frecuente entre el crecimiento del gasto sanitario (o de alguno de sus componentes) y el aumento del precio de la atención sanitaria. Las medidas económicas del valor de los servicios sanitarios se encuentran sesgadas por el hecho de asumir la hipótesis implícita, utilizada en la contabilidad nacional, de que el valor de los servicios sanitarios es simplemente igual al gasto. Este hecho se debe sobre todo al insuficiente conocimiento y medida de los cambios en los precios de la atención. Para valorar y obtener implicaciones de la observación del crecimiento del gasto sanitario, resulta necesario tratar de separar el aumento de la atención (cantidad y calidad de ésta) del aumento de su precio.

En segundo lugar, es importante tener en cuenta que el crecimiento del gasto sanitario debe ponerse en relación con el valor económico de las mejoras en la supervivencia y en la calidad de vida que las innovaciones introducidas en el campo sanitario hayan aportado. Los estudios que han aplicado nuevos enfoques económicos a este problema, como el análisis coste-beneficio generalizado (ACB), permiten evaluar de forma monetaria el impacto global en condiciones reales de las innovaciones en el tratamiento de una enfermedad a lo largo del tiempo (productividad media de la atención sanitaria).

Finalmente, la reconsideración del valor económico del gasto en servicios sanitarios ha conllevado la descripción y análisis de la construcción de nuevos indicadores del nivel de bienestar atribuible a la atención sanitaria, utilizando medidas que escapan al convencionalismo de la contabilidad nacional. Entre estas nuevas medidas de bienestar, el capital-salud y la renta-salud son una referencia a partir de las cuales puede juzgarse la bondad de los aumentos del gasto sanitario.

Este trabajo se organiza de la forma siguiente. Para analizar estos tres aspectos, se realiza una revisión de las limitaciones metodológicas de las medidas convencionales del gasto sanitario, con especial referencia a la problemática relacionada con la cons-

trucción de índices de precios y a la separación del gasto sanitario en cambios en las cantidades (y la calidad) y cambios en los precios de la atención.

También se revisan los métodos y los principales resultados de la literatura que recientemente ha aplicado el llamado análisis coste-beneficio (ACB) generalizado en el conjunto del gasto sanitario en Estados Unidos y en determinadas enfermedades seleccionadas. Asimismo, se realizan una descripción y un análisis de la posición relativa del sistema sanitario español en los estudios que han llevado a cabo medidas de nuevas magnitudes macroeconómicas que implican una mejor aproximación al bienestar «sanitario», como el capital-salud y la renta-salud. De todo ello se obtienen ilustraciones empíricas y lecciones para la política sanitaria española.

El aumento del gasto no equivale a pagar un precio más elevado por la salud

En una encuesta reciente, la mayoría de economistas de la salud, gestores sanitarios y clínicos españoles confirmaban creer que el cambio tecnológico había sido la causa más importante del aumento en la proporción del PIB destinada a sanidad en los últimos 30 años (Puig-Junoy y cols., 2000). No obstante, en principio, el cambio tecnológico puede hacer aumentar o disminuir el coste de producir determinado servicio sanitario. De hecho, algunas innovaciones han permitido sustituir tratamientos costosos por procedimientos menos caros –sustitución de tratamientos– mientras que otras han conseguido mejoras marginales en el estado de salud del paciente o han implicado una posibilidad de tratamiento nueva para pacientes para los cuales antes no existía ninguna alternativa –extensión de tratamientos– (Gelijns y Rosenberg, 1994). La dirección y el coste del desarrollo económico están directamente relacionados con la manera de tomar las decisiones de adopción de nuevas tecnologías, así como las de utilización de las previamente disponibles.

Las innovaciones tecnológicas no conducen inevitablemente al crecimiento del gasto (inevitabilidad relacionada con la tecnología como factor exógeno a la gestión sanitaria). Ahora bien, el conocimiento descriptivo empírico disponible en el ámbito internacional presenta un consenso aparente al señalar que, en realidad, el efecto global del cambio tecnológico ha llevado a una tendencia al alza en los costes.

La mayoría de los intentos académicos por cuantificar la conexión entre tecnología y aumento del gasto sanitario han optado por la descomposición del crecimiento del gasto, de manera parecida a como se hace en crecimiento económico, y han asignado el factor residual (aquella parte del gasto que no puede explicarse por los otros factores) al cambio tecnológico. Éste ha sido, precisamente, el procedimiento utilizado en el capítulo 3 de este trabajo. Sin embargo, un problema importante que aparece al medir el gasto sanitario es que los índices tradicionales de precios aplicados a los servicios sanitarios y a los medicamentos tienden a confundir los aumentos de coste con aumentos de precios debido a las dificultades para medir los cambios en la calidad del producto que aportan las innovaciones (Berndt y cols., 2002).

Los índices de precios miden los cambios en los precios nominales y, a su vez, tienen importantes aplicaciones y repercusiones al nivel de la vida diaria en la política fiscal y monetaria, en la actualización de impuestos, transferencias, bonos y salarios, pensiones, y en la medida de los cambios en la productividad y los salarios reales, por poner algu-

nos ejemplos. En lo que se refiere a los índices de precios médicos, existen otras razones por las cuales hay que preocuparse, como las dificultades en la medida de los cambios en el producto real y la productividad de los servicios sanitarios, y la medida del gasto en sanidad (Newhouse, 2001).

Los índices de precios incluyen una cesta de mercado de servicios específicos. Los problemas aparecen a la hora de incluir cambios en la calidad de los servicios o servicios nuevos (Newhouse, 2001):

1. Aunque la tecnología asociada a los servicios cambie, la definición de los servicios incluidos en la cesta de mercado no cambia.
2. Lo mismo sucede cuando un fármaco sustituye a un procedimiento quirúrgico, como fue el caso del tratamiento de las úlceras de estómago en la pasada década.
3. El índice de precios sigue sin tener en cuenta la sustitución de procedimientos hospitalarios o extrahospitalarios por fármacos y, en general, la aparición de métodos alternativos más baratos de tratamiento, y no refleja los ahorros que se ocasionan.
4. Tampoco recogen los cambios en la gestión de los pacientes que en el ámbito hospitalario puedan generar una disminución de la estancia.
5. Aunque los nuevos servicios supuestamente aumentan el bienestar con la mejora en el estado de salud, el cambio en el bienestar no queda recogido en los índices de precios oficiales.
6. La frecuencia con que se recalibra el índice es también importante ya que en general tiende a exacerbar estos efectos.
7. Los índices también ignoran todas las mejoras en la eficiencia en la producción de servicios sanitarios.

Un ejemplo recientemente estudiado es el de las enfermedades mentales. El gasto en enfermedades mentales ha ido en aumento y es un área de especialización médica en que hay continuos avances farmacológicos, como han sido los nuevos antipsicóticos. Sin tener en cuenta los cambios en la calidad de la atención, el coste del tratamiento de la esquizofrenia ha aumentado a un ritmo del 0,5 % anual. En cambio, si se mantienen constantes en el tiempo la calidad y las características de los pacientes, el coste medio del tratamiento ha disminuido el 5,5 % (Frank y cols., 2003).

Así pues, los índices de precios tradicionales no recogen los cambios que se suceden en la atención médica y farmacéutica, y las consecuencias para los costes del tratamiento de los pacientes. Dado que no se tiene en cuenta el cambio en la calidad de los productos, todo se asimila a un puro cambio de precios y se realizan valoraciones de gasto sobreestimadas. Al respecto, son varias las recomendaciones de los expertos para mejorar los índices, evitar los sesgos y obtener mejores estimaciones (Newhouse, 2001; Schultze y Mackie, 2002).

Valor económico de los cambios en las tecnologías médicas y farmacéuticas

Para ser de utilidad para la toma de decisiones e informar de su productividad, la medida del valor de las innovaciones médicas ha de tener en cuenta el cambio en los costes y los beneficios obtenidos. Los costes del cambio tecnológico serían los cambios

en los costes presentes y futuros de las condiciones clínicas estudiadas. Los beneficios estarían representados por el valor del cambio en las mejoras del estado de salud y las ganancias en productividad derivadas (menor pérdida de días de trabajo). La diferencia entre el aumento de costes y de beneficios determinará el valor de las innovaciones médicas.

En los últimos años, ha aparecido una literatura creciente que tiene como finalidad llevar a cabo una valoración monetaria de la productividad del cambio tecnológico en el tratamiento de enfermedades concretas a lo largo del tiempo. En realidad, se trata de ACB que huyen de la evaluación de tecnologías concretas en condiciones ideales y que aplican el ACB de manera generalizada a todas las innovaciones aplicadas a una enfermedad determinada en condiciones reales de determinado país o región durante un largo período de tiempo, lo que llamaremos análisis coste-beneficio generalizado. Los resultados de este tipo de estudios permiten una aproximación a la productividad media de la atención.

Desde el punto de vista del método empleado, el grado de sofisticación analítica puede ser bastante diferente. Una primera propuesta sería la utilizada por Cutler y McClellan, analizando varias condiciones clínicas específicas (Cutler y Berndt, 2001; Cutler y McClellan, 2001a). A partir de datos agregados de gasto en diferentes momentos del tiempo, puede calcularse el coste del tratamiento de cada una de las condiciones clínicas. De manera parecida, y a partir de datos de supervivencia, puede calcularse el aumento en el número de años de vida ganados por pacientes tratados con un mismo problema de salud en diferentes momentos del tiempo, a los cuales puede aplicarse un valor económico. La diferencia entre el valor económico de los años de vida ganados y el aumento en el coste del tratamiento refleja la productividad de las tecnologías aplicadas al tratamiento de las condiciones clínicas seleccionadas.

El caso de los niños con bajo peso al nacer es bastante espectacular como ejemplo, tal y como ilustran Cutler y McClellan, a partir de un análisis realizado con datos de Estados Unidos (Cutler y McClellan, 2001b). Hacia el año 1950, poco podía hacerse para que un niño que naciese con un peso inferior a los 2,5 kg sobreviviese. La mortalidad era del 18 % en estos casos y del 70 % para los que nacían con un peso por debajo de 1,5 kg. Dado que la tecnología de que se disponía para atender a estos niños era más bien escasa, también era reducido el coste que comportaba. Hacia la década de 1990, ya se disponía de muchos más servicios para ayudar a estos niños a sobrevivir, con un coste aproximado de 40.000 dólares, que incluían el coste durante el período del nacimiento, el coste de tratar las complicaciones derivadas del nacimiento prematuro y los costes no médicos relacionados (como la educación especial).

Ahora bien, la mortalidad disminuyó mucho también en ese período de tiempo, ya que representó un aumento de 12 años en la esperanza de vida al nacer para estos niños. Si se da un valor de 100.000 dólares a cada año de vida ganado y se calcula su valor actual, el valor del aumento de la esperanza de vida es de 240.000 dólares por niño. Si se comparan los 240.000 dólares de beneficio con los 40.000 dólares de coste, la conclusión parece clara: los cambios tecnológicos asumidos en esta área han representado un aumento de costes, pero los beneficios aún son mayores. En la tabla 5-1 pueden apreciarse estos resultados, así como las conclusiones de la investigación sobre el valor de los cambios en otras 4 tecnologías médicas y farmacéuticas en Estados Unidos.

Cutler y Huckman presentan un análisis que, con un objetivo parecido, tiene una metodología más sofisticada, aplicada al caso del cambio tecnológico en el tratamiento

Tabla 5-1. Valor de los cambios en las tecnologías médicas y farmacéuticas en Estados Unidos

Condición	Años	Cambio en el coste del tratamiento (en dólares)	Resultado		
			Cambio[a]	Valor (en dólares)	Beneficio neto (en dólares)
Nacidos de bajo peso	1950-1990	40.000	12 AVG	240.000	200.000
Ataque de corazón	1984-1998	10.000	1 AVG	70.000	60.000
Depresión	1991-1996	0	Probabilidad superior de remisión con cierto coste para los ya tratados[b]		
		< 0	Más individuos tratados, con beneficios superiores a los costes		
Cataratas	1969-1998	0	Mejoras sustanciales en la calidad sin ningún aumento de costes para los ya tratados		
		< 0	Más individuos tratados, con beneficios superiores a los costes		
Cáncer de mama	1985-1996	20.000	0,33 AVG	20.000	0

[a]Cambios en la esperanza de vida (AVG: años de vida ganados).
[b]Reducción del 20 % en el coste por remisión.
Adaptado de Cutler y McClellan, 2001b.

de los ataques de corazón (Cutler y Huckman, 2003). Las opciones de tratamiento son básicamente dos: el tratamiento clínico con medicamentos trombolíticos y la cirugía. La cirugía de *bypass*, desarrollada a finales de la década de 1960, permite la inserción de una vena o arteria para obviar la arteria coronaria que está obstruida. La angioplastia, desarrollada a finales de la década de 1970, incorpora el uso de un catéter con el objetivo de deshacer la obstrucción. Hasta entonces, los pacientes con enfermedad coronaria grave eran sometidos a *bypass* coronario mientras que los moderados y menos graves eran tratados de manera médica. Desde mediados de la década de 1990, la angioplastia ha sido utilizada cada vez más (sustitución de tratamientos) con la inserción de *stents* coronarios en la arteria obstruida (TECH, 2001).

El trabajo de Cutler y Huckman se basa en datos demográficos, administrativos y clínicos de pacientes hospitalizados del Estado de Nueva York entre los años 1982 (inicio aproximado del uso generalizado de la angioplastia en Estados Unidos) y 2000. Mediante análisis de regresión se analizó la expansión del uso de la angioplastia y el grado de sustitución entre el *bypass* y la angioplastia en el período de tiempo analizado, así como la relación entre el uso de angioplastia y la mejora de la mortalidad, ajustando por el diferente riesgo de la población que recibía uno u otro tratamiento. Los resultados reflejan que la angioplastia sustituyó al *bypass* coronario de manera progresiva en el período 1989-2000 en el 25 %. Mientras que el crecimiento de las tasas de utilización de la angioplastia representó mayor coste total, este aumento fue compensado por el hecho de sustituir procedimientos de *bypass* (más caros). En cuanto a los resultados clínicos, los pacientes que recibieron una angioplastia tuvieron una probabilidad menor de morir en el hospital que los pacientes que recibieron *bypass*.

Si se asume una supervivencia de 10 años para los pacientes que reciben una angioplastia y un beneficio de 20.000 dólares anuales por paciente curado de un ataque de

corazón (0,2 AVACs × 100.000 dólares), y ninguna ganancia derivada de la sustitución de tratamientos, el beneficio total de la realización de 100 angioplastias es de 2,5 millones de dólares. Si se resta el coste de estas angioplastias (0,5 millones de dólares), el beneficio neto es de 2 millones de dólares (tabla 5-2). Así, puede concluirse que en el área del tratamiento de los ataques de corazón, el aumento del gasto ocurrido es menor que el beneficio obtenido, incluso después de haber tenido en cuenta la expansión y la sustitución de tratamientos acaecida.

Hay dos factores comunes en estos estudios. Primero, al igual que en la mayoría de los casos ilustrados en la tabla 5-1, los aumentos de costes no superan los aumentos en beneficios. Y, en segundo lugar, los estudios utilizan un valor monetario por año de vida ganado. Aunque éste es un parámetro clave en estos estudios, generalmente se toma como una variable exógena y su valoración es muy controvertida. La referencia habitual en este tema son los trabajos de Viscusi (Viscusi, 1993; Viscusi y Adler, 2003), que establece el valor de promedio de 1 año de vida en 100.000 dólares. La justificación de esta cifra procede de estudios sobre el valor estadístico de la vida obtenido a partir de la referencia en el mercado de trabajo, que sitúan este valor entre 70.000 y 175.000 dólares si bien existen metodologías alternativas (Puig-Junoy y cols., 2001). En caso de que se utilicen valores distintos, esto dificulta la comparación de los estudios (Tolley y cols., 1994; Meyer, 2002). También es importante destacar que el uso de un valor promedio no permite contemplar que la valoración del año de vida varía, sobre todo según la edad de los individuos y según la calidad de vida con que se vive la mayor supervivencia.

Medida del bienestar relacionado con la salud de la población

Capital salud

Las mejoras en el estado de salud conseguidas a lo largo del tiempo son, en realidad, un aumento del capital o de los activos de que disponen los individuos. El capital monetario de un individuo es el valor monetario de su riqueza en un momento determina-

Tabla 5-2. Implicaciones de la angioplastia en la productividad médica

Número de angioplastias adicionales	100
Debidas a expansión del tratamiento	68
Debidas a sustitución de tratamientos	32
Beneficio de la expansión del tratamiento	
Número de pacientes curados de ataque de corazón	12,2
Beneficio de ser curado, por paciente y año	20.000 dólares
Supervivencia estimada por paciente	10 años
Beneficio total de ser curado de ataque de corazón	2.448.000 dólares
Beneficio de la sustitución de tratamientos	NC
Beneficio de 100 angioplastias	2.448.000 dólares
Coste de 100 angioplastias	450.014 dólares
Beneficio neto de 100 angioplastias	1.997.986 dólares
Beneficio neto por angioplastia	19.980 dólares

NC: no puede calcularse.
Adaptado de Cutler y Huckman, 2003.

do del tiempo (magnitud de tipo *stock*). El capital humano de los individuos a menudo se ha identificado sólo con el valor de su formación y experiencia, y se ha omitido la importancia del valor de la salud como parte integrante del capital humano. Así, de manera paralela, debería hablarse de capital salud como el valor que tiene la salud (esperanza de vida y calidad de vida relacionada con la salud) de la cual se espera que podrá disfrutar un individuo.

La economía se ha preocupado de medir y estudiar los cambios en el *stock* de capital público y privado de una economía, así como los cambios en su *stock* de capital humano, como factores muy importantes de su crecimiento económico. En el caso de la economía española pueden consultarse magníficas series temporales de capital público, privado y humano producidas por el Instituto Valenciano de Investigaciones Económicas y la Fundación BBVA. Resulta paradójico, en cambio, que aún no se disponga de medidas parecidas para medir y estudiar los cambios en el capital salud, que seguramente es el activo que más se ha transformado a lo largo del siglo XX y uno de los que puede haber contribuido tanto o más que el capital monetario y/o humano al bienestar y al crecimiento económico. Así, ¿cuál es el valor del activo capital salud?, ¿cómo ha cambiado el valor de este activo a lo largo del tiempo?

No ha sido hasta los años más recientes que la literatura económica se ha hecho eco del interés por conocer los cambios en el activo capital salud como magnitud macroeconómica. El valor de un activo monetario depende del valor esperado de las rentas que de él puedan obtenerse. El valor del activo capital salud corresponderá al valor monetario actual de la salud, de la cual se espera que un individuo pueda disfrutar a partir de una edad determinada. Así, por ejemplo, podemos hablar del capital salud al nacer, a los 40 o a los 60 años.

Bajo este punto de vista, puede llevarse a cabo una comparación del tipo ACB generalizado entre el valor monetario del aumento del capital salud para una población determinada a lo largo del tiempo y el valor actual del aumento de la inversión en servicios sanitarios (el mayor coste de las innovaciones médicas y farmacéuticas). El resultado de la comparación será el beneficio neto de la inversión, es decir, podremos saber si el aumento del gasto es mayor o menor que el beneficio obtenido. Ésta es, precisamente, la característica del replanteamiento económico del valor del gasto en sanidad: para saber si gastamos demasiado o demasiado poco en sanidad, hace falta conocer el beneficio neto del gasto o inversión en capital.

Las estimaciones pioneras de la magnitud del capital salud para la economía de Estados Unidos son las de Cutler y Richardson (Cutler y Richardson, 1997, 1998, 1999). Estos autores estiman el capital salud, utilizando información sobre la esperanza de vida de determinada población a cada edad, la prevalencia de problemas de salud para los cuales sobreviven en cada estado y la calidad de vida asociada a la supervivencia con determinado problema de salud.

La salud media de una persona a determinada edad será igual a la probabilidad de sobrevivir hasta aquella edad, multiplicada por la calidad de vida media de los individuos que sobreviven a aquella edad (años de vida ajustados por calidad, AVAC). El coeficiente que mide la calidad de vida se mueve en una escala entre 0 (estado de salud muerte) y 1 (estado de salud perfecta). Si multiplicamos esta salud media a determinada edad por el valor monetario de 1 año de vida en buena salud, constante a lo largo del tiempo e igual para todos los individuos, obtendremos el valor monetario de la salud de este individuo. Por tanto, en la práctica, para llevar a cabo la estimación empírica del ca-

pital salud, hace falta, primero, evaluar la salud a cada edad; segundo, estimar el valor monetario de 1 año de vida en buena salud, y tercero, calcular el valor actual, aplicando una tasa de descuento.

Cutler y Richardson (Cutler y Richardson, 1999) utilizan este enfoque, seleccionando 9 estados de salud identificados en una encuesta de salud en Estados Unidos entre 1970 y 1990, que permite saber la incidencia de cada uno de ellos. El coeficiente de calidad de vida en cada estado de salud lo obtienen a partir de la autopercepción del estado de salud de los encuestados. Los autores escogen un valor monetario del año de vida en buena salud de 100.000 dólares y una tasa de descuento del 3 %. La aplicación de este método para los años 1970 y 1990 en Estados Unidos da como resultado un aumento del capital salud de 94.000 dólares al nacer y de 169.000 dólares a los 65 años (tabla 5-3). Esto equivale a un aumento limitado del 4 % en el *stock* de capital al nacer en estos 20 años y, en cambio, un aumento del 29 % en el *stock* de capital a los 65 años.

Los autores calculan el valor actual del aumento del gasto sanitario por persona en Estados Unidos entre 1970 y 1990 con los mismos parámetros que los utilizados para el cálculo del capital salud y obtienen que el cambio en el gasto sanitario (la inversión) es muy inferior al valor del cambio del capital salud (tabla 5-3). Ahora bien, el capital salud ha aumentado por razones diversas, una de las cuales es la inversión en servicios sanitarios. La *ratio* de efectividad de la tabla 5-3 indica que el 27 % de la mejora en el capital salud debería ser atribuida al mayor gasto sanitario para que el aumento en el capital fuese igual al valor de la inversión (es decir, beneficio neto 0) o, lo que es lo mismo, para que la inversión en tecnologías médicas y farmacéuticas no tenga rentabilidad negativa.

Una opción para contrastar esta situación es calcular el capital salud y el beneficio neto del mayor gasto en tecnologías médicas y farmacéuticas de las cuales se disponga de información directa sobre su contribución a la mejora del estado de salud. En la tabla 5-4 se presentan los resultados de la estimación del capital salud y el beneficio neto de la inversión en el tratamiento de las enfermedades cardiovasculares y el cáncer.

El análisis de estas dos enfermedades concretas pone de relieve que existe una fuerte heterogeneidad en los cambios en el capital salud y en la rentabilidad del gasto en innovaciones, tanto entre enfermedades como entre diferentes grupos de edad. En las enfermedades cardiovasculares, sólo hace falta que el aumento de la inversión sea responsable del 8 % de la mejora en el capital salud para que no se obtenga ninguna rentabilidad negativa en los mayores de 65 años, pero en cambio ha de ser del 64 % para los recién

Tabla 5-3. Crecimiento del capital salud en Estados Unidos (1970-1990)

	Capital salud		Cambio entre 1970 y 1990		Ratio efectividad
	1970	1990	Capital salud	Gasto sanitario	
Al nacer	2.350	2.444	94	25	0,27
A los 65 años	590	759	169	45	0,27

Miles de dólares (tasa de descuento del 3 %).
Adaptado de Cutler y Richardson, 1999.

Tabla 5-4. Variación del capital salud en Estados Unidos atribuible a enfermedades cardiovasculares y cáncer (1970-1990)

		Cambio entre 1970 y 1990		Ratio efectividad
		Capital salud	Gasto sanitario	
Al nacer	Cardiovasculares	5	3	0,64
	Cáncer	−2	3	–
A los 65 años	Cardiovasculares	69	6	0,08
	Cáncer	−12	4	–

Miles de dólares (tasa de descuento del 3 %).
Adaptado de Cutler y Richardson, 1999.

nacidos. La situación para el caso del cáncer parece muy diferente: el cáncer ha reducido el valor del capital salud entre 1970 y 1990 en Estados Unidos tanto al nacer como a los 65 años. La inversión en tratamientos contra el cáncer no pasaría la prueba del valor actual del beneficio neto. Sin embargo, algún trabajo posterior, como el de Lichtenberg (2004), muestra resultados mucho más favorables para los nuevos medicamentos para el tratamiento del cáncer. Este autor ha estimado que, en Estados Unidos, los medicamentos nuevos han aumentado en 1 año la esperanza de vida de los pacientes con cáncer entre 1975 y 1995, lo cual implicaría un coste de 3.000 dólares por año de vida ganado, cifra muy inferior al valor económico del año de vida empleada en la mayoría de estudios económicos.

La única estimación disponible en Europa del valor de los cambios en el capital salud hasta este momento corresponde a Suecia. El estudio de Burström ha calculado el cambio en el capital salud en Suecia entre 1980 y 1981 y entre 1996 1997 (Burström y cols., 2003). En este trabajo se utiliza el mismo valor monetario por AVAC ganado y la misma tasa de descuento que en los trabajos de Cutler y Richardson en Estados Unidos, pero utilizando información sobre calidad de vida mucho más precisa. Los resultados obtenidos para Suecia muestran que el valor monetario del capital salud ha aumentado en el período estudiado si bien la variación es menor para los niños e, incluso, negativa para las niñas (tabla 5-5). En cambio, el mayor aumento del capital salud se presenta en los hombres, en especial entre los mayores de 65 años.

Renta salud

Los cambios en el valor del capital salud a lo largo del tiempo se producen porque cambia la esperanza y la calidad de vida. Al igual que el valor del capital humano depende de la capacidad para generar rentas futuras, el capital salud depende de los años de vida que le queden a un individuo y de su calidad de vida. La renta nacional es el consumo máximo anual que una economía puede permitirse con su dotación de recursos. Si tenemos en cuenta que los avances médicos permiten a las personas vivir más tiempo y con más calidad de vida, entonces se ha de añadir a la medida de renta nacional el valor o la utilidad del consumo equivalente de las mejoras de salud. Esta medida sería la renta salud.

Tabla 5-5. Crecimiento del capital salud en Suecia (1980/1981 y 1996/1997). Tasas de crecimiento real anual acumulativo

Edad	Hombres	Mujeres
Al nacer	0,5	–3,0
A los 16 años	1,9	–1,6
A los 25 años	3,0	–0,2
A los 35 años	4,4	1,8
A los 45 años	7,2	3,8
A los 55 años	10,4	5,5
A los 65 años	13,6	7,9
A los 75 años	17,5	10,1

Miles de dólares (tasa de descuento del 3 %).
Adaptado de Burström y cols., 2003.

Este último enfoque ha sido sugerido recientemente por Nordhaus (Nordhaus, 2002). Si sólo se tienen en cuenta los cambios en la esperanza de vida, este autor encuentra que entre 1975 y 1995 el consumo por persona ha crecido en Estados Unidos a razón del 2 % anual, mientras que el valor de la renta salud aumentó entre el 1,6 y el 2 % anual (tabla 5-6). Desde 1900 hasta 1995, el consumo real creció el 2,1 % anual, mientras que el valor de la renta salud lo hizo entre el 2,2 y el 3 % anual. Así, en conjunto, el crecimiento del valor monetario de las mejoras en la esperanza de vida ha sido, incluso, mayor que el de la renta consumida.

Cabe mencionar como limitación que, por dificultades en las estimaciones y por falta de datos, el autor incluye el valor del aumento de la esperanza de vida, pero no incluye el valor de la reducción en morbilidad. Es razonable asumir que, en caso de incluirse la reducción en morbilidad, aún sería mayor el valor de la mejora en estado de salud. También hay que afirmar que esta aproximación no permite atribuir el aumento en el valor del estado de salud a ningún gasto o inversión específica, ni saber si las mejoras se deben a investigación biomédica o a mejoras en infraestructura y educación para la salud, o si han sido propiciadas por un conocimiento propio o importado. A pesar de esto, esta metodología resulta muy atractiva ya que permite calcular el valor de las ganancias en estado de salud y compararlo con otras magnitudes económicas relevantes en las economías.

De hecho, es interesante observar que uno de los parámetros de comparación del nivel de desarrollo de las economías es la renta *per capita*, tanto a nivel estático como en crecimiento económico y series temporales a lo largo del tiempo. Al respecto, hay evidencia que indica gran divergencia en la renta *per capita* de los países pobres y ricos, y esa divergencia se ha hecho mayor con el tiempo puesto que los países ricos se han hecho más ricos y los pobres han permanecido estancados o con un crecimiento muy pequeño.

Sin embargo, la inclusión de la renta salud en las valoraciones de la renta *per capita* en los países permitiría establecer comparaciones más precisas. El análisis de Becker y cols. (2001) va en esta dirección: tener en cuenta el impacto de la ganancia en esperanza de vida en la evolución del bienestar económico de los países. Los autores asignan valores monetarios a las ganancias en esperanza de vida experimentadas en distintos países

Tabla 5-6. Crecimiento de la renta y de la renta salud en Estados Unidos. Tasas de crecimiento real anual acumulativo

	1900-1925	1925-1950	1950-1975	1975-1995
Consumo	2,0	1,8	2,4	2,0
Renta salud	2,3	3,2	1,8	1,6

Valor monetario del año de vida de 95.300 dólares y una tasa de descuento del 3 %.
Adaptado de Nordhaus, 2002.

entre 1962 y 1995 (Usher, 1973; Rosen, 1988; Murphy y Topel, 1999). La tabla 5-7 presenta los resultados de los valores de las ganancias en esperanza de vida en el caso de distintas regiones del mundo.

Tal y como puede observarse, para los valores de las ganancias en esperanza de vida, el nivel de renta tiene un efecto muy fuerte: las regiones ricas tienden a dar un valor más alto a estas ganancias, aun cuando éstas sean cuantitativamente menores. Australia, Europa y Norteamérica dan un valor de 16.712 dólares a 7 años de vida ganados mientras que África da un valor de 3.229 dólares a 9 años de vida ganados. El efecto positivo de la renta se debe al hecho de que las extensiones marginales en la esperanza de vida son más valiosas para valores más altos de consumo en esta mayor esperanza de vida o, de manera equivalente, para valores más altos de nivel de renta. También puede apreciarse en la tabla 5-7 el crecimiento de Asia, la región que experimenta mayor crecimiento del PNB y de la esperanza de vida en el período de tiempo considerado.

Costa y Steckel hacen estimaciones de renta salud para el período 1800-1970 y llegan a las mismas conclusiones (Costa y Steckel, 1995). En el período 1800-1900, los aumentos en renta fueron insuficientes para compensar la disminución en esperanza de vida. Sin embargo, en el período 1900-1970, el valor del aumento en salud fue muy superior: si bien el PNB de Estados Unidos aumentó el 100 %, su aumento real (incluyendo el valor del aumento en esperanza de vida) fue del 700 %.

Tabla 5-7. Estimaciones de las medidas de renta salud para distintas regiones del mundo (1962 y 1995)

	África	Asia	América Latina y Caribe	Australia, Europa y Norteamérica
PNB 1962 (en dólares de 1995)	550,06	3.967,61	1.965,79	10.201,93
1995	947,40	7.437,15		22.959,94
Esperanza de vida 1962	43	54	59	70
1995	54	71	71	77
Crecimiento del PNB (%)	72,3	263,7	67,0	171,5
Crecimiento de la esperanza de vida (%)	25,6	34,5	22,0	9,4
Valor de las ganancias en esperanza de vida (en dólares de 1995)	3.229,23	21.111,19	7.819,42	16.712,64

Fuente: adaptado de Becker y cols., 2001.

Así pues, la inclusión del valor de la ganancia en esperanza de vida, a la hora de hacer comparaciones de renta nacional entre países, permite comparaciones más precisas sobre el nivel de bienestar de cada país. Los resultados de la tabla 5-7 indican que los cambios recientes en esperanza de vida, contrariamente a los cambios en nivel de renta, han reducido las diferencias en bienestar entre los distintos países del mundo. La inclusión de la esperanza de vida en la medida de bienestar tiende a aumentar la convergencia entre países en el período 1962-1995. Un análisis todavía más completo podría ir un paso más allá y tener en cuenta el hecho de que esta mayor esperanza de vida se traduce, por ejemplo, en una inversión en educación durante más años, hecho que también influye, a su vez, en el desarrollo económico (Becker y cols., 2001; Philipson y Soares, 2001).

Algunas estimaciones empíricas

Becker y cols. (Becker y cols., 2001) presentan estimaciones de los valores de capital y renta salud para muchos países del mundo, incluyendo España. En la tabla 5-8 podemos apreciar el crecimiento del PNB y de la esperanza de vida entre 1962 y 1995 en España, Reino Unido, Estados Unidos y Canadá.

En el período de tiempo analizado, España es el país con mayor crecimiento del PNB (166,4 %), casi el doble del crecimiento del Reino Unido y Estados Unidos (89,2 y 81,2 %, respectivamente), y el triple del de Canadá (52,3 %). El crecimiento de la esperanza de vida es del 10,3 %, valor muy parecido al crecimiento de la esperanza de vida de Canadá (10,4 %), y algo superior al del Reino Unido y Estados Unidos (8,3 y 8,1 %, respectivamente).

España da un valor de 10.705 dólares a 7 años de vida ganados, valor parecido al del Reino Unido, que valora 6 años de vida ganados en 13.917 dólares. En Estados Unidos, en cambio, un aumento de 6 años de vida se valora en 22.146 dólares y en Canadá se valoran 8 años de vida en 21.478 dólares. De nuevo puede apreciarse en este caso el efecto del nivel de renta: los países ricos tienden a dar un valor más alto a las ganancias en esperanza de vida aun cuando éstas sean cuantitativamente menores.

Tabla 5-8. Estimaciones de las medidas de renta salud para España, Reino Unido, Estados Unidos y Canadá (1962-1995)

	España	Reino Unido	Estados Unidos	Canadá
PNB 1962 (en dólares 1995)	5.292,90	9.949,56	14.891,07	12.238,34
1995	14.102,45	18.824,93	26.979,04	18.640,88
Esperanza de vida 1962	70	71	70	71
1995	77	77	76	79
Crecimiento del PNB (%)	166,4	89,2	81,2	52,3
Crecimiento de la esperanza de vida (%)	10,3	8,3	8,1	10,4
Valor de las ganancias en esperanza de vida (en dólares de 1995)	10.705,39	13.917,23	22.146,74	21.478,34

Fuente: adaptado de Becker y cols., 2001.

Resumen e implicaciones políticas

El objetivo de este capítulo ha sido describir y analizar las aportaciones recientes de la economía de la salud a la interpretación del valor del gasto en servicios sanitarios.

Las mejoras en la esperanza de vida han sido espectaculares a lo largo del siglo XX, pues se ha multiplicado la esperanza de vida de hombres y mujeres en más de 2,2 veces entre 1900 y 1995. La mejora de la supervivencia ha tendido a concentrarse en la población de más edad, en especial en los últimos 20 años del siglo XX. La contribución de las innovaciones en las tecnologías médicas y farmacéuticas en la mejora de la esperanza de vida y en la calidad de vida no se encuentra bien establecida. En el caso de las enfermedades cardiovasculares, se ha constatado que el cambio de las tecnologías puede ser responsable hasta del 71 % de la reducción en la mortalidad a los 30 días por infarto agudo de miocardio en Estados Unidos entre 1975 y 1995.

Los resultados de los estudios recientes sobre productividad de las nuevas tecnologías médicas y farmacéuticas implican la necesidad de trasladar el énfasis de la política sanitaria desde la contención del crecimiento del gasto sanitario hacia la consideración de los costes y los beneficios en la salud de las tecnologías.

La distinción entre gasto sanitario y coste de los servicios sanitarios pasa por el uso de índices de precios que permitan hacer estimaciones más precisas del aumento de precios y de la calidad. La construcción actual de estos índices no está exenta de problemas, como las dificultades en la medida de los cambios en el *output* real y la productividad de los servicios sanitarios, y la medida del gasto en sanidad. Los índices de precios no recogen los cambios que se suceden en la atención médica y farmacéutica, y las consecuencias para los costes del tratamiento de los pacientes. Dado que no se tiene en cuenta el cambio en la calidad de los productos, todo se asimila a un puro cambio de precios y se realizan valoraciones de gasto sobreestimadas.

Sin embargo, aunque el gasto aumente, ello no ha de ser necesariamente un hecho negativo o no deseable para la sociedad. Es necesario medir los costes y las consecuencias en salud de las tecnologías médicas, es decir, su productividad. Para ser de utilidad para la toma de decisiones e informar de su productividad, la medida del valor de las innovaciones médicas ha de tener en cuenta el cambio en los costes y los beneficios obtenidos. Los costes del cambio tecnológico serían los cambios en los costes presentes y futuros de las condiciones clínicas estudiadas. Los beneficios estarían representados por el valor del cambio en las mejoras del estado de salud y las ganancias en productividad derivadas. La diferencia entre el aumento de costes y de beneficios determinará el valor de las innovaciones médicas.

El cálculo de la diferencia entre el valor actual del aumento de costes y el valor de las mejoras en el estado de salud derivados de cambios en los tratamientos médicos y farmacéuticos requiere utilizar dos tipos de información sobre la cual se tiene un conocimiento, en general, bastante incierto y que ha mejorado poco en los últimos años. El primero es la parte de la mejora en el estado de salud que es contribución de las innovaciones en los tratamientos y el segundo es el valor monetario o la disponibilidad que debe pagarse por un AVAC. Éstas son líneas de investigación epidemiológica y económica de futuro.

La extensión del análisis coste-beneficio a todo el gasto sanitario ha llevado a la definición y estimación de conceptos económicos interesantes y novedosos, como el capital salud y la renta salud. La inversión en innovaciones médicas y el gasto sanitario a lo lar-

go del tiempo son una inversión en la mejora de la salud de los individuos, es decir, en su capital salud. Algunos trabajos en el caso de Estados Unidos muestran que sería suficiente que el 27 % de las mejoras en el capital salud fueran atribuibles al sistema de salud para que el beneficio neto del gasto sanitario no fuese negativo.

Las estimaciones del capital salud muestran, también en el caso de Estados Unidos, que puede haber una fuerte heterogeneidad en la eficiencia en el tratamiento de diferentes problemas de salud. Mientras que para la gente de edad avanzada el beneficio neto de los tratamientos cardiovasculares sería positivo, si la contribución de los servicios sanitarios a la mejora de la salud de estos pacientes hubiese sido sólo del 8 %, en el caso del cáncer no se observa ninguna mejora del capital salud, a pesar de todo el gasto en innovaciones costosas.

También puede calcularse el valor de la renta salud, es decir, el valor monetario de la renta que se deriva de las mejoras en esperanza de vida, y comparar esta renta con lo que se destina al consumo de bienes y servicios no sanitarios. Los resultados en el caso de Estados Unidos son espectaculares: desde el año 1900 el valor monetario de las mejoras en el estado de salud ha crecido tan rápidamente como el consumo de otros bienes. Las cifras de renta nacional, tal y como se calculan en los sistemas de contabilidad nacional, no han recogido nunca el valor de las mejoras en el estado de salud, razón por la cual son una aproximación muy pobre al bienestar de la población, si se olvidan estos cambios en el estado de salud.

En el caso de España, en el período 1962-1995, España tuvo un crecimiento del PIB del 166,4 %, casi el doble del crecimiento del Reino Unido y Estados Unidos (89,2 y 81,2 %, respectivamente), y el triple del de Canadá (52,3 %). El crecimiento de la esperanza de vida fue del 10,3 %, valor muy parecido al crecimiento de la esperanza de vida de Canadá (10,4 %), y algo superior al del Reino Unido y Estados Unidos (8,3 y 8,1 %, respectivamente). El valor de la ganancia de 7 años de vida acaecida en este período de tiempo es de 10.705 dólares.

Las estimaciones del capital y la renta salud aportan una nueva visión del gasto sanitario, desde la perspectiva de su productividad y su beneficio neto. El hecho de que los resultados globales indiquen que la productividad media del gasto en innovaciones sea positiva y que, en conjunto, su valor social es superior a su coste, no es razón suficiente que justifique el optimismo y el crecimiento indiscriminado del gasto en innovaciones médicas y farmacéuticas. Los resultados disponibles, a pesar del nivel de agregación del análisis, muestran claros indicios de heterogeneidad entre los problemas de salud y tecnologías, así como una productividad marginal decreciente.

La implicación para la toma de decisiones es la necesidad de valorar impactos en los costes y en los beneficios, en términos monetarios, siempre que sea necesario y a pesar de las limitaciones en los métodos, para saber tomar decisiones, no en función de argumentos de gasto, sino por variaciones en el beneficio neto.

De hecho, si el valor de la productividad media de las innovaciones supera los costes, ello no es ninguna indicación de la productividad de las innovaciones a nivel macro ni micro. En cuanto a práctica clínica, la extensión de cualquier innovación a pacientes marginales, aquellos que obtienen un beneficio más pequeño del tratamiento, puede hacer que los beneficios adicionales del gasto sean muy reducidos aunque el tratamiento promedio pase el examen del beneficio neto.

A causa de la influencia de los procesos de investigación y desarrollo en la adopción y uso de las innovaciones y, si aceptamos como condición previa que es necesario hacer

un esfuerzo hacia la mejora de la eficiencia en el gasto sanitario, hay que considerar maneras de eliminar el uso ineficiente de las intervenciones médicas existentes y redireccionar la innovación médica hacia el desarrollo de tecnologías más productivas que pasen el examen del beneficio neto. Haría falta considerar la redistribución de los fondos de investigación e incluir el potencial de la mejora de la eficiencia como una de las variables que debe tenerse en cuenta en los procesos de priorización de la investigación. No obstante, por ejemplo, las ganancias potenciales de la investigación en el tratamiento contra el cáncer, medidas en AVAC, y a pesar de las limitaciones en los resultados conseguidos hasta ahora, es evidente que son potencialmente muy elevadas.

Bibliografía

Becker G, Philipson T, Soares RR. Growth and mortality in less developed nations. Chicago: University of Chicago, 2001.

Berndt ER, Bir A, Busch SH, Frank RG, Normand SL. The medical treatment of depression, 1991-1996: productive inefficiency, expected outcome, and price indexes. J Health Econ 2002; 21(3): 373-396.

Burström K, Johannesson M, Direrichsen F. The value of the change in health in Sweden 1980/81 to 1996/97. J Health Econ 2003; 12: 637-654.

Costa DL, Steckel RH. Long-term trends in health, welfare, and economic growth in the United States. NBER Working paper series on historical factors in long run growth. Historical paper 76. Cambridge: National Bureau of Economic Research, 1995.

Cutler DM, Berndt ER. Medical care output and productivity. Studies in Income and Wealth Volume 62. Cambridge: National Bureau of Economic Research, 2001.

Cutler DM, Huckman RS. Technological development and medical productivity: the difussion of angioplasty in New York state. J Health Econ 2003; 22: 187-217.

Cutler DM, McClellan M. Is technological change in medicine worth it? Health Affairs 2001b; 20(5): 11-29.

Cutler DM, McClellan M. Productivity change in health care. Am Econ Rev 2001a; 91(2): 281-286.

Cutler DM, Richardson E. The value of health: 1970-1990. Am Econ Rev 1998; AEA Papers and Proceedings: 97-100.

Cutler DM, Richardson E. Your money and your life: The value of health and what affects it. NBER Working paper series. Working Paper 6895. Cambridge: National Bureau of Economic Research, 1999.

Cutler DM, Richardson E. Measuring the health of the U.S. population. Brooking Papers: Microeconomics 1997; 217-271.

Fuchs VR. Values and health care reform. Am Econ Rev 1996; 86: 1-24.

Frank R, Berndt ER, Busch AB, Lehman AF. Quality-constant price indexes for the ongoing treatment of schizophrenia: an exploratory study. NBER Working paper series. Working paper 10022. Cambridge: National Bureau of Economic Research, 2003.

Gelijns A, Rosenberg N. The dynamics of technological change in medicine. Health Affairs 1994; 20(3): 25-42.

Lichtenberg, F.R. The expanding pharmaceutical arsenal in the war of cancer, Working Paper 10328. Cambridge: National Bureau of Economic Research, 2004.

López-Casasnovas G. Diagnóstico de situación y pronóstico de evolución futura de la financiación y el gasto de la sanidad española. Barcelona: CRES-UPF, 2000. Mimeo.

Meyer, JA. Assessing the impact of pharmaceutical innovation: A comprehensive framework. Washington, DC: New Directions for Policy, 2002.

Murphy KM, Topel R. The economic value of medical research. Chicago: University of Chicago, 1999.

Newhouse JP. Medical costs: How much welfare loss. Journal of Economic Perspectives 1992; 6(3): 3-21.

Newhouse JP. Medical care price indices: problems and opportunities. The Cheng-Hua lectures. NBER Working paper series. Working paper 8168. Cambridge: National Bureau of Economic Research, 2001.

Nordhaus WD. The health of nations: the contribution of improved health to living standards. NBER Working paper series. Working paper 8818. Cambridge: National Bureau of Economic Research, 2002.

Philipson T, Soares R. Human capital, longevity, and econolic growth: a quantitative assessment of full income measures. Chicago: University of Chicago, 2001.

Puig-Junoy J, Ortún V, Ondategui S. Conocimientos, valores y políticas en economía de la salud. Gaceta Sanitaria 2000; 14(5): 378-385.

Puig-Junoy J, Pinto JL, Dalmau E. El valor monetario de la salud. Barcelona: Springer, 2001.

Rosen S. The value of changes in life expectancy. Journal of Risk and Uncertainty 1988; 1: 285-304.

Schultze CL, Mackie C, eds. At what price? Conceptualizing and measuring cost-of-living and price indexes. Washington, DC: Nacional Academy Press, 2002

The Technological Change in Health Care Research Network (TECH). Technological change around the world: evidence from the heart attach care. Health Aff 2001; 20(3): 25-42.

Tolley G, Kenkel D, Fabian R, eds. Valuing health for policy: An economic approach. Chicago: Chicago University Press, 1994.

Usher D. An imputation of the measure of economic growth for changes in life expectancy. En: Moss M, ed. The measurement of economic and social performance. Studies in income and wealth. Vol. 38. Nueva York: Columbia University Press, 1973.

Viscusi WK, Aldy JE. The value of statistical life: a critical review of market estimates trought the World. NBER Working paper series. Working Paper 9487. Cambridge: National Bureau of Economic Research, 2003.

Viscusi WK. The value of risks to life and health. Journal of Economic Literature 1993; 31(4): 1912-1946.

Annex 2. García-Altés A, Pinilla J, Ortún V. The evolution of health capital in Barcelona, 1994-2006: the paradox of health revisited. In press.

The evolution of health capital in Barcelona, 1994-2006: the paradox of health revisited

Anna García-Altés (1,2,3), Jaime Pinilla (4), Vicente Ortún (5,6)

1 Agència de Salut Pública de Barcelona

2 Fundación Instituto de Investigación en Servicios de Salud

3 CIBER Epidemiología y Salud Pública (CIBERESP), Spain

4 Departamento de Métodos Cuantitativos en Economía y Gestión, Universidad de Las Palmas de Gran Canaria

5 Departament d'Economia i Empresa, Universitat Pompeu Fabra

6 Centre de Recerca en Economia i Salut, Universitat Pompeu Fabra

Address for correspondence:

Anna García-Altés

Agència de Salut Pública de Barcelona

Pl. Lesseps 1

08023 Barcelona

Tel. 932027783

Fax. 933686943

agarcia@aspb.cat

annagarcia@post.harvard.edu

Abstract

Introduction. The assessment of the health status of populations has important consequences in health policy. Following Grossman's model, health capital could be the present value of a person's lifetime health, in terms of health expectancy and quality of life. Some estimations done for the US have revealed increases in health capital in the last decades. However, although objective measures of health have improved in many developed countries, there has also been an increase in the reported prevalence of chronic conditions, and doctor consultations. This fact has been described as "the paradox of health". The objective of this paper is to test "the paradox of health" in Barcelona from 1994 to 2006, analysing the evolution of self-assessed health status from 1994 to 2006, and estimating net self-assessed health status gains, for women and men, taking into account changes in cohort characteristics such as the age group, and the prevalence of chronic conditions and limitations in usual activities due to chronic conditions.

Methods. Longitudinal cross-sectional study using the Barcelona Health Interview Survey of 2000 and 2006, and the Barcelona data of the Catalonia Health Interview Survey of 1994 and 2002. To analyse the evolution of HSW, cross-sectional data has been pulled, and separate ordered probit regressions have been run for every sex and age group (15-44, 45-64, 65-74, and 75 years old and more). The variables included in the model were self-assessed health status, year, all common chronic conditions over the five cross-sections, a variable for non-common chronic conditions, limitations in usual activities due to chronic conditions, the interaction between common chronic conditions and limitations in usual activities. To estimate the net change in self-assessed health status, using the model obtained with 2006 data, 1994 self-assessed health status values have been predicted.

Results. The results showed that HSW depend on the condition studied, and the lowest values correspond to nervous problems for both sexes, osteoarthritis for women, and bronchitis, diabetes, and cardiac problems for men. HSW decrease with age; the higher HSW values of the 75 and more age group for some conditions could reflect their adaptation to chronic conditions. Gender effects are less clear. Limitations in usual activities have a strong negative effect on self-assessed health status, both in women and men. Estimated self-assessed health status for 1994 using the model for 2006 suggest that for both sexes, and for all age groups –specially the 15-44 years old- self-assessed health status would have been better (more people in the "good" and "very good" categories) if the value of the parameters of the model of 2006 would hold in 1994.

Discussion. The results of the present analysis corroborate the paradox of health hypothesis for the population of Barcelona: despite the increase in the prevalence of chronic conditions, HSW tend to increase over the 1994-2006 period for women and men, especially for the youngest age groups. Moreover, self-assessed health status would have been better if the prevalence of chronic conditions and the characteristics of the cohort in 2006 would hold in 1994. This fact could suggest the positive contribution of health services, and the influence of the improvement of living conditions, individual behaviours and social determinants in

the quality of life of the population of Barcelona. As an application of those results, economic evaluation of health interventions should be encouraged, using proper methods, to take into account all effects in society, in terms of extended life and quality of life improvement, and in relation of existing alternative interventions, including health technologies, public health interventions, and lifestyle behaviours.

Introduction

The assessment of the health status of populations has important consequences in health policy. Arguments in favour of limiting health spending due to its low marginal productivity have no value if health spending is not assessed in parallel with changes in population health status that come as a consequence of this spending. The assessment of benefits in terms of changes in health status is also relevant when analyzing allocation of resources among health programs, as is the case of formal economic assessment. Finally, health status also has an influence on other individual behaviours such as labour market decisions and investment in health, as well as on economic growth[1-3].

Based on the previous work in human capital theory developed in the 60's, Grossman was the first to describe demand for health and health care. According to the theory of the human capital, the increase in the stock of health increases the productivity of individuals in the productive (labour) and non-productive (other goods that enter in their utility function) market, and decreases lost productivity due to illness. Improvements in health status through time represent an increase in individuals' capital. In a similar way as human capital theory, health capital could be the present value of a person's lifetime health, in terms of health expectancy and quality of life[4].

However, the interest of economic research on health capital and its impact on behaviours, allocation decisions, and economic growth is very new, despite being one of the actives in economies with the greatest growth and the greatest influence on the economic development of many countries[5]. The first empirical approximations come from the US[1,6-8]. In particular, Cutler and Richardson stated that changes in health capital over time can be decomposed into two terms: the change in the discounted number of quality-adjusted life years times the monetary value of those life years. Accordingly, they calculated changes in life expectancy and quality of life from 1970 to 1990, and assigned them a monetary value. Quality of life was calculated relating self-perceived health status to the presence of chronic conditions, and adjusting for demographic characteristics (sex and age). They found that health capital increased in the period 1970-1990, especially for those over 65 years old, and more for men than for women.

After the appearance of this seminal work, some further research has been done in this area, and some modifications have been proposed for the derivation of quality of life weights. In particular, it has been suggested that the interaction between the presence of chronic conditions and age be taken into account to control for adaptation behaviour and for the use of different scales of reference that may bias self-assessed health status, and thereby avoid overestimating health capital[9,10]. Finally, some recent research has suggested the importance of chronic limitations on health status and its relationship with socioeconomic characteristics[11].

Although objective measures of health have improved during the last decades in many developed countries, there has also been an increase in the reported prevalence of chronic conditions, and doctor consultations.

This fact has been described as “the paradox of health” and several factors have been suggested to explain this phenomenon, such as: the decrease in mortality due to acute diseases, the increase in the awareness of bodily symptoms, the commercialization of health, and the increase in the expectation of being cured[12,13].

The objective of this paper is to test “the paradox of health” in Barcelona from 1994 to 2006, analysing the evolution of self-assessed health status from 1994 to 2006, and estimating net self-assessed health status gains, for women and men, taking into account changes in cohort characteristics such as the age group, and the prevalence of chronic conditions and limitations in usual activities due to chronic conditions.

Methods

A longitudinal cross-sectional study was carried out using the Barcelona Health Interview Survey of 2000 and 2006, and the Barcelona data of the Catalonia Health Interview Survey of 1994 and 2002. The study population corresponded to the survey sample of the interviews, i.e. adults in Barcelona excluding those institutionalized, and the unit of analysis corresponding to the individuals that responded to the surveys of 1994 (n=3,534), 2000 (n=8,833), 2002 (n=1,833) and 2006 (n=5,399). The Barcelona and Catalonia Health Surveys collect, by means of direct personal interview, demographic variables, self-assessed health status, chronic diseases, perceived morbidity, utilization of healthcare services and drugs, health-related lifestyles, and healthcare coverage.

The analysis assumed that people have a latent measure of their health status (y_i^*) of which only the category the individual is in (bad, fair, good, very good, excellent) is known. To be in a particular category would depend on several measurable factors x, such as the diseases that the individual has, sociodemographic characteristics such as age and sex, chronic limitations on usual activities, and other non-observable factors u. Formalizing: $y_i^* = x_i b + u_i$ where $ui = yi^* - E(y_i^*/x_i)$.

The categories of the dependent discrete variable y_i are matched with five intervals in which y_i^* takes values, in such a way that if $y=0$ *if* $y^* \leq c_1$, $y=1$ *if* $c_1 < y^* \leq c_2$, ..., $y=3$ *if* $y^* > c_j$. If the values of the endogenous variable are ordered, as is here the case, the probability estimation could take the form of $p(y \leq j/x) = F(c_j + xb)$, where j refers to each of the ordered categories defined (0, 1, ..., j). The previous expressions are a kind of data censorship. The coefficients ç are parameters that have to be estimated together with the vector of coefficients of explanatory variables b, once an error distribution has been imposed. For the estimation of this model, it is assumed that u follows a normal distribution, ordered probit model. The final model is built taking into account the estimation of the previously defined variables, as well as their products, which reflect the effect of the interaction of these variables. Quality of life weights –or health status related weights (HSW)- could be calculated by normalizing the obtained estimators in the ordered probit model. In this particular case, the dependent variable has five categories, and the regression coefficients obtained for each independent variable (ß) have been normalized using the minimum (c_1) and maximum (c_4) cut-points obtained in the model: $HSW = 1 - (ß/c1 - c4)$[1]. Standard errors were clustered for city districts.

To analyse the evolution of HSW, cross-sectional data has been pulled, and separate ordered probit regressions have been run for every sex and age group (15-44, 45-64, 65-74, and 75 years old and more). Sample weights have been applied. The variables included in the model and their categorizations are:

- Self-assessed health status. Respondents are asked: "How would you rate your health in general?" Possible responses are: bad, fair, good, very good and excellent (1 to 5).
- Year: 1994, 2000, 2002 or 2006 (for each: no=0, yes=1).

- All common chronic conditions over the five cross-sections. Respondents are asked: “Do you currently have or did your doctor tell you that you had any of the following chronic conditions?” The common conditions are allergy, degenerative osteoarthritis-rheumatism, bronchitis, asthma, diabetes, cardiac problems, nervous problems-depression, embolism, varicose veins, cataracts, hypertension, duodenal ulcer, constipation and other problems (for each: no=0, yes=1). Prostate or urinary problems, despite being common, were not included because of co linearity problems.
- A variable for non-common chronic conditions (none=0, one or more=1).
- Limitations in usual activities due to chronic conditions. To select individuals with limitations we used the responses to the question: “During the last 12 months, did you have to restrict or decrease your usual activities due to any chronic condition?” (no=0, yes=1).
- The interaction between common chronic conditions and limitations in usual activities. The descriptive analysis made it possible to choose the chronic conditions that are more often limiting, i.e. degenerative osteoarthritis-rheumatism, nervous problems-depression, and varicose veins (for each: no=0, yes=1).

To estimate the net change in self-assessed health status, ordered probit regressions were run for every sex and age group with 2006 data. Then, using the obtained 2006 model, 1994 self-assessed health status values were predicted. Finally, ordered probit regressions were run with 1994 data, so that real and estimated 1994 self-assessed health status values could be compared. Significance level was set at $p = 0.05$. All analyses were performed using Stata 9.0.

Results

Table 1 shows the frequencies of the variables included in the model for every cross-section and sex. The sex distribution is similar in the five surveys, and the age distribution changes slightly, showing an increase in the 75 years old and more group, especially for women, owing to the changes in the demography of the city. People tend to declare more chronic conditions through time, especially nervous problems-depression (11.3% in 1994, 22.6% in 2006), varicose veins (19.5% in 1994, 25.8% in 2006), and cataracts (6.8% in 1994, 15.4% in 2006) among women, and nervous problems-depression (4.4% in 1994, 10.9% in 2006), and cataracts (4.7% in 1994, 13.2% in 2006) among men. A few conditions have decreased, such as osteoarthritis both for women and men. Self-assessed health status has also changed, and a similar pattern could be observed for both sexes: there has been a decrease in those reporting good and fair health status, an increase in those reporting very good and excellent health –especially in the 15-44 and 45-64 age groups-, and also an increase in those reporting poor and fair health –especially in the 75 and more age group. Finally, there has also been an increase in the prevalence of limitations in usual activities, especially for women (15.8% in 1994, 17.8% in 2006).

Table 2 and Table 3 show the results of the ordered probit models for women and men. Across cross-sections, there has been an increase in HSW for every year compared to 2004 for the youngest age groups (15-44 and 45-64 years old). HSW depend on the condition studied, the lowest values corresponding to nervous problems for both sexes, osteoarthritis for women, and bronchitis, diabetes, and cardiac problems for men. Allergy and cataracts do not have a statistically significant effect on self-perceived health status. Regarding sex differences, HSW are higher for men than for women for osteoarthritis, but are higher for women than for men for bronchitis, diabetes, cardiac problems, and nervous problems. HSW decrease with age; however, the 75 years old and more age group has higher HSW than other age groups for some conditions. Limitations in usual activities have a strong negative effect on self-assessed health status, both in women and men. When considering their interaction with chronic conditions, osteoarthritis for women 65-74 years old and men 45-64 and 75 years old and more have health status weights higher than one; the interaction with varicose veins for men 65-74 years old also has a statistically significant value. Finally, and regarding the cut-points, it is possible to see that for women and men, the distance between c_1 and c_2 increases with age, while the distance between c_2 and c_3, and c_3 and c_4 decreases. Models correctly predict between 46.5% and 57.7% of the cases. From the initial samples, the number of observations was reduced due to the existence of missing values.

Figure 1 shows the results of the estimation of self-assessed health status for 1994 using the model for 2006, and the model for 1994. For both sexes, and for all age groups –especially the 15-44 years old- self-assessed health status would have been better (more people in the good and very good categories) if the values of the parameters of the 2006 model had been maintained in 1994, with the exception of women 75 years old and more. The comparison with 1994 self-assessed health status makes it possible to observe the goodness of fit of the model for 1994.

Discussion

This analysis is a partial replica of the previous work of Cutler and Richardson and some other posterior research, estimating health capital changes in Barcelona from 1994 to 2006, using self-assessed health status to estimate quality of life and information on the interaction between chronic conditions and limitations in usual activities. This methodology makes it possible to calculate HSW from systematically available data on health surveys, which has several advantages. For example, it avoids having to carry out *ad-hoc* studies to know the health status and the quality of life of the population, which saves a considerable amount of money and time for those who need this kind of information. Also, working with representative population data has advantages when extrapolating results[14].

The results showed that HSW depend on the condition studied, the lowest values corresponding to nervous problems for both sexes, osteoarthritis for women, and bronchitis, diabetes, and cardiac problems for men. Also, HSW decrease with age, probably related to the increase in comorbidity. The higher HSW of the 75 and more age group for some conditions could reflect their adaptation to chronic conditions[15]. Gender effects are less clear; although women tend to report worse health status, HSW are higher for women than for men for bronchitis, diabetes, cardiac problems, and nervous problems, probably because these conditions have a bigger effect on men's self-perceived health status. It is worth mentioning the considerable increase in some chronic conditions over time, like nervous problems-depression, probably related to the increase in the availability of drugs for their treatment, and cataracts, probably related to the increase in their diagnosis and treatment by means of surgery. On the contrary, osteoarthritis has decreased, probably due to the fact that over time other related conditions have been included in the health survey, such as backache and osteoporosis.

One of the novelties of this work is the inclusion of limitations in usual activities. This parameter has a strong negative effect on self-assessed health status, both in women and men. When considering their interaction with chronic conditions, osteoarthritis for women 65-74 years old, and men 45-64 and 75 years old and more have health status weights higher than one, also reflecting the adaptation to both problems: quality of life for those with both osteoarthritis and limitations is slightly better than the sum of the quality of life associated with osteoarthritis and limitations in usual activities.

Following the paradox of health, despite the increase in the prevalence of chronic conditions, HSW tend to increase over time, especially for the youngest age groups. Moreover, estimated self-assessed health status for 1994 using the model for 2006, suggests that for both sexes, and for all age groups –especially the 15-44 years old- self-assessed health status would have been better (more people in the good and very good categories) if the values of the parameters of the 2006 model had been maintained in 1994. In other words, and adjusting for the different prevalence of chronic conditions and limitations, and different cohort characteristics –sex and age-, there has been a net increase in self-assessed health status over the 1994-2006 period, especially for women and men 15-44 years old. It is worth pointing out that in 1994 no

conditions were present that were not also present in 2006; so, when applying the 2006 model to 1994 data, results reflect the "pure" effect of the changes in the prevalence of all conditions included in the model and in the characteristics of the cohorts.

This fact could suggest the positive contribution of health services, and the influence of the improvement of living conditions, individual behaviours and social determinants in the quality of life of the population of Barcelona. Also, the increase in the diagnosis of chronic conditions could be the result of adding individuals with less severe health problems to the sample in the most recent cohorts. This hypothesis would be reinforced by the increase, in the study period, of the percentage of people reporting very good and excellent health. Although outside the scope of this paper, it should be mentioned that life expectancy of the Barcelona population has also been increasing in the last two decades[16].

Finally, the changes in the cut-points with age suggest that the distance between bad and fair, and fair and good health status are bigger as age increases, while the differences among the other categories are smaller as age increases, fitting the pattern of the distribution of self-assessed health status by age group.

The main limitation of this analysis is that the HSW found are not directly equivalent to utility values that could be derived with an analogical scale, or with elicitation methods like time trade-off or standard gamble. Although some attempts have been done to propose alternative cardinalizations, any of them have not been validated[17,18]. To satisfy the QALY concept, quality of life weights should be based on preferences, anchored in perfect health and death, and measured on an interval scale. Although the results found in the present study make intuitive sense, these conditions are not met in HSW.

As can be seen in the tables, the HSW corresponding to year variables and to a few chronic conditions are higher than one. The normalization used does not bind the regressors' values, so they could be higher or lower than one. Also, it has been argued that health interviews have an inherent selection bias, because of the death of some individuals before the interview. The probability of declaring a good or bad health status is conditioned to being alive, so there could be a selective truncation of the distribution function[19].

Another limitation is due to the use of self-declared information, both regarding health status and chronic conditions, although the good correlation of subjective health indicators and final outcome indicators is known[20]. Considerable attention has been devoted to the reliability of self-assessed health status and the scope for contamination by measurement error, and there is evidence of reporting bias[21,22]. Different groups (according to age, gender, education, income, language, or personal experience of illness) appear to interpret the questions within their own specific context and therefore use different reference points when responding to the same question, which may invalidate comparisons and measures of health inequality. While the evidence shows mixed results depending on the variable analyzed, the methodology used in this study makes it possible to control for age and sex bias in self-reported health, and the year variable reflects

the cohort effect. In relation to this, the methodology used does not make it possible to control for cut-point shifts over time[23].

The estimation of HSW has been previously done, using data from the Spanish National Health Survey for 1987, 1993, and 2001[24]. The same procedure was used in that case, except for the inclusion of "pain, limitations, and diseases in the previous 12 months", and education level, and the non-inclusion of chronic limitations on usual activities. Results showed HSW related to chronic diseases varied depending on the diseases. In the present case, the non-inclusion of "pain, limitations, and diseases in the previous 12 months" was due to the fact that this set of variables was not included in the Barcelona Health Survey. Educational level was not included because we considered that socioeconomic status could be measured by other variables besides educational level, such as income level, occupational class or employment status, among others, and it is associated with other characteristics that are related to health status as well, such as health behaviours. These relationships are better dealt with using other methodologies[25,26].

As previously mentioned, Cutler and Richardson used this approach to calculate changes in quality of life in the US from 1970 to 1990; they also calculated changes in life expectancy and assigned them a monetary value, to estimate health capital changes. A different approximation has been done for Sweden and Catalonia, calculating years of life gained, quality of life weights using EQ-5D and British and Spanish tariffs respectively, and a monetary value to life years gained[27,28]. Results for Sweden for 1980/81 and 1996/97 showed considerable health gains for older people and small or non-existent gains for younger women. Results for Catalonia for 1994 and 2002 showed that health capital declined during this period, mainly due to the worsening of the health status of the population. The main caveat in both cases is that they use the same tariffs for both cross-sections, while the reported prevalence of the problems included in the EQ-5D has increased over time, so that the worsening in health capital is a direct consequence of the increase in the prevalence of diseases. Using time varying tariffs may take into account the effect of changes in population preferences across health problems while at the same time reporting more health problems.

An alternative methodological approximation to the measurement of health capital is the one proposed by Nordhaus, and Murphy and Topel[29,30], estimating income and consumption equivalents of longevity improvements. Their results showed the value of increasing life expectancy over time for the US for 1900-95. The same estimation has been made for the UK for 1870-2001[31]. Notice that these approximations do not take into account changes in morbidity or in quality of life of populations. The main applications of those concepts and methodologies are in economic growth models, taking into account the value of improvements in life expectancy[32,33], and in economic evaluation, comparing the value of improvements in health capital and the level of spending on health services[34-36].

The results of the present analysis corroborate the paradox of health hypothesis for the population of Barcelona: despite the increase in the prevalence of chronic conditions, HSW tend to increase over the 1994-2006 period for women and men, especially for the youngest age groups. Moreover, self-assessed health

status would have been better if the prevalence of chronic conditions and the characteristics of the cohort in 2006 had been maintained in 1994. This fact could suggest the positive contribution of health services, and the influence of the improvement of living conditions, individual behaviours and social determinants in the quality of life of the population of Barcelona. As an application of these results, economic evaluation of health interventions should be encouraged, using proper methods, full income measures, and broad perspectives, to take into account all effects on society, in terms of extended life and quality of life improvement, and in relation to existing and alternative interventions, including health technologies, public health interventions, and lifestyle behaviours.

Acknowledgements

The authors are grateful to Maarten Lindeboom (Free University, Amsterdam) for his suggestions on the data analysis, and to all the members of the Centre for Health Economics, and the Health, Econometrics and Data Group (HEDG) of the University of York, for their comments on a previous version of this paper.

References

1. Cutler DM, Richardson E. Measuring the health of the U.S. population. *Brookings Papers on Economic Activity. Microeconomics* 1997:217-71
2. Sala-i-Martin X, Doppelhofer G, Miller R. Determinants of long-term growth: a Bayesian averaging of classical estimates (BACE) approach. *Am Econ Rev* 2004;45:827-38.
3. World Health Organization. *Macroeconomics and health: Investing in health for economic development. Report of the Commission on Macroeconomics and Health*. Geneva: World Health Organization, 2001.
4. Grossman M. On the concept of health capital and the demand for health. *J Pol Economy* 1972:80(2):223-55.
5. McDonald S, Roberts J. Growth and multiple forms of human capital in an augmented Solow Model: a panel data investigation. *Econ Letters* 2002;74:271-76
6. Cutler DM, Richardson E. The value of health: 1970-1990. *Am Econ Rev* 1998; AEA Papers and Proceedings: 97-100.
7. Cutler DM, Richardson E. *Your money and your life: The value of health and what affects it*. NBER Working paper series. Working Paper 6895. Cambridge, MA: National Bureau of Economic Research, 1999.
8. Nordhaus WD. The health of nations: the contribution of improved health to living standards. NBER Working paper series. Working paper 8818. Cambridge, MA: National Bureau of Economic Research, 2002.
9. Groot W. Adaptation and scale of reference bias in self-assessments of quality of life. *J Health Econ* 2000;19(3):403-20.
10. van Praag BMS, Ferrer-i-Carbonell A. *Age-differentiated QALI Losses*. Amsterdam: Timbergen Institute, 2001.
11. Hernández-Quevedo C, Jones AM, Rice N. *Persistence in health limitations: a European comparative analysis*. Health, Econometrics and Data Group (HEDG) Working Paper 07/03. York: University of York, 2007.
12. Barsky AJ. The paradox of health. *N Engl J Med* 1988;318(7):414-8.
13. Sen A. Health: perception versus observation. *Br Med J* 2002;324(7342);860-1.
14. Gold MR, Franks P, McCoy KI, Fryback DG. Toward consistency in cost-utility analyses: using national measures to create condition-specific values. *Med Care* 1998;36(6):778-92.
15. Frederick S, Loewenstein G. Hedonic adaptation. In: Kahneman D, Deiner E, Schwarz N, eds. *Well-being: The foundations of hedonic psychology*. New York: New York Russell Sage Foundation, 2003. 302-29.
16. Agència de Salut Pública de Barcelona. *La salut a Barcelona 2006*. Barcelona: Agència de Salut Pública de Barcelona, 2007.
17. van Praag BMS, Ferrer-i-Carbonell A. *Age-differentiated QALI Losses*. Tinbergen Institute Discussion Paper TI 2002-015/3. Amsterdam: Tinbergen Institute, 2002.

18. van Doorslaer E, Jones AM. Inequalities in self-reported health: validation of a new approach to measurement. *J Health Econ* 2003;22(1):61-87.
19. Heckman J. Sample selection bias as a specification error. *Econometrica* 1979. 47:153-61.
20. Idler EL, Benyamini Y. Self-rated health and mortality: a review of twenty-seven community studies. *J Health Soc Behav* 1997;38(1):21-37.
21. Hernández Quevedo C, Jones AM, Rice N. *Reporting bias and heterogeneity in self-assessed health. Evidence from the British Household Panel Survey*. Health, Econometrics and Data Group (HEDG) Working paper 05/04. York: University of York, 2005.
22. Bago d'Uva T, O'Donnell O, van Doorslaer E. *Differential health reporting by education level an its impact on the measurement of health inequalities among older Europeans*. Health, Econometrics and Data Group (HEDG) Working paper 07/28. York: University of York, 2008.
23. Lindeboom M, van Doorslaer E. *Cut-point shift and index shift in self-reported health*. IZA Discussion Paper No. 1286; Tinbergen Institute Working Paper No. 2003-042/3. Amsterdam: Tinbergen Institute, 2004.
24. García-Altés A, Pinilla J, Peiró S. [An approach to "quality-adjusted life years" quality of life weights from self-assessed health status] *Gac Sanit* 2006;20(6):457-64.
25. Balia S, Jones AM. Mortality, lifestyle and socio-economic status. *J Health Econ* 2008;27(1):1-26.
26. Contoyannis P, Jones AM. Socio-economic status, health and lifestyle. *J Health Econ* 2004;23(5):965-95.
27. Zozaya N, Oliva J, Osuna R. *Measuring changes in health capital*. Documento de Trabajo 2005-15. Madrid: FEDEA, 2005.
28. Burström K, Johannesson M, Diderichsen F. The value of the change in health in Sweden 1980/81-1996/97. *Health Econ* 2003;12(8):637-54.
29. Nordhaus WD. The health of nations: the contribution of improved health to living standards. In: Murphy KM, Topel R, eds. *Measuring the gains from medical research*. Chicago: University of Chicago Press, 2003. 9-40.
30. Murphy KM, Topel RH. *The value of health and longevity*. NBER Working Paper No. 11405. Cambridge: National Bureau of Economic Research, 2005.
31. Crafts N. *The contribution of increased life expectancy to the growth of living standards in the UK, 1870-2001*. London: London School of Economics, 2005.
32. Becker G, Philipson T, Soares RR. *The quantity and quality of life and the evolution of world inequality*. Cambridge: National Bureau of Economic Research, 2003.
33. Philipson T, Soares R. *Human capital, longevity, and economic growth: a quantitative assessment of full income measures*. Chicago: University of Chicago, 2001.
34. Cutler DM, McClellan M. Is technological change in medicine worth it? *Health Aff (Millwood)* 2001;20:11-29.
35. Cutler DM, Huckman RS. Technological development and medical productivity: the diffusion of angioplasty in New York state. *J Health Econ* 2003;22:187-217.
36. Cutler DM, Rosen AB, Vijan S. The value of medical spending in the United States, 1960-2000. N Engl J Med 2006;355(9):920-7.

Table 1. Frequencies of the variables included in the model. Barcelona, 1994-2006.

		Women			
		1994	2000	2002	2006
Number of individuals		1,984	4,764	986	2,866
15-44 years old		46.4%	45.4%	44.9%	46.0%
45-64 years old		29.0%	27.0%	28.3%	27.8%
65-74 years old		13.2%	14.7%	14.3%	11.8%
75 years old and more		11.3%	12.8%	12.4%	14.3%
15-44 years old	Poor	1.0%	1.1%	1.1%	2.2%
	Fair	11.3%	7.8%	7.6%	11.6%
	Good	58.6%	49.1%	50.9%	43.3%
	Very good	21.5%	31.0%	30.5%	32.6%
	Excellent	7.6%	11.0%	10.0%	10.3%
45-64 years old	Poor	5.9%	6.2%	4.2%	8.5%
	Fair	28.8%	25.2%	22.5%	24.5%
	Good	51.8%	50.5%	56.6%	48.3%
	Very good	8.9%	12.9%	13.9%	14.6%
	Excellent	4.6%	5.2%	2.8%	4.1%
65-74 years old	Poor	14.4%	12.2%	13.0%	15.9%
	Fair	43.2%	39.6%	40.6%	40.5%
	Good	34.5%	39.8%	34.2%	34.4%
	Very good	5.0%	5.8%	11.2%	7.4%
	Excellent	2.9%	2.6%	1.0%	1.7%
75 years old and more	Poor	12.6%	16.3%	14.1%	20.7%
	Fair	32.8%	45.2%	52.4%	39.0%
	Good	44.5%	31.2%	30.0%	30.9%
	Very good	8.4%	6.1%	2.3%	8.0%
	Excellent	1.7%	1.2%	1.1%	1.4%
Allergy		15.9%	16.4%	16.2%	19.2%
Degenerative osteoarthritis, rheumatism		35.4%	29.4%	33.0%	29.8%
Bronchitis		3.9%	5.4%	5.1%	5.1%
Asthma		4.3%	4.7%	4.6%	6.6%
Diabetes		3.4%	4.8%	6.4%	5.4%
Cardiac problems		5.9%	6.6%	5.7%	7.6%
Nervous problems, depression		11.3%	18.0%	19.0%	22.6%
Embolism		1.1%	1.8%	1.3%	2.4%
Varicose veins		19.5%	22.7%	29.0%	25.8%
Cataracts		6.8%	8.6%	9.9%	15.4%
Hypertension		16.5%	14.5%	18.3%	20.5%
Duodenal ulcer		2.9%	3.7%	5.3%	5.3%
Constipation		12.6%	12.0%	15.0%	12.8%
Other problems		27.0%	19.5%	12.3%	17.9%
Non-common chronic problems		12.58%	61.1%	69.5%	67.6%
Limitations in usual activities		15.8%	18.0%	19.5%	17.8%

Table 1. Frequencies of the variables included in the model. Barcelona, 1994-2006 (cont.).

		Men			
		1994	2000	2002	2006
Number of individuals		1,550	4,069	846	2,533
15-44 years old		52.2%	50.5%	51.1%	54.4%
45-64 years old		28.1%	29.2%	29.3%	27.3%
65-74 years old		12.8%	12.7%	12.9%	10.1%
75 years old and more		6.8%	7.6%	6.7%	8.2%
15-44 years old	Poor	0.7%	0.8%	1.0%	1.8%
	Fair	9.1%	5.2%	6.4%	7.4%
	Good	57.8%	46.4%	51.1%	41.9%
	Very good	21.4%	32.5%	30.0%	33.7%
	Excellent	10.9%	15.0%	11.4%	15.1%
45-64 years old	Poor	5.2%	3.6%	3.9%	4.3%
	Fair	20.3%	19.4%	23.9%	16.6%
	Good	57.6%	53.4%	54.1%	52.6%
	Very good	12.1%	15.6%	11.5%	20.2%
	Excellent	4.8%	8.0%	6.6%	6.4%
65-74 years old	Poor	6.7%	8.2%	5.2%	6.6%
	Fair	29.5%	29.0%	29.8%	28.2%
	Good	56.2%	47.9%	54.7%	48.3%
	Very good	7.6%	10.9%	9.1%	11.3%
	Excellent	0.0%	5.0%	1.2%	5.5%
75 years old and more	Poor	10.7%	9.9%	17.9%	12.8%
	Fair	35.7%	43.3%	27.1%	43.2%
	Good	44.7%	37.8%	50.2%	33.3%
	Very good	7.1%	6.9%	4.8%	7.2%
	Excellent	1.8%	2.2%	0.0%	2.9%
Allergy		10.3%	12.7%	13.0%	13.1%
Degenerative osteoarthritis, rheumatism		17.9%	12.7%	16.5%	13.0%
Bronchitis		5.7%	6.9%	9.0%	5.6%
Asthma		4.1%	4.5%	7.2%	6.1%
Diabetes		4.5%	4.5%	7.7%	5.6%
Cardiac problems		7.7%	5.9%	7.9%	6.4%
Nervous problems, depression		4.4%	8.8%	10.5%	10.9%
Embolism		1.8%	1.8%	1.8%	1.8%
Varicose veins		5.1%	5.7%	8.3%	8.0%
Cataracts		4.7%	5.6%	6.5%	13.2%
Hypertension		13.4%	11.7%	18.8%	17.0%
Duodenal ulcer		5.6%	4.3%	6.4%	4.9%
Constipation		3.6%	3.4%	4.4%	4.3%
Other problems		24.5%	15.0%	14.2%	16.0%
Non-common chronic problems		12.1%	41.8%	48.7%	43.2%
Limitations in usual activities		10.2%	12.3%	14.6%	10.8%

Table 2. Results of the ordered probit models for women. Barcelona, 1994-2006.

	Women 15-44			Women 45-64		
Variables	**Coeff.**	**HSW**	**SE**	**Coeff.**	**HSW**	**SE**
Year 2000	0.363*	1.089	0.069	0.231*	1.056	0.076
Year 2002	0.544*	1.133	0.075	0.709*	1.173	0.066
Year 2006	0.336*	1.082	0.078	0.271*	1.066	0.080
Allergy	-0.010	0.998	0.067	0.059	1.014	0.056
Degenerative osteoarthritis, rheumatism	-0.500*	0.878	0.105	-0.555*	0.864	0.050
Bronchitis	-0.322*	0.921	0.159	-0.408*	0.900	0.089
Diabetes	-0.339	0.917	0.267	-0.562*	0.863	0.128
Asthma	-0.329*	0.920	0.091	-0.261*	0.936	0.112
Cardiac problems	-0.359*	0.912	0.149	-0.247*	0.940	0.089
Nervous problems, depression	-0.550*	0.866	0.056	-0.493*	0.879	0.042
Embolism	0.905*	1.221	0.432	-0.177	0.957	0.296
Varicose veins	-0.278*	0.932	0.087	-0.200*	0.951	0.033
Cataracts	0.186	1.046	0.197	-0.124	0.970	0.102
Hypertension	-0.348*	0.915	0.120	-0.242*	0.941	0.055
Duodenal ulcer	-0.193	0.953	0.120	-0.258*	0.937	0.072
Constipation	-0.132	0.968	0.092	-0.123	0.970	0.086
Other problems	-0.346*	0.915	0.041	-0.405*	0.901	0.051
Non-common chronic problems	-0.271*	0.934	0.060	-0.269*	0.934	0.079
Limitations in usual activities	-0.603*	0.853	0.100	-0.695*	0.830	0.106
Osteoarthritis*Limitations usual activities	-0.036	0.991	0.146	-0.044	0.989	0.122
Nervous problems*Limitations usual activities	-0.185	0.955	0.141	-0.072	0.982	0.087
Varicose veins*Limitations usual activities	0.172	1.042	0.133	0.050	1.012	0.103
c1	-2.798		0.124	-2.726		0.113
c2	-1.521		0.059	-1.256		0.093
c3	0.215		0.058	0.507		0.081
c4	1.298		0.080	1.362		0.096
	n=4,784; Correctly classified = 48,1%; Pseudo R2 = 0.0850; Log pseudo-likelihood = -5344.198; AIC = 2.245; BIC = -29626.292			n=2,901; Correctly classified = 57.7%; Pseudo R2 = 0.1659; Log pseudo-likelihood = -3081.734; AIC = 2.143; BIC = -16758.363		

Coeff.: Regression coefficient; HSW: Health status weight; SE: Standard error; AIC: Akaike information criterion; BIC: Bayesian information criterion; * = p<0.05.

Table 2. Results of the ordered probit models for women. Barcelona, 1994-2006 (cont.).

	Women 65-74			Women 75 and more		
Variables	**Coeff.**	**HSW**	**SE**	**Coeff.**	**HSW**	**SE**
Year 2000	0.180	1.046	0.123	-0.055	0.986	0.113
Year 2002	0.575*	1.146	0.108	0.317*	1.079	0.135
Year 2006	0.146	1.037	0.104	0.061	1.015	0.081
Allergy	-0.068	0.983	0.084	-0.060	0.985	0.123
Degenerative osteoarthritis, rheumatism	-0.574*	0.854	0.064	-0.421*	0.895	0.096
Bronchitis	-0.273*	0.930	0.082	-0.211	0.947	0.108
Diabetes	-0.355*	0.910	0.052	-0.467*	0.883	0.088
Asthma	-0.222	0.943	0.154	-0.387*	0.903	0.171
Cardiac problems	-0.459*	0.883	0.135	-0.267*	0.933	0.071
Nervous problems, depression	-0.529*	0.865	0.123	-0.477*	0.881	0.073
Embolism	-0.509	0.870	0.270	-0.123	0.969	0.117
Varicose veins	-0.158*	0.960	0.070	0.023	1.006	0.120
Cataracts	-0.044	0.989	0.055	-0.070	0.982	0.051
Hypertension	-0.252*	0.936	0.084	-0.064	0.984	0.084
Duodenal ulcer	-0.285*	0.927	0.111	-0.326*	0.918	0.145
Constipation	-0.189	0.952	0.104	-0.215*	0.946	0.087
Other problems	-0.401*	0.898	0.082	-0.348*	0.913	0.123
Non-common chronic problems	-0.093	0.976	0.086	-0.382*	0.904	0.114
Limitations in usual activities	-1.123*	0.714	0.138	-0.850*	0.787	0.206
Osteoarthritis*Limitations usual activities	0.535*	1.136	0.143	0.167	1.042	0.236
Nervous problems*Limitations usual activities	0.069	1.018	0.229	0.122	1.030	0.168
Varicose veins*Limitations usual activities	0.009	1.002	0.210	-0.282	0.929	0.125
c1	-2.525		0.146	-2.545		0.095
c2	-0.912		0.138	-1.015		0.070
c3	0.634		0.142	0.441		0.096
c4	1.401		0.171	1.451		0.131
	n=1,414; Correctly classified = 52.6%; Pseudo R2 = 0.1688; Log pseudo-likelihood = -1493.6663; AIC = 2.149; BIC = -7081.466			n=1,246; Correctly classified = 49.0%; Pseudo R2 = 0.1567; Log pseudo-likelihood = -1330.6492; AIC = 2.178; BIC = -6034.488		

Coeff.: Regression coefficient; HSW: Health status weight; SE: Standard error; AIC: Akaike information criterion; BIC: Bayesian information criterion; * = $p<0.05$.

Table 3. Results of the ordered probit models for men. Barcelona, 1994-2006.

	Men 15-44			Men 45-64		
Variables	**Coeff.**	**HSW**	**SE**	**Coeff.**	**HSW**	**SE**
Year 2000	0.334*	1.087	0.049	0.264*	1.066	0.102
Year 2002	0.406*	1.106	0.071	0.442*	1.111	0.128
Year 2006	0.373*	1.097	0.078	0.322*	1.081	0.112
Allergy	-0.004	0.999	0.044	0.129	1.032	0.087
Degenerative osteoarthritis, rheumatism	-0.256	0.933	0.141	-0.590*	0.852	0.069
Bronchitis	-0.340*	0.911	0.085	-0.520*	0.869	0.108
Diabetes	-0.390	0.898	0.234	-0.518*	0.870	0.111
Asthma	-0.056	0.985	0.117	-0.097	0.976	0.179
Cardiac problems	-0.474*	0.876	0.231	-0.674*	0.831	0.116
Nervous problems, depression	-0.712*	0.814	0.077	-0.418*	0.895	0.122
Embolism	1.207	1.315	0.650	-0.361*	0.909	0.141
Varicose veins	-0.390*	0.898	0.092	-0.006	0.998	0.062
Cataracts	-0.229	0.940	0.162	-0.122	0.969	0.106
Hypertension	-0.060	0.984	0.117	-0.162*	0.959	0.056
Duodenal ulcer	-0.349*	0.909	0.158	-0.260*	0.935	0.075
Constipation	-0.275*	0.928	0.124	-0.200	0.950	0.109
Other problems	-0.353*	0.908	0.056	-0.265*	0.933	0.121
Non-common chronic problems	-0.244*	0.936	0.045	-0.258*	0.935	0.048
Limitations usual activities	-0.411*	0.893	0.075	-1.082*	0.728	0.111
Osteoarthritis*Limitations usual activities	-0.180	0.953	0.169	0.836*	1.210	0.149
Nervous problems*Limitations usual activities	-0.121	0.968	0.233	-0.236	0.941	0.245
Varicose veins*Limitations usual activities	-0.355	0.907	0.220	0.071	1.018	0.151
c1	-2.629		0.126	-2.608		0.116
c2	-1.530		0.100	-1.216		0.085
c3	0.207		0.090	0.557		0.117
c4	1.198		0.100	1.371		0.164
	n=4,621; Correctly classified = 46.5%; Pseudo R2 = 0.0604; Log pseudo-likelihood = -5302.0446; AIC = 2.306; BIC = -28170.204			n=2,529; Correctly classified = 57.3%; Pseudo R2 = 0.1280; Log pseudo-likelihood = -2757.335; AIC = 2.201; BIC = -14097.785		

Coeff.: Regression coefficient; HSW: Health status weight; SE: Standard error; AIC: Akaike information criterion; BIC: Bayesian information criterion; * = p<0.05.

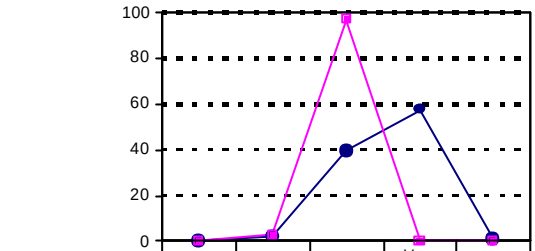
Table 3. Results of the ordered probit models for men. Barcelona, 1994-2006 (cont.).

	Men 65-74			Men 75 and more		
Variables	**Coeff.**	**HSW**	**SE**	**Coeff.**	**HSW**	**SE**
Year 2000	0.147	1.038	0.134	-0.073	0.981	0.202
Year 2002	0.516*	1.133	0.142	0.264	1.068	0.254
Year 2006	0.301*	1.077	0.114	-0.043	0.989	0.223
Allergy	0.196	1.050	0.155	-0.115	0.970	0.142
Degenerative osteoarthritis, rheumatism	-0.302*	0.922	0.119	-0.380*	0.902	0.096
Bronchitis	-0.454*	0.883	0.155	-0.406*	0.896	0.109
Diabetes	-0.573*	0.853	0.125	-0.664*	0.829	0.100
Asthma	-0.438	0.887	0.247	-0.436*	0.888	0.169
Cardiac problems	-0.491*	0.874	0.137	-0.149	0.962	0.147
Nervous problems, depression	-0.232	0.940	0.177	-0.551*	0.858	0.103
Embolism	-0.807*	0.793	0.120	-0.652*	0.832	0.277
Varicose veins	0.005	1.001	0.184	-0.340	0.912	0.205
Cataracts	0.027	1.007	0.131	-0.051	0.987	0.092
Hypertension	-0.182*	0.953	0.082	-0.040	0.990	0.071
Duodenal ulcer	-0.105	0.973	0.135	0.113	1.029	0.193
Constipation	0.008	1.002	0.177	-0.236	0.939	0.157
Other problems	-0.328*	0.916	0.060	-0.367*	0.906	0.107
Non-common chronic problems	-0.297*	0.924	0.099	-0.153	0.961	0.142
Limitations usual activities	-0.595*	0.847	0.130	-0.833*	0.786	0.112
Osteoarthritis*Limitations usual activities	0.266	1.068	0.180	0.499*	1.128	0.158
Nervous problems*Limitations usual activities	-0.372	0.904	0.200	-0.348	0.911	0.392
Varicose veins*Limitations usual activities	-0.536*	0.862	0.253	0.278	1.072	0.305
c1	-2.444		0.148	-2.519		0.145
c2	-0.995		0.072	-0.891		0.167
c3	0.678		0.088	0.615		0.127
c4	1.444		0.139	1.370		0.182
	n=1,059; Correctly classified = 56.6%; Pseudo R2 = 0.1277; Log pseudo-likelihood = -1154.3636; AIC = 2.229; BIC = -4886.201			n=632; Correctly classified = 50.0%; Pseudo R2 = 0.1461; Log pseudo-likelihood = -676.78628; AIC = 2.224; BIC = -2554.454		

Coeff.: Regression coefficient; HSW: Health status weight; SE: Standard error; AIC: Akaike information criterion; BIC: Bayesian information criterion; * = p<0.05.

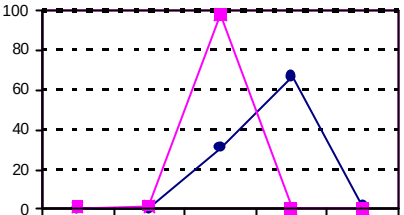
Figure 1. Estimation of 1994 self-assessed health status.

Women 15-44 years old



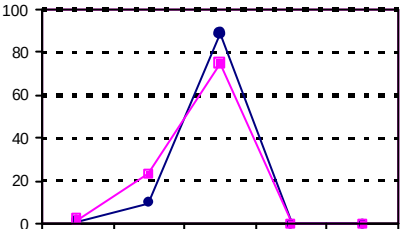
	Bad	Fair	Good	Very good	Excellent
2006 model 1994 data	0,00	2,07	39,54	57,56	0,83
1994 model 1994 data	0,21	2,90	96,89	0,00	0,00

Men 15-44 years old



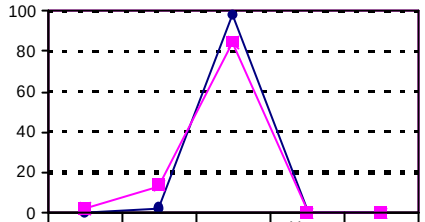
	Bad	Fair	Good	Very good	Excellent
2006 model 1994 data	0,47	0,00	30,84	66,82	1,87
1994 model 1994 data	0,70	1,40	97,66	0,00	0,23

Women 45-64 years old



	Bad	Fair	Good	Very good	Excellent
2006 model 1994 data	1,32	9,93	88,74	0,00	0,00
1994 model 1994 data	1,99	23,18	74,83	0,00	0,00

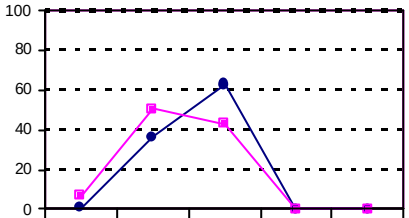
Men 45-64 years old



	Bad	Fair	Good	Very good	Excellent
2006 model 1994 data	0,00	2,17	97,83	0,00	0,00
1994 model 1994 data	2,17	13,48	84,35	0,00	0,00

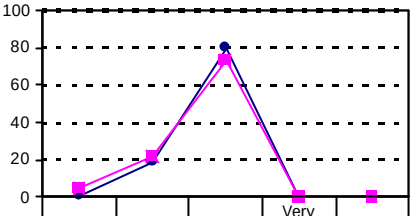
Figure 1. Estimation of 1994 self-assessed health status (cont.).

Women 65-74 years old



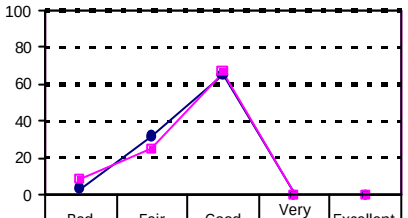
	Bad	Fair	Good	Very good	Excellent
2006 model 1994 data	0,73	36,50	62,77	0,00	0,00
1994 model 1994 data	6,57	50,36	43,07	0,00	0,00

Men 65-74 years old



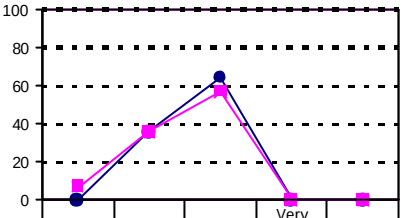
	Bad	Fair	Good	Very good	Excellent
2006 model 1994 data	0,95	19,05	80,00	0,00	0,00
1994 model 1994 data	4,76	21,90	73,33	0,00	0,00

Women 75 years old and more



	Bad	Fair	Good	Very good	Excellent
2006 model 1994 data	3,42	31,62	64,96	0,00	0,00
1994 model 1994 data	8,55	24,79	66,67	0,00	0,00

Men 75 years old and more



	Bad	Fair	Good	Very good	Excellent
2006 model 1994 data	0,00	35,71	64,29	0,00	0,00
1994 model 1994 data	7,14	35,71	57,14	0,00	0,00

Annex 3. García-Altés A. Twenty years of health care economic analysis in Spain: are we doing well? Health Economics 2001;10(8):715-29.

HEALTH ECONOMICS
Health Econ. **10**: 715–729 (2001)
DOI: 10.1002/hec.608

REVIEW

TWENTY YEARS OF HEALTH CARE ECONOMIC ANALYSIS IN SPAIN: ARE WE DOING WELL?

ANNA GARCÍA-ALTÉS*
Catalan Agency for Health Technology Assessment and Research, Fundación Instituto de Investigación en Servicios de Salud, Spain

SUMMARY

The rising demand for health care, together with the scarce available resources, has increased the use of economic analysis as a support tool for policy making. The objective of this study was to make a description of economic evaluation studies carried out in Spain and published during the last 20 years, and to assess their quality.

A systematic bibliographic search was made in the main biomedical databases. Full economic evaluation studies made in Spain comparing two or more health care alternatives were included. Statistical analyses included a descriptive analysis, the assessment of the association between pairs of variables, and a homogeneity analysis.

A total of 87 studies were included in the review. According to the methodology, the technique most frequently used was cost-effectiveness analysis. In most cases, some weaknesses could be pointed out: absence of any objective directly linked to the decision-making process, a non-explicit perspective, no inclusion of indirect costs, or clinical and economical data not concurrently collected.

A continuing challenge for health care economic analysis in Spain is to follow methodological guidelines and reporting conventions, to improve the dissemination of research, as well as to use more sophisticated economic analysis techniques, and to publish in international journals. Copyright © 2001 John Wiley & Sons, Ltd.

KEY WORDS — economic analysis; health care services; Spain

INTRODUCTION

The rising demand for health care together with the scarce available resources increase the pressure upon governments and society at large to develop and implement better mechanisms for the allocation and distribution of health care resources. Issues such as rationing, priority setting, cost containment policies, definition of health resources, basic health care packages, and others lie behind the debate on the economic pressures faced by today's health care systems.

Under this scenario it is no wonder that eyes have turned to economic analysis as a support tool for policy making: after all, economics is about making decisions and choices in the face of scarcity. The fact that new health care services are expensive makes economic analysis a useful tool to assess the value of those new services compared with existing ones. Some authors have identified four factors that influence the development and utilization of medical technologies: only those technologies that improve the quality and outcome of care, reduce costs, improve access, and are accepted by providers, show good potential

* Correspondence to: Catalan Agency for Health Technology Assessment and Research, Travessera de les Corts, 131-159, Pavelló Ave Maria, 08028 Barcelona, Spain. Tel.: + 34 93 2272900; fax: + 34 93 2272998; e-mail: agarcia@hsph.harvard.edu

Received 3 July 2000
Accepted 8 February 2001
Published online 30 May 2001

for widespread diffusion. And efficiency is related to value, as the relationship between outcomes and costs.

Economic analysis provides health care practitioners, policy makers, and consumers with useful information for informed decision-making, in terms of efficiency, for a fair allocation and distribution of specific health services under defined circumstances and settings. Economic analysis, using economic and epidemiologic data under different techniques, allows estimating the costs and outcomes of alternative choices [1]. Most of the time, these decisions deal with the selection among different and competing alternatives in prevention, diagnosis, treatment, or rehabilitation of conditions. The information provided by economic analysis has to be appraised together with other types of assessments that measure the impact of specific health technologies in terms of efficacy, effectiveness, safety, equity, or ethical implications.

Although economic analysis has a longer tradition in Anglo-Saxon countries, it has been increasingly used in Spain since 1980. Nowadays, it is considered a useful instrument for health care decision-making. The objectives of this study were to describe and assess the quality of the research in economic analysis carried out in Spain and published for the past 20 years in the economic and medical literature. By comparing these results with similar and earlier Spanish [2] and international research [3,4], we expect to be able to make useful recommendations to advance the economic analysis in Spain.

METHODS

Data sources. A systematic bibliographic search was made in the main biomedical databases: MEDLINE (1966–1999), HealthStar (1975–1999), Embase (1988–1999), Índice Médico Español (up to 1999), and NHS Economic Evaluation Database—NEED—(up to 1999).

The MeSH descriptors used were: 'cost–benefit analysis', 'cost-effectiveness analysis', 'cost and costs analysis', 'hospital cost', 'hospital running cost', 'cost control', 'drug cost', 'energy cost', 'health care cost', 'decision theory', and 'Spain'. Other terms used in title field were 'cost', 'costs', 'econom*', and the geographic terms 'Spain', 'España', 'Catalonia', 'Cataluña', 'Barcelona', 'Madrid', 'Sevilla', 'Bilbao', 'Sabadell', 'Hospitalet', 'Málaga' as free text in title and address fields.

In relation with grey literature, a specific search was performed to look for doctorate thesis about economic analysis of health care services in TESEO database—a database containing all doctorate theses carried out in Spain. Additionally, a hand searching process was carried out in order to identify proceedings of the Annual Meeting of the Spanish Health Economics Association, health technology assessment reports, and Spanish journals not included—or partially included—in bibliographic databases:

- Agència d'Avaluació de Tecnologia i Recerca Mèdica
- Osteba-Servicio de Evaluación de Tecnologías Sanitarias
- Agencia de Evaluación de Tecnologías Sanitarias
- Agencia de Evaluación de Tecnologias Sanitarias de Andalucia
- Todo Hospital, 1983–1984
- Revista de Administración Sanitaria, 1997–1999
- Revista Española de Farmacoeconomía, 1998–1999

Selection criteria. From the bibliographic search performed, and after reading the full text, full economic evaluation studies performed in Spain which compared two or more health care alternatives—or the 'do-nothing' alternative—were included in the study. We defined studies 'performed' in Spain as those in which the costs were expressed in the Spanish currency 'pesetas' and having at least one Spanish author. That means that cost-minimization analyses, cost-effectiveness analyses, cost-utility analyses and cost-benefit analyses comparing two or more alternatives were included, and partial evaluations like cost analysis were excluded. (The list of excluded studies is available under request.) Proceedings—except for those above mentioned—editorials and letters were excluded, since their scarce information available made their quality assessment impossible. In case of duplicate publication, only the most recent study or the one published in the journal with the highest impact factor was included in the review.

Classification parameters. All studies were reviewed according to:

- First author name
- Year of publication
- Journal of publication
- Workplace of the first author, either hospital, primary care, administration (local or state), academic, private and others
- Province of workplace of the first author
- Topic, a synthetic, non-systematic description of the main topic of the analysis
- Medical function
- Study type
- Objective of study related to decision-making
- Perspective of analysis used, when explicit
- Included costs, direct and indirect
- Explicit sources of information for cost data
- Use of decision analysis techniques
- Clinical and economical data obtained concurrently in the study
- Recommendations of the study related to decision-making
- Study funding, for-profit or not-for-profit

Studies were classified by their medical function: in order to maintain comparability with previous works [3,4], the classification scheme used in them was adopted, that is, whether the focus was on preventive (medically oriented and education/behaviour topics), diagnostic (symptomatic conditions and screening), or therapeutic interventions (medication, devices/procedures, education/behaviour and surgery).

Since economic analysis deals with decision-making, it was recorded whether the study objectives and recommendations were directly related to the decision-making process. The study type, such as cost-minimization, cost-effectiveness, cost-utility and cost–benefit analyses, was identified after reading the full text and verifying the outcome measures and costs. Cost-effectiveness analyses were analysed independently from cost-utility analyses since they are still considered as pertaining to different categories by most Spanish researchers. In the same way, cost-minimization analyses were analysed independently from cost-effectiveness analyses, contrarily to many recommendations, for the same reasons.

Studies were categorized as 'for profit', or 'not for profit' when it was stated as such, otherwise they were categorized as 'non-explicit'. However, and as an approximation, if at least one of the authors of the study was working for a for-profit company, the study was categorized as 'for profit' as well.

Statistical analysis. Simple frequencies and bivariate tables were produced for each of the study variables. The level of association between pairs of variables was assessed with the Fisher's exact test (Yate's correction). A homogeneity analysis—a variation of multiple case correspondence analysis—was performed to assess the inter-relationships between the different response variables [5,6]. The analysis included all the studies and seven categorical variables with 23 categories in total: indirect costs (two categories), study type (four categories), workplace of the first author (six categories), type of publication (four categories), recommendations of the study (two categories), medical function (three categories), and concurrent clinical and economic data (two categories).

RESULTS

A total of 2692 studies were identified by means of the bibliographic search. After applying the above mentioned inclusion criteria, a total of 87 studies were included in the review [7–93]. Six duplicate publications were identified. The rest of the studies were rejected because they did not perform a full economic evaluation, were abstracts, editorials or letters, or were not performed by Spanish authors.

Figure 1 represents the trend in the number of economic analysis studies performed between 1983 and 1999. As shown in the figure, there was a constant and growing trend in economic analysis studies published in the literature. The 1990 peak corresponded to the Annual Meeting of the Spanish Health Economics Association, which was devoted to the economic analysis of health technologies. The lowest value of 1999 reflected the delay in introducing studies in bibliographic databases. According to the main methodology followed, few cost-benefit and cost-utility analyses were performed. Cost-effectiveness and cost-minimization analyses had been constantly performed through time; the latter were increasingly being used. Topics varied through time as well. Diagnostic and preventive techniques had been constantly performed, but treatment strategies

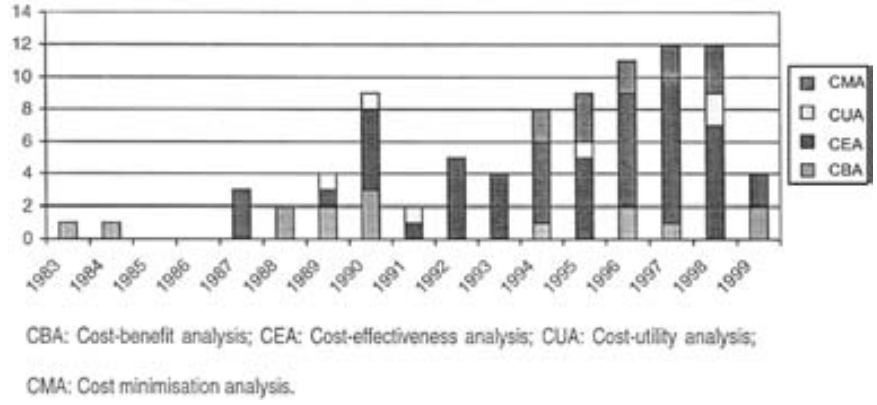


Figure 1. Economic analysis literature in Spain, 1983–1999. CBA: cost–benefit analysis; CEA: cost-effectiveness analysis; CUA: cost-utility analysis; CMA: cost-minimization analysis

increased their relevance from 1994. Hepatitis, diabetes and cardiovascular diseases were among the most studied topics.

Figure 2 displays the geographical distribution of first authors. Barcelona and Madrid accounted for 45.9% of all the literature. Twelve out of the 25 studies performed in Barcelona were carried out by the local and regional administration located in Barcelona, another six by hospitals and another six by private settings. In Madrid, 12 out of 15 studies were performed by hospitals and by private settings, and just one by the public administration. The rest of studies were almost equally distributed through the rest of provinces.

Following the classification of Elixhauser *et al.* [3,4], as could be seen in Table 1, the technique most frequently used was cost-effectiveness analysis (62.1%), similar to other countries, followed by cost-benefit analyses (17.2%), cost-minimization analyses (13.8%), and cost-utility analyses (6.9%). According to the medical function, 54% were treatment oriented (68.0% medication), 20% dealt with prevention (95.0% medically oriented) and 20% with diagnosis (100% screening). As in other reviews, cost-effectiveness analyses were more often used in the evaluation of diagnostic tests for symptomatic persons, while cost-benefit analyses were more commonly applied to preventive interventions.

According to the methodological characteristics of the studies (Table 2), most of them (73.6%) did not state objectives directly linked to decision-making, although most of them (62.1%) made recommendations related to decision-making. The

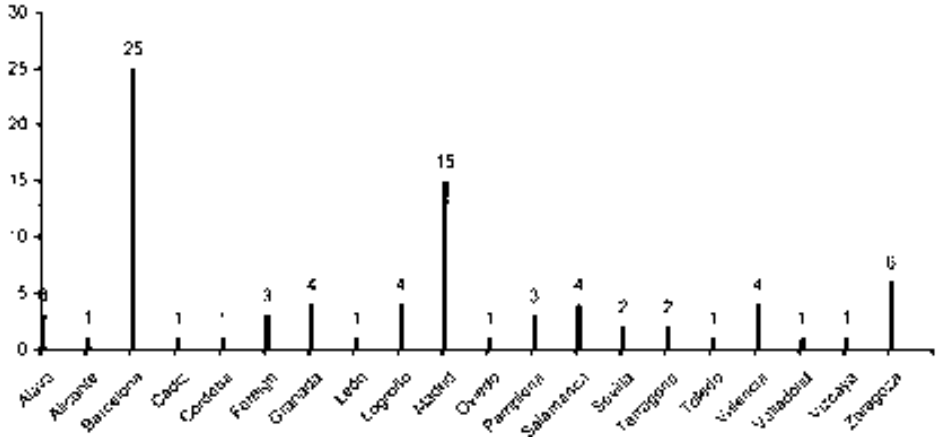


Figure 2. Distribution of studies according to the province of workplace of the first author

Table 1. Comparison of main characteristics among reviewed studies

Characteristics	Spain 1969–1999 [*n* (%)]	Elixhauser *et al.* (1998) 1979–1990 [*n* (%)]	Elixhauser *et al.* (1993) 1991–1996 [*n* (%)]
Study type			
CBA	15 (17.2)	680 (37.7)	430 (19.4)
CEA	54 (62.1)	1123 (62.3)	1792 (80.6)
CUA	6 (6.9)	–	–
CMA	12 (13.8)	–	–
Origin of publication			
US	–	1249 (66.0)	1167 (53.1)
Non-US	87 (100.0)	644 (34.0)	1029 (46.9)
Medical function			
Prevention	20 (23.0)	334 (19.5)	352 (16.5)
Diagnosis	20 (23.0)	612 (35.9)	557 (26.1)
Treatment	47 (54.0)	761 (44.6)	1226 (57.4)
Prevention function			
Medically oriented	19 (95.0)	273 (80.4)	251 (68.8)
Education/behaviour	1 (5.0)	66 (19.6)	114 (31.2)
Diagnosis function			
Symptomatic	0 (0.0)	354 (55.6)	301 (50.8)
Screening	20 (100.0)	282 (44.4)	292 (49.2)
Treatment function			
Medication	32 (68.0)	233 (38.3)	525 (52.4)
Device/procedure	8 (17.0)	152 (25.0)	191 (19.1)
Surgery	2 (4.3)	133 (21.9)	185 (18.5)
Education/behaviour	5 (10.7)	58 (9.5)	48 (4.8)

CBA: cost–benefit analysis; CEA: cost-effectiveness analysis; CUA: cost-utility analysis; CMA: cost-minimization analysis.

perspective of the analysis was not usually stated (72.4%), leaving it to the readers' judgement. However, if explicit, the most frequent one was the health care system perspective (14.9%). Only a small part of studies included indirect costs (18.4%) in addition to direct costs. In relation to the design of studies, clinical and economical data were concurrently collected in 19.5% of the cases, corresponding mainly to those performed in hospitals, and only 28.7% used decision analysis techniques. In most of the studies (71.3%), the source of financing was not stated, but if explicit, it was for profit in 23.0% of the cases and not for profit in 5.7%.

Paying attention to the source of information of the outcome measures used in the cost-effectiveness and cost-utility analyses, 41 (67.2%) studies find it in the literature through systematic and non-systematic reviews, 12 (19.7%) of them in the realization of prospective studies, 1 (1.6%) in a meta-analysis, 5 (8.2%) using a combination of sources such as literature, experts, and registers, and 2 (3.3%) of them did not make it explicit. Frequently, the methods for utility calculation in cost-utility analyses were not always reported. There were six cost-utility analyses, of which two of them did not report the utility measurement, another two of them use literature values and only two used specific designs (Rosser matrix) to explicit preferences.

Table 3 shows the distribution of economic analysis studies in different journals. Among Spanish journals, most studies were published in general bio-medical journals, as for example the 14.9% in Medicina Clínica—Med Clin (Barc). The rest were published in specific journals or journals specialized in economic analysis. It should be pointed out that 22.9% of the studies were published in international journals.

Table 4 shows the association between some variables. As could be seen, there was a statistically significant (90% significance) association between the year of study and the study type; the study funding, recommendations, study type,

Table 2. Methodological characteristics of the reviewed studies

Characteristics	*n* (%)
Objective	
Yes	23 (26.4)
No	64 (73.6)
Perspective	
Not explicit	63 (72.4)
Society	5 (5.7)
Health care system	13 (14.9)
Hospital	5 (5.7)
Others	1 (1.1)
Costs	
Direct	71 (81.6)
Indirect	16 (18.4)
Cost information	
Yes	66 (75.9)
No	21 (24.1)
Decision analysis techniques	
Yes	32 (28.7)
No	55 (63.2)
Clinical and economical data	
Yes	17 (19.5)
No	60 (80.5)
Recommendations	
Yes	54 (62.1)
No	33 (37.9)
Study founding	
For profit	20 (23.0)
Not for profit	5 (5.7)
Non-explicit	62 (71.3)

included costs, the workplace of the first author; and study perspective and included costs.

The results of the homogeneity analysis confirmed the relationships between variables. After extracting two dimensions, the first one was defined by the study type, the workplace of the first author and the inclusion of indirect costs. The workplace of the first author, type of publication, and medical function defined the second dimension. The variables 'recommendations of study' and 'concurrent clinical and economical data' did not add further information to the dimensions. Two dimensions seemed to be present in the studies; one was formed by the variables: 'study type', 'workplace of first author', and 'presence of indirect costs'. The second dimension was formed by the variables: 'workplace of first author', 'type of publication' and 'medical function'.

Table 3. Journals publishing health care economic analysis

Journal	*n*	%
Actas Luso-Esp. Neurol Psiquiat	1	1.1
Agència d'Avaluació de Tecnologia Mèdica	2	2.3
Am J Hosp Pharm	1	1.1
Am J Pub Health	1	1.1
Anales de Medicina Interna	1	1.1
Anales Españoles de Pediatría	1	1.1
Arch Esp Urol	1	1.1
Arch Odont-Estom Prev y Comunit	1	1.1
Aten Primaria	2	2.3
Biol Clín Hematol	1	1.1
Br J Med Econ	2	2.3
Cir Plástica Ibero-Latinoamericana	1	1.1
Clin Pharmacol Ther	1	1.1
Community Dent Oral Epidemiol	1	1.1
Eur J Public Health	1	1.1
Farmacia Clínica	4	4.6
Farmacia Hospitalaria	2	2.3
Gac Sanit	4	4.6
Gastroenterol Hepatol	1	1.1
GEDYT	1	1.1
Int J Technol Assess Health Care	2	2.3
J Drug Dev	1	1.1
Jornadas AES	11	12.6
Laboratorio	1	1.1
Med Clin (Barc)	13	14.9
Medicina Militar	1	1.1
Nutr Hosp	1	1.1
Osteba. Servicio de Evaluación de Tecnologias Sanitarias	3	3.4
Pharmacoeconomics	4	4.6
Public Health	1	1.1
Reg Cancer Treat	1	1.1
Revista de Administración Sanitaria	1	1.1
Rev Clin Esp	1	1.1
Rev Esp Cardiol	2	2.3
Rev Esp Enf Digest	1	1.1
Revista Española de Farmacoeconomía	5	5.7
Rev Esp Salud Publica	3	3.4
Rev San Hig Pub	1	1.1
Semin Oncol	1	1.1
Todo Hospital	1	1.1
Vaccine	2	2.3
Total	87	100.0

Dimension 1 could be interpreted as sophistication of the study type, from cost-minimization analyses to cost-utility, cost-effectiveness and cost–benefit analyses. Dimension 2 mainly represented the type of publication, from health

Table 4. Association between variables

Variables	Value*	*p*-value
Year—Study type	57.9	0.051
Year—Perspective	65.7	0.174
Year—Information for cost data	15.1	0.369
Year—Decision analysis techniques	29.8	0.372
Workplace—Study funding	36.3	0.000
Workplace—Decision analysis techniques	8.0	0.783
Workplace—Objective	6.3	0.389
Workplace—Recommendations	10.6	0.101
Workplace—Medical function	29.8	0.756
Workplace—Study type	29.8	0.039
Workplace—Included costs	15.2	0.018
Workplace—Concurrent data	8.6	0.191
Medical function—Study type	23.6	0.168
Study perspective—Included costs	26.5	0.000

* Fisher's exact test.

technology assessment reports to scientific meetings, Spanish journals and international journals, and the medical function, from diagnosis to treatment and prevention. These relationships could be seen in Figure 3 that shows different areas. In the first and second quadrant, cost-effectiveness analyses and cost-utility analyses were performed by people working in the administration or in private settings, were presented in meetings, and were published in international journals (especially cost-utility analyses). They did not included indirect costs, clinical and economical data were not collected concurrently and recommendations for decision-making were made. In the third quadrant, cost–benefit analyses could be found, with indirect costs, made by academic authors, and usually devoted to prevention. In the fourth quadrant there were cost-minimization analyses, carried out in hospitals, with clinical and economical data concurrently collected, and published in international journals. Primary care and health technology assessment reports were far from the corresponding groups because there were only few, very heterogeneous, studies. Studies were uniformly distributed in the two dimensions in time and in geographical place.

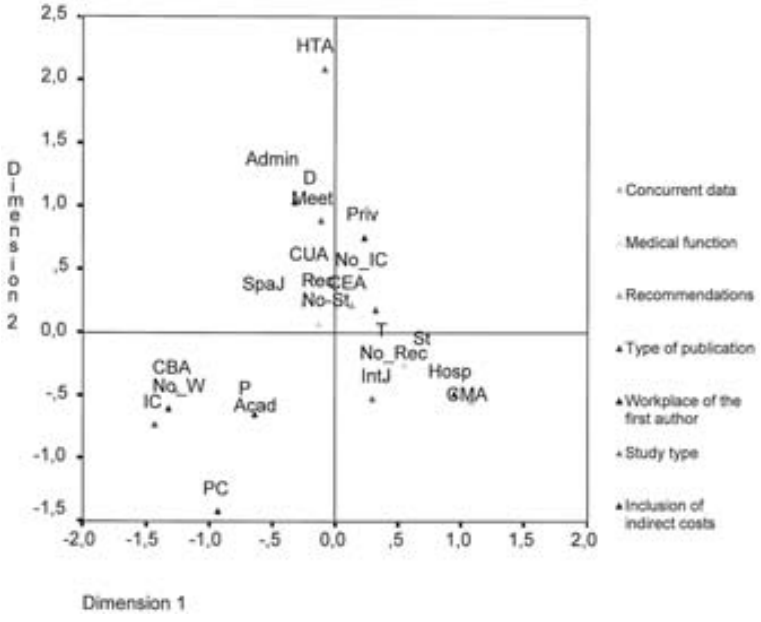


Figure 3. Quantification of categories. HTA: health technology assessment report; SpaJ: Spanish journal; IntJ: international journal; Meet: scientific meeting; Admin: administration; Hosp: hospital; PC: primary care; Priv: private setting; Acad: academic; No_W: no explicit workplace; CBA: cost–benefit analysis; CEA: cost-effectiveness analysis; CUA: cost-utility analysis; CMA: cost-minimization analysis; D: diagnosis; T: treatment; P: prevention; Rec: recommendations; No_Rec: no recommendations; IC: indirect costs; No_IC: no indirect costs; St: data concurrently obtained; No_St: data not concurrently obtained

CONCLUSIONS

The increasing trend in economic analysis literature identified in earlier and foreign work [2–4] has clearly continued in Spain, despite the fact that there is still not much work about this subject. The expansion of the economic analysis literature could be explained by the growing emphasis on evaluating health outcomes, which are an important consequence of medical care. Other factors that have undoubtedly contributed to the growth of health care economic analysis are the increasing competition in the health care industry and the growing perception by health care purchasers that health care services provide value for money.

Common to other reviews, there is the possibility that some significant studies had been missed. In the present case, this probability was minimized using systematic bibliographic search techniques. Then, the main reason for the relatively large number of rejected articles after applying the inclusion criteria was the extensive criteria used in the bibliographic search in order to not missing studies for the review.

This review, as others previously published [2–4,94–99], showed that in many cases, articles do not publish enough information on the methods and data used. As such, the perspective of analysis was not explicit in 72.4% of the studies, sources of cost data were missing in 24.1% of them, and objectives and recommendations directly oriented to decision-making were lacking in 73.6% and 37.9% of them, respectively.

The recognition of the existing methodological controversies and the interest in facilitating the implementation and the interpretation of economic analysis has promoted the development and implementation of methodological standards for the economic assessment of health care services [100–107]. It seems that economists have reached an agreement upon a number of important characteristics that would ensure the validity and reliability of the results. Standards for economic analysis should contribute to make the results of analyses relevant and credible for policy-making. The use of the society perspective, to explicit cost calculation methods and sources of economic information, and the performance of sensitivity and incremental analyses, are some of the main recommendations. The experience in the use of those guidelines is available in some countries [108].

Furthermore, several methodological checklists for critically appraising published studies have been proposed [1,109–112], with some interesting and promising results. Another interesting initiative is the one carried out by the Department of Health of England which published a register of cost-effectiveness studies containing details of a large amount of economic evaluations conducted in the last two decades [94,99]. This kind of databases could help in the task of increasing the quality and transparency of the studies. New thing in review studies, this one has pointed out the usefulness of methodologies such as homogeneity analysis to analyse this sort of data, beyond counting and frequencies. Homogeneity analysis has proved to be a useful tool to analyse the relationships between multiple variables assessing the quality of economic analysis studies.

Adherence to reporting conventions and attention to providing information required understanding and interpreting study results would improve the relevance and accessibility to economic analyses [113]. The methodological rigour in the application of economic analysis techniques is essential to guarantee the study reproducibility.

Equally important seems to be the use of clinical outcome measures obtained in study designs of the highest level of evidence, such as randomized controlled trials or meta-analysis of randomized controlled trials [114]. As we could see, most of the reviewed studies find the effectiveness measures in the literature, without making explicit the use of systematic reviews; and some of them find it in the realization of a prospective study, collecting the economic and the clinical data concurrently. Since the quality of the estimates of effectiveness used in the evaluations is a cardinal point, one should expect in the foreseeable future more evaluations based on randomized controlled trials, systematic reviews or large observational studies. Integration of outcome measures based on the best scientific evidence available in economic assessment studies will allow for a higher quality of the performed analysis [115].

Moreover, the peer-review process has revealed to be a key element in the improvement of the quality of the published studies. The incorporation of guidelines within the peer-review process of the medical literature would contribute to a rise in reporting standards, specially in specific medical journals, were greater methodological deficiencies have been found [116,117]. As an example,

the *British Medical Journal* checklist for the submission of economic assessment studies has proved to be a feasible tool to assess the quality of economic assessment studies, and has been suggested as a guideline for other journals [118].

Transparency in the use of economic analysis methods is also important to avoid biases in methodology and in reporting of the results. As showed in the review, 22.7% of the reviewed studies had a for-profit funding. The relationship between pharmaceutical companies and research is increasingly important, with some recent problems [119,120]. In that way, some recommendations have been proposed to conduct and report economic analyses to avoid biases [121], such as to make always explicit the relationships between researchers and sponsors, or to make contracts to guarantee the fact that whatever the results would be, they will be published.

There is little sense in performing an economic analysis if it is going to have no impact on decision-making at all. Its impact on decisions, however, is still unclear. A survey of economic analysis in EC countries to identify the impact of the results on decision analysis and policy-making in health care, stated that 27% of the selected studies were thought to have influenced health care decision-makers or policy [122]. The results of the survey suggested that economic analysis had a relative low impact on health care policies or on decision-making. However, there is a considerable potential for the use of economic assessment in developing policies for the rational diffusion and use of health care services [123]. Some examples of uses of economic analysis are the Dutch policy of the public health insurance system [124], the National Health Service research and development strategy [125], advising the purchase of technologies in Catalonia [126], and its use in Australia and Ontario in the introduction of drugs on the national and regional formulary, respectively [127,128].

A continuing challenge for health care economic analysis is to improve the dissemination of the studies, and to produce health care economic analyses that are timely and relevant to the needs of decision-makers. One of the reasons that economic analysis is not more frequently used in the decision-making process is because economic analyses themselves could be expensive and time consuming, and their results are often not available at the time that decisions must be made [129]. Thus, decisions are generally based in information regarding the short-term clinical efficacy and the acquisition costs of an intervention, rather than the cascade of costs and outcomes that result from its use in actual clinical practice [130]. Nonetheless, cost-effectiveness was ranked among the top five considerations in making coverage decisions in a survey of 231 medical directors at private insurance plans [131], ranking much higher than costs alone, and outranking many clinical considerations.

Some areas of future development could be pointed out. First, the use of decision analysis techniques, unless its methodological constraints [132], is a useful way to model the reality when direct observation of the phenomenon is not available and cannot be collected, and could be useful in trying to understand a complex reality [133]. Decision analysis techniques could be further used in those cases. At the same way, concurrent clinical and cost data collection should be stimulated as well as the realization of economic clinical trials when possible.

Second, an interesting alternative to cost-effectiveness analysis is cost-benefit analysis using direct or indirect methods to estimate the value of goods for which an explicit market not exists [1]. Methodologies such as willingness to pay, contingent valuation techniques, or hedonic prices should be further emphasized. Those methodologies could be especially interesting when effectiveness measures are lacking or it is not possible to measure them.

Third, the application of economic analyses results in health care context different from the original ones should be further developed. Factors such as the relative price of resources, the availability of health care resources, local epidemiological data, or variations in medical practice, also affect the efficiency of the alternatives under comparison. But there is not yet developed a methodology for reviewing and summing up evidence from individual economic evaluations which may have been conducted at different times and in different places, unless some interesting initiatives have recently appeared [134,135].

Finally, the methodological problems of economic analyses performed in Spain are the same than those performed abroad. That should not be the reason to not try to publish in international journals. Publishing in this kind of journals would help in the consolidation of a long course action and in the recognition of a high quality research.

ACKNOWLEDGEMENTS

The author thanks Beatriz González for her help in the statistical analysis, Itziar Larizgoitia, Fernando Antoñanzas, Salvador Peiró, Marc Sáez and Joan MV Pons for their help in the review of a previous version of this manuscript, and Antoni Parada and Noël Marsal for their support in the bibliographic search and request of documents. This work was presented in the 20th Annual Meeting of the Spanish Health Economics Association (Palma de Mallorca, 3–5 May 2000).

REFERENCES

1. Drummond MF, O'Brien B, Stoddart GL, Torrance GL. *Methods for the Economic Evaluation of Health Care Programmes* (2nd edn). Oxford University Press: New York, 1997.
2. Badia X. La evaluación económica en el sector sanitario: Revisión de estudios españoles y apuntes para el futuro. *Revisiones en Salud Pública* 1991; **2**: 107–117.
3. Elixhauser A, Halpern M, Schmier J, Luce BR. Health care CBA and CEA from 1991 to 1996: an updated bibliography. *Med Care* 1998; **36**: MS1–MS9.
4. Elixhauser A, Luce BR, Taylor WR, Reblando J. Health care CBA/CEA: An update on the growth and composition of the literature. *Med Care* 1993; **31**: JS1–JS11.
5. González López-Valcárcel B. *Análisis multivariante. Aplicaciones en el ámbito sanitario*. Editorial SG: Barcelona, 1991.
6. Benzecri JP et collaborateurs. *L'Analyse des données: II. L'Analyse des correspondances*. Dunod: Paris, 1980.
7. Alcaide J, Altet MN, Canela J, *et al*. Influencia de la educación sanitaria en el cumplimiento de la quimioprofilaxis antituberculosa en niños: ensayo comunitario. *Rev Clin Esp* 1990; **187**: 89–93.
8. Almuzara Sauras I. Economic analysis of the costs of influenza applied to the province of Huesca. *Rev Sanid Hig Publica (Madr)* 1987; **61**: 1017–1028.
9. Altimiras J, Bonal J, Segu JL. Economic appraisal of lactitol in unit doses. *Farmacia Clinica* 1994; **11**: 298–310.
10. Antoñanzas F, Forcen T, Garuz R. A cost-effectiveness analysis of vaccination against the hepatitis B virus. *Med Clin (Barc)* 1992; **99**: 41–46.
11. Antoñanzas F, Rovira J, Garuz R, Anton F. Economic evaluation of prophylaxis with recombinant granulopoiesis stimulating factor. *Med Clin (Barc)* 1992; **99**: 685–689.
12. Antoñanzas F, Garuz R, Rovira J, *et al*. Cost-effectiveness analysis of hepatitis B vaccination strategies in Catalonia, Spain. *Pharmacoeconomics* 1995; **7**: 428–443.
13. Antoñanzas Villar F, Anton Botella F, Echevarría Echarri L. Cost-effectiveness analysis of the treatment with enalapril of chronic heart failure in Spain. *Gac Sanit* 1996; **10**: 135–142.
14. Arana A, Astier P, Lopez MA, Oterino D, Peiró S. Evaluación económica de la hospitalización para intervención de cataratas un análisis de minimización de costes. *Todo Hosp* 1994; **112**: 57–64.
15. Arnal JM, Frisas O, Garuz R, Antoñanzas F. Cost effectiveness of hepatitis A virus immunisation in Spain. *Pharmacoeconomics* 1997; **12**: 361–373.
16. Artells JJ. *Aplicación del análisis coste-beneficio en la planificación de los servicios sanitarios. Eficiencia y equidad en la atención perinatal*. Masson, SA: Barcelona, 1989.
17. Asua J, Arnaez R, Gutiérrez MA. Evaluación preoperatoria del paciente sano/asintomático. Vitoria-Gasteiz: Servicio de Evaluación de Tecnologías Sanitarias (OSTEBA). Departamento de Sanidad. Gobierno Vasco, 1994.
18. Asua J, Baile MA, Gutiérrez A, Aizpuru K, Aizpurua I, Toña I. Utilización de contrastes iodados en radiodiagnóstico. Vitoria-Gasteiz: Servicio de Evaluación de Tecnologías Sanitarias (OSTEBA). Departamento de Sanidad. Gobierno Vasco, 1995.
19. Aulesa C, Olive T, Bastida P, Ortega JJ. Análisis del coste de dos modalidades de tratamiento en leucemias agudas no linfoblásticas en niños: poliquimioterapia intensiva secuencial prolonganda versus quimioterapia de intensificación seguida de transplante de médula osea alogénico. *Biol Clin Hematol* 1992; **14**: 221–228.
20. Badia X, Segu L, Garcia Alonso F, Rovira J. A cost-efficacy analysis of treatment with antiendotoxin monoclonal antibodies in gram-negative sepsis. *Med Clin (Barc)* 1993; **100**: 84–89.
21. Bermejo B, Candell RJ, Olona M, Rossello J, Vaque J, Permanyer MG, *et al*. A cost-effectiveness analysis of prognostic studies in acute uncomplicated myocardial infarct. *Rev Esp Cardiol* 1993; **46**: 477–482.
22. Bermejo B, Rovira J, Olona M, Serra M, Soriano M, Vaqué. Análisis coste-efectividad de la determinación de ferritina sérica de cribado en los exámenes periódicos de salud en las mujeres en edad fértil. *Med Clin (Barc)* 1996; **106**: 445–450.
23. Borràs JM coordinador. El cribratge del càncer de mama a Catalunya: cost-efectivitat, impacte assistencial i cost del tractament del càncer de mama. Barcelona: Agència d'Avaluació de Tecnologia Mèdica. Servei Català de la Salut. Departament de Sanitat i Seguretat Social. Generalitat de Catalunya, Novembre 1996 [IN96010].
24. Bravo Perez M, Llodra Calvo JC, Baca Garcia P, Osorio Ruiz E. Fissure sealants versus fluorine varnish on the first permanent molars: economic assessment. *Aten Primaria* 1995; **15**: 143–147.

25. Buti M, Casado MA, Fosbrook L, Esteban R. Cost effectiveness of the treatment of chronic hepatitis C with interferon-alpha. *Gastroenterol Hepatol* 1998; **21**: 161–168.
26. Cabasés J, Moja F, Errezola M. Nuevas indicaciones de la vacunación contra la hepatitis B basadas en el análisis coste-efectividad. *Jornadas de Economía de la Salud* 1990: 313–326.
27. Cabrera A, Domínguez C, Huertas F, Carretero A. Evaluación de un programa: análisis coste-beneficio. *Aten Primaria* 1989; **6**: 94–97.
28. Calvo MV, Perez Encinas M, Nieto F, Domínguez Moronta F, Muñoz A. Cost-effectiveness of individualized enteral nutrition by a nutrition support team in laryngectomized cancer patients. *Nutr Hosp* 1991; **6**: 87–93.
29. Calvo MV, Pilar DV, Mar AM, Dominguez-Gil A. Decision analysis to assess cost-effectiveness of low-osmolality contrast medium for intravenous urography. *Am J Hosp Pharm* 1992; **49**: 577–584.
30. Castan Cameo S, García Latorre FJ, Martínez Gorostiaga J, Sierra Moros MJ, Solano Bernad VM, Peral Casado A. Minimizing the costs of prescription of anti-infective drugs in two areas of primary health care. *Rev Esp Salud Publica* 1998; **72**: 33–42.
31. Catalán JL, Real JV, Pérez C, Jiménez NV. Evaluación farmacoeconomía del envase de dos litros para fluidoterapia intravenosa. *Revista Española de Farmacoeconomía* 1995; **III**: 15–21.
32. Cercós A, Escrivá J. Análisis farmacoeconómico de pautas de profilaxis antibiótica en cesáreas. *Farm Hosp* 1994; **18**: 9–14.
33. Charlo Dupont T, Fernández Martin M, Tejido Sanchez C. A cost analysis of laparoscopic cholecystectomy compared with the open technic. *Rev Esp Enferm Dig* 1995; **87**: 449–452.
34. Comas A, Suárez R, López MªL, Cueto A. Coste-efectividad del consejo sanitario antitabaco en atención primaria de salud. *Gac Sanit* 1998; **12**: 126–132.
35. Copley-Merriman C, Martin C, Johnson N, *et al*. Economic value of gemcitabine in non-smal cell lung cancer. *Semin Oncol* 1996; **23**: 90–98.
36. Costa B. Conversion to U100 insulin. Clinical and pharmacoeconomic suggestions. *Med Clin (Barc)* 1996; **106**: 495–497.
37. Costa B, Estopa A, Borràs J, Sabaté A. Medication use in diabetes mellitus (VI). Economics and effectiveness of insulin and sulfonyl-urea combination therapy compared with conventional two daily doses. *Med Clin (Barc)* 1998; **111**: 568–572.
38. de Juana P, García B, Bermejo T. Análisis coste-beneficio de la calcitonina en jeringa precargada frente a sistemas clásicos de inyección. *Jornadas de Economía de la Salud* 1990: 365–376.
39. de Miguel A, Carretero F. Relación costo-eficcia en el tratamiento con hormona del crecimiento. *Medicina Militar* 1990; **46**: 187–192.
40. Diaz DR, Rodrigo-Saez L. Cost-effectiveness of omeprazole in the treatment of duodenal ulcer—a Spanish study. *J Drug Develop* 1993; **6**: 49–55.
41. Diez Domingo J, Ridao M, Latour J, Ballester A, Morant A. A cost benefit analysis of routine varicella vaccination in Spain. *Vaccine* 1999; **17**: 1306–1311.
42. Domínguez-Gil A, Rubio C. Análisis coste efectividad del tratamiento de las infecciones intra-abdominales con piperaciclina/tazobactam, en comparación con imipenem/cilastatina. *Revista Española de Farmacoeconomía* 1998; (Marzo): 15–24.
43. Fernández-Crehuet J, Delgado M. Coste-beneficio de una campaña de caunación antihepatitis B. *Laboratorio* 1983; **76**: 5655–5683.
44. Fernández de Gatta MD, Calvo MV, Hernández JM, Caballero D, San Miguel JF, Dominguez-Gil A. Cost-effectiveness analysis of serum vancomycin concentration monitoring in patients with hematologic malignancies. *Clin Pharmacol Ther* 1996; **60**: 332–340.
45. Fernandez Munoz J, Lopez de Andres A, Zapater Hernandez P, Abad Santos F. Cost-effectiveness analysis of the eradication of *Helicobacter pylori* as treatment for duodenal ulcer. *An Med Intern* 1998; **15**: 515–522.
46. Ferriols F, Lisart F, Ferriols R. Análisis coste-efectividad de la utilización de gemcitabina y ciplastino, ifosfamida y mesna en el tratamiento del cancer de pulmon no microcitico. *Farmacia Clinica* 1998; **15**: 326–335.
47. García A, Mercadal J, Lozano R. Prednicarbate versus Fluocortin for inflamatory dermatoses. *Pharmacoeconomics* 1997; **12**: 193–208.
48. García Martínez AM, Rovira Forns J. Análisis coste-efectividad de dos formas alternativas de tratamiento del tabaquismo. *Jornadas de Economía de la Salud* 1990.
49. Garuz R, Torrea JL, Arnal JM, Forcen T, Trinxet C, Anton F, *et al*. Vaccination against hepatitis B virus in Spain: a cost- effectiveness analysis. *Vaccine* 1997; **15**: 1652–1660.
50. Garuz R, Forcen T, Cabases J, Trinxet C, Rovira J, *et al*. Economic evaluation of a mammography-based breast cancer screening programme in Spain. *Eur J Public Health* 1997; **7**: 68–76.
51. Garuz R, Arnal JM, Forcén T, Antoñanzas F. Análisis coste-efectividad de la prevención prenatal frente al virus de la hepatitis B. *Anales Españoles de Pediatría* 1994; **40**: 405–410.
52. Gavira FJ, Lardinois R. Cost-effectiveness analysis of antigrippal vaccination in a rural population (La Victoria, Cordoba). *Med Clin (Barc)* 1990; **94**: 777–781.
53. Gisbert Gelonch R, Fernandez Augusto L. Cost-effectiveness analysis of preventive treatment of urinary lithiasis recurrence using potassium citrate. *Arch Esp Urol* 1997; **50**: 373–380.

54. Guillen Grima F, Espin Rios MI. Cost-effectiveness analysis of different alternatives of universal vaccination against hepatitis B in the region of Murcia. *Med Clin (Barc)* 1995; **104**: 130–136.
55. Gutiérrez A, Asua J. Análisis coste-efectividad de la cámara de retina no-midriática en el diagnóstico de retinopatía diabética. Vitoria-Gasteiz: Servicio de Evaluación de Tecnologías Sanitarias (OSTEBA). Departamento de Sanidad. Gobierno Vasco, 1996.
56. Gutiérrez RR, Inesta GA, Jiminez CE. Cost minimization analysis: Treatemnt of severe candidiasis and aspergillosis with liposomal amphotericin B or amphotericin B lipid complex. *Farmacia Clinica* 1997; **14**: 162–173.
57. Iníguez A. Prótesis intracoronarias (stent): una aproximación al análisis coste-efectividad. *Revista Española de Cardiología* 1997; **50**: 83–94.
58. Jiménez FJ, Guallar P, Rubio C, Villasante P, Guallar E. Cost-effectiveness analysis of pneumococcal vaccination in the elderly Spanish population. *Br J Med Econom* 1996; **10**: 193–202.
59. Jimenez FJ, Guallar-Castillon P, Rubio TC, Guallar E. Cost-benefit analysis of Haemophilus influenzae type b vaccination in children in Spain. *Pharmacoeconomics* 1999; **15**: 75–83.
60. Jonsson B, Horisberger B, Bruguera M, Matter L. Cost-benefit analysis of hepatitis-B vaccination. A computerized decision model for Spain. *Int J Technol Assess Health Care* 1991; **7**: 379–402.
61. Jovell AJ, Aymerich M, García-Altés A, Serra-Prat M. Guía de práctica clínica del tratamiento erradicador de la infección por *Helicobacter pylori* asociada a úlcera duodenal en la atención primaria Barcelona: Agència d'Avaluació de Tecnologia Mèdica. Servei Català de la Salut. Departament de Sanitat i Seguretat Social. Generalitat de Catalunya. , Septiembre 1998 (BR98002).
62. Manau C, Cuenca E, Martinez-Carretero J, Salleras L. Economic evaluation of community programs for the prevention of dental caries in Catalonia, Spain. *Community Dent Oral Epidemiol* 1987; **15**: 297–300.
63. Martín V, Domínguez A, Alcaide J. Cost-benefit analysis of the active screening of pulmonary tuberculosis in a recluse population entering prison. *Gac Sanit* 1997; **11**: 221–230.
64. Martín J, Recio F, Solas O. Análisis coste-beneficio del programa de extracción periférica de muestras del distrito sanitario de las Alpujarras—Año 1997. *Jornadas de Economía de la Salud* 1990.
65. Martínez-Bengoechea MJ, Errecalde MF, Jaio N, Siáz C, Arana A, Ibarra O. Coste-efectividad de alteplasa versus estreptoquinasa en infarto de miocardio. *Revista Española de Farmacoeconomía* 1994; **1**: 26–34.
66. Mugarra Bidea I, Cabases Hita JM. Cost-benefit analysis of the early detection program for metabolic diseases in the Autonomous Basque Community. *Gac Sanit* 1990; **4**: 140–144.
67. Navas E. Análisis coste-efectividad de la resonancia magnética. *Jornadas de Economía de la Salud* 1987.
68. Olier J, Antoñanzas F. Análisis coste-efectividad de la resonancia magnética. *Jornadas de Economía de la Salud* 1990.
69. Oterino de la Fuente D, Ridao M, Peiro S, Marchan C. Hospital at home and conventional hospitalization. An economic evaluation. *Med Clin (Barc)* 1997; **109**: 207–211.
70. Pardo L, Alfonso Sanchez JL. Aplicación del analisis de coste-utilidad al tratamiento delos pacientes quemados, en una unidad especializada. *Cirugía Plástica Ibero-Latinoamericana* 1998; **24**: 425–435.
71. Peinado JA, Peiró S. Análisis coste-efectividad de la reproducción asistida. *Revista de Administración Sanitaria* 1997; **1**: 141–160.
72. Pérez M, Santos L, Martín ML, Rubio C, Sanz A, Domínguez-Gil A. Análisis coste-efectividad de piperacilina-tazobactam versus ceftazidima en pacientes con neutropenia febril. Aplicación de un programa informático de farmacoeconomía. *Revista Española de Farmacoeconomía* 1999; (Marzo): 27–36.
73. Plans-Rubio P, Rovira Forns J. Estudio coste-efectividad de los tratamiento farmacologicos hipolipemiantes. *Med Clin (Barc)* 1995; **105**: 327–333.
74. Plans Rubio P, Garrido Morales P, Salleras Sanmarti L. The cost-effectiveness of pneumococcal vaccination in Catalonia. *Rev Esp Salud Publica* 1995; **69**: 409–417.
75. Plans P, Navas E, Tarín A, *et al*. Cost-effectiveness of the methods of smoking cessation. *Med Clin (Barc)* 1995; **104**: 49–54.
76. Plans P, Casademont L, Tarín A, Navas E. The study of cost effectiveness of breast cancer detection in Catalonia. *Rev Esp Salud Publica* 1996; **70**: 15–23.
77. Plans P. Cost-effectiveness of dietary treatment of hypercholesterolemia in Spain. *Public Health* 1997; **111**: 33–40.
78. Plans-Rubio P. Cost-effectiveness of cardiovascular prevention programs in Spain. *Int J Technol Assess Health Care* 1998; **14**: 320–330.
79. Requena CT, Santos HO, Espinola GE, Luque IR, Hervas LG, Sanjurjo SM. Cost-effectiveness analysis of fluconazol versus ketoconazol in oropharyngeal candidiasis associated with AIDS. *Farm Hosp* 1993; **17**: 75–80.
80. Rivera F, Lissen E, Vazquez R, *et al*. Cost-benefit analysis of a program for vaccination against hepatitis B in health personnel of a hospital. *Med Clin (Barc)* 1984; **83**: 611–614.

81. Rodríguez Recio MJ, Gutiérrez Meléndez P, Paniagua Tejo S. Análisis coste-beneficio de la vacunación sistemática frente al Haemophilus Influenzae tipo b en Castilla y León. *Jornadas de Economía de la Salud* 1996.
82. Roig R. Rentabilidad social y económica de la aplicación de fluor en aguas potables. *Jornadas de Economía de la Salud* 1988.
83. Rovira J, Lobo F, Badía X, Ventura J, de la Fuente Ma J, Brosna M. Aproximación a un análisis coste-utilidad de la terapéutica transfusión/eritropoyetina en los pacientes afectos de anemia nefrológica en hemodiálisis: resultados del estudio en curso. *Jornadas de Economía de la Salud* 1990.
84. Rovira J, Lobo F, Badía X, Ventura J, de la Fuente Ma J, Brosna M. Aproximación a un análisis coste-utilidad de la terapéutica transfusión/eritropoyetina en los pacientes afectos de anemia nefrológica en hemodiálisis: resultados del estudio en curso. *GEDYT* 1989; **XI**: 15–20.
85. Sacristán JA, Gómez JC, Martín J, *et al*. Pharmaeconomic assessment of olanzapine in the treatament of refractory schizophrenia based on a pilot clinical study. *Clin Drug Investig* 1998; **15**: 29–35.
86. Sacristán JA, Navarro O, Huete T, Iñiguez A. Cost-effectiveness of the monoclonal antibody c7E3 in high-risk coronary angioplasty in Spain. *Bri J Med Econom* 1996; **10**: 169–183.
87. Salvador-Carulla L, Seguí J, Fernández-Cano P, Canet J. The use of services, the effect of compensation and the costs of a panic disorder. *Med Clin (Barc)* 1994; **103**: 287–292.
88. Sard J, Cuenca E, Rovira J, Salleras L. La fluoración de las aguas de Barcelona. Análisis coste-beneficio. *Arch Odont-Estom Prev Comunit* 1989; **1**: 58–62.
89. Serra-Prat M, Gallo P, Jovell AJ, Aymerich M, Estrada MD. Trade-offs in prenatal detection of Down syndrome. *Am J Public Health* 1998; **88**: 551–557.
90. Soto Alvarez J. Análisis de minimización de costes sobre las diferentes presentaciones de interferon-alpha existente en el mercado para el tratamiento de la hepatitis C y la leucemia mieloide crónica. *Farmacia Clinica* 1998; **15**: 219–226.
91. Soto J, Rubio S. Análisis coste-efectividad de micofenolato mofetil en la prevención del rechazo agudo en pacientes con transplante renal alogénico. *Revista Española de Farmacoeconomía* 1999; (Junio): 17–28.
92. Trinxet C, Rovira J, Badía X. Análisis coste-efectividad de la terapia hormonal sustitutiva en la menopausia. *Jornadas de Economía de la Salud* 1992.
93. Vidal-Jove J, Mas J, Gili F, Domínguez A, Nieto S, Barrios P. Intra-arterial chemotherapy for advanced pelvic malignancies. Results and cost-effectiveness evaluation. *Reg Cancer Treat* 1994; **1**: 2–5.
94. Mason J, Drummond M. Reporting guidelines for economic studies. *Health Econ* 1995; **4**: 85–94.
95. Briggs AH, Gray AM. Handling uncertainty in economic evaluations of healthcare interventions. *Brit Med J* 1999; **319**: 635–638.
96. Salkeld G, Davey P, Arnolda G. A critical review of health-related economic evaluations in Australia: implications for health policy. *Health Policy* 1995; **31**: 111–125.
97. Severens JL, van der Wilt G-J. Economic evaluation of diagnostic tests. *Int J Technol Assess Health Care* 1999; **15**: 480–496.
98. Udvarhelyi IS, Colditz GA, Rai A, Epstein AM. Cost-effectiveness and cost-benefit analyses in the medical literature. Are the methods being used correctly? *Ann Intern Med* 1992; **116**: 238–244.
99. OHE HEED. Trends in economic evaluation. Office of Health Economics (OHE) Briefing; number 36, April, 1998.
100. Rovira J. Standardizing economic appraisal of health technologies in the European Union. *Soc Sci Med* 1994; **38**: 1675–1678.
101. Australia Commonwealth Department of Health, Housing and Community Services. Guidelines for the pharmaceutical industry on preparation of submissions to the Pharmaceutical Benefits Advisory Committee. Commonwealth Department: Canberra, 1992.
102. Canadian Coordinating Office for Health Technology Assessment (CCOHTA). Guidelines for economic evaluation of pharmaceuticals: Canada. CCOHTA: Ottawa, 1994.
103. Ontario Ministry of Health. Ontario guidelines for economic analysis of pharmaceutical products. Ontario Ministry of Health: Toronto, 1994.
104. England and Wales Department of Health. Guidelines on good practice in the conduct of economic evaluation of medicines. Department of Health: London, 1994.
105. Gold MR, Siegel JE, Russell LB, Weinstein MC (eds). *Cost-Effectiveness in Health Care and Medicine*. Oxford University Press: New York, 1996.
106. Rovira J, Antoñanzas F. Estandarización de algunos aspectos metodológicos de los análisis coste/efectividad y coste/utilidad en la evaluación de tecnologías y programas sanitarios. In *Subdirección de Prestaciones y Evaluación de Tecnologías Sanitarias. Guías de práctica clínica e informes de evaluación*. Ministerio de Sanidad y Consumo: Madrid, 1994.
107. Rovira J, Antoñanzas F. Economic analysis of health technologies and programmes: a Spanish proposal for methodological standarization. *Pharmacoeconomics* 1995; **8**: 245–252.

108. Baladi JF, Menon D, Otten N. Use of economic evaluation guidelines: 2 years' experience in Canada. *Health Econ* 1998; **7**: 221–227.
109. Evers S, Goossens M, van Tulder M, de Vet R, Ament A. Criteria list for quality assessment of economic evaluation reviews. In *Proceedings of the 15th Annual Meeting of the International Society of Technology Assessment in Health Care (ISTAHC)*. June 20–23; Edinburgh, United Kingdom, 1999; 153.
110. Pang F, Tolley K. Developing a quality assessment scoring system for economic evaluations. In *Proceedings of the 15th Annual Meeting of the International Society of Technology Assessment in Health Care (ISTAHC)*. June 20–23; Edinburgh, United Kingdom, 1999; 120.
111. Pang F, Drummond M. Meta-analysis of economic evaluations: a methodological approach and case-study. In *Proceedings of the 15th Annual Meeting of the International Society of Technology Assessment in Health Care (ISTAHC)*. June 20–23; Edinburgh, United Kingdom, 1999; 78.
112. Stoykova B, Nixon J, Glanville J, Christie J, Drummond M, Kleijnen J. Issues concerning the sources of effectiveness data used in economic evaluations included in the National Health Service Economic Evaluation Database (NHS EED). In *Proceedings of the 15th Annual Meeting of the International Society of Technology Assessment in Health Care (ISTAHC)*. June 20–23; Edinburgh, United Kingdom, 1999; 47.
113. Siegel JE, Weinstein MC, Russell LB, Gold MR. Recommendations for reporting cost-effectiveness analyses. Panel on Cost-Effectiveness in Health and Medicine. *J Am Med Assoc* 1996; **276**: 1339–1341.
114. Jovell AJ, Navarro-Rubio MD. Evaluación de la evidencia científica. *Med Clin (Barc)* 1995; **105**: 740–743.
115. Jovell AJ, Jovell E. Evidencia científica y análisis económico: ¿dos conceptos excluyentes? *Revista Española de Farmaeconomía* 1998; (Junio): 23–29.
116. Gerard K, Smoker I, Seymour J. Raising the quality of cost-utility analyses: lessons learnt and still to learn. *Health Policy* 1999; **46**: 217–238.
117. Neuman PJ, Stone PW, Chapman RH, Sandberg EA, Bell CM. The quality of reporting in published cost-utility analyses, 1976–1997. *Ann Intern Med* 2000; **132**: 964–972.
118. Gerard K, Seymour J, Smoker I. A tool to improve quality of reporting published economic analyses. *Int J Technol Assess Health Care* 2000; **16**: 100–110.
119. Angell M, Utiger RD, Wood AJJ. Disclosure of authors' conflict of interest: a follow-up. *N Eng J Med* 2000; **342**: 586–587.
120. Price VH, Angell M, Wood AJJ. Authors' conflict of interest: a disclosure and editors' reply. *N Eng J Med* 1999; **341**: 1618–1619.
121. Hillman AL, Eisenberg JM, Pauly M, *et al*. Avoiding bias in the conduct and reporting of cost-effectiveness research sponsored by pharmaceutical companies. *N Eng J Med* 1991; **324**: 1362–1365.
122. Davies L, Coyle D, Drummond M. Current status of economic appraisal of health technology in the European Community: report of the network. The EC Network on the Methodology of Economic Appraisal of Health Technology. *Soc Sci Med* 1994; **38**: 1601–1607.
123. Drummond M. Evaluation of health technology: economic issues for health policy and policy issues for economic appraisal. *Soc Sci Med* 1994; **38**: 1593–1600.
124. Rutten F, van der Linden JW. Integration of economic appraisal and health care policy in a health insurance system; the Dutch case. *Soc Sci Med* 1994; **38**: 1609–1614.
125. Henshall C, Drummond M. Economic appraisal in the British National Health Service: implications of recent developments. *Soc Sci Med* 1994; **38**: 1615–1623.
126. Granados A, Borràs JM. Technology assessment in Catalonia: integrating economic appraisal. *Soc Sci Med* 1994; **38**: 1643–1646.
127. Commonwealth of Australia. Guidelines for the pharmaceutical industry on preparation of submissions to the Pharmaceutical Benefits Advisory Committee: including submissions involving economic analyses. Woden (ACT) Department of Health, Housing and Community Services, 1990.
128. Ontario Ministry of Health. Guidelines for the preparation of economic analysis to be included in submission to Drug Programs Branch for listing in the Ontario Drug Benefit Formulary/Comparative Drug Index. Ministry of Health: Toronto, 1991.
129. Steiner CA, Powe NR, Anderson GF, Das F. Coverage decisions for medical technology by managed care: relationship to organizational and physician payment characteristics. *Am J Managed Care* 1996; **2**: 1321.
130. Office of Technology Assessment, US Congress. Coverage of laser technology by health insurers. Office of Technology Assessment OTA-BP-H-159: Washington, DC, January, 1995.
131. Steiner CA, Powe NR, Anderson GF, Das F. Technology coverage decisions by health care plans and considerations by medical directors. *Med Care* 1997; **35**: 472–489.

132. Sheldon TA. Problems of using modelling in the economic evaluation of health care. *Health Econ* 1996; **5**: 1–11.
133. Buxton MJ, Drummond MF, Van Hout BA, *et al*. Modelling in economic evaluation: an unavoidable fact of life. *Health Econ* 1997; **6**: 217–227.
134. Jefferson T, Mugford M, Gray A, Demichelli V. An exercise on the feasibility of carrying out secondary economic analyses. *Health Economics* 1996; **5**: 155–165.
135. Haycox A, Dubois D, Butterworth M. Customising an international disease management model to the needs of individual countries. Application to upper gastrointestinal disease. *Pharmacoeconomics* 1998; **14**: 39–56.

References

1. Hurley J. An overview of the normative economics of the health sector. In: Culyer AJ, Newhouse JP, eds. *Handbook of health economics*. Volume 1A. Amsterdam: Elsevier Sience B.V., 2000.
2. Arrow K. Uncertainty and the welfare economics of medical care. *Am Econ Rev* 1963;53(5):941-73.
3. Rice T. *The economics of health reconsidered*. Chicago: Health Administration Press, 1998.
4. Williams A. Welfare economcis and health status measurement. In: Culyer AJ, Wright KG, eds. *Economic aspect of health services*. London: Martin Robertson, 1981.
5. Sen A. Personal utilities and public judgments: or what's wrong with welfare economics. Econ J 1979;89(September):537-58.
6. Culyer AJ. The normative economics of health care finance and provision. *Oxf Rev Econ Policy* 1989;5(1):34-58.
7. Culyer AJ, van Doorslaer E, Wagstaff A. Comment: utilization as a measure of equity by Mooney , Donaldson and Gerard. J Health Econ 1991;11(1):93-8.
8. Weisbrod BA. The health care quadrilemma: An essay on technological change, insurance, quality of care, and cost containment. *J Econ Lit* 1991;29(2):523-52.
9. Newhouse JP. Medical costs: How much welfare loss. *J Econ Perspect* 1992;6(3):3-21.
10. Gelijns A, Rosenberg N. The dynamics of technological change in medicine. *Health Aff (Millwood)* 1994;20(3):25-42.
11. Fogel R. Economic growth, population theory and physiology: The bearing of long-term proceses on the making of economic policy. *Am Econ Rev* 1994;84(3):369-95.
12. McKeown T. *The modern rise of population*. New York: Academic Press, 1976.
13. Marmot MG, Shipley MJ, Rose G. Inequalities in death --specific explanations of a general pattern? *Lancet* 1984;1(8384):1003-6.
14. Preston SH. The changing relation between mortality and level of economic development. *Popul Stud (Camb)* 1975;29(2):231-48.
15. Grossman M. On the concept of health capital and the demand for health. *J Pol Economy* 1972:80(2):223-55.
16. Auster R, Levenson I, Saracheck D. The production of health, an exploratory study. *J Hum Resour* 1969;4:411-36.
17. Hadley J. *More medical care, better health?* Washington DC: Urban Institute; 1982.

18. Viscusi WK. The value of risks to life and health. *J Econ Lit* 1993; 31(4):1912-46.
19. Viscusi WK, Aldy J. The value of a statistical life: A critical review of market estimates throughout the world. *J Risk Uncertainty*2003;27:5-76.
20. Rosen R. The quantity and quality of life: A conceptual framework. In: Tolley G, Kenkel D, Fabian R, eds. *Valuing health for policy: An economic approach*. Chicago: Chicago University Press, 1994.
21. Cutler DM, McClellan M. Is technological change in medicine worth it? *Health Aff (Millwood)* 2001;20:11-29.
22. Woodward RM, Brown ML, Stewart ST, Cronin KA, Cutler DM. The value of medical interventions for lung cancer in the elderly: Results from SEER-CMHSF. *Cancer* 2007;110(11):2511-8.
23. Rosen AB, Cutler DM, Norton DM, Hu HM, Vijan S. The value of coronary heart disease care for the elderly: 1987-2002. *Health Aff (Millwood)* 2007;26(1):111-23.
24. Pinilla J. Comparación entre costes y beneficios a largo plazo en el proceso tecnológico en sanidad: caso de las afecciones con origen en el período perinatal. In: González López-Varcárcel B, ed. *Difusión de nuevas tecnologías sanitarias y políticas públicas*. Barcelona: Masson, 2005.
25. Cutler DM, Huckman RS. Technological development and medical productivity: the diffusion of angioplasty in New York state. *J Health Econ* 2003;22:187-217.
26. Cutler DM. The lifetime costs and benefits of medical technology. *J Health Econ* 2007;26(6):1081-100.
27. Cutler DM, Rosen AB, Vijan S. The value of medical spending in the United States, 1960-2000. *N Engl J Med* 2006;355(9):920-7.
28. Becker G, Philipson T, Soares RR. *Growth and mortality in less developed nations*. Chicago: University of Chicago, 2001.
29. Costa DL, Steckel RH. *Long-term trends in health, welfare, and economic growth in the United States*. NBER Working paper series on historial factors in long run growth. Historical paper 76. Cambridge: National Bureau of Economic Research, 1995.
30. Becker G, Philipson T, Soares RR. *The quantity and quality of life and the evolution of world inequality*. Cambridge: National Bureau of Economic Research, 2003.
31. Philipson T, Soares R. *Human capital, longevity, and economic growth: a quantitative assessment of full income measures*. Chicago: University of Chicago, 2001.
32. García-Altés A, Zonco L, Borrell C, Plasència A; Barcelona Group on the Performance of Health Care Services.Measuring the performance of health care services: a review of international experiences and their application to urban contexts. *Gac Sanit* 2006;20(4):316-24.

33. Dawson D, Gravelle H, O'Mahony M, Street A, Weale M, Castelli A, Jacobs R, Kind P, Loveridge P, Martin S, Stevens P, Stokes L. *Developing new approaches to measuring NHS outputs and productivity.* CHE Research Paper 6. York: Centre for Health Economics, University of York, 2005.
34. Castelli A, Dawson D, Gravelle H, Street A. Improving the measurement of health system output growth. *Health Econ* 2007;16(10):1091-107.