Economic Impact of the Taxus Coronary Stent: Implications for the Spanish Healthcare System

Stephen Russell,[a] Fernando Antoñanzas[b], and Vicente Mainar[c]

[a]Premor Associates, Madrid, Spain.
[b]Departamento de Economía y Empresa, Universidad de la Rioja, Logroño, Spain.
[c]Departamento de Cardiología, Hospital General de Valencia, Valencia, Spain.

Introduction and objectives. This article examines the cost impact associated with the utilization of the Taxus drug eluting stent versus a conventional bare-metal stent for percutaneous coronary interventions in a Spanish hospital setting.

Methods. A decision analysis model has been developed to compare the intervention and re-hospitalization costs at 12 and 24 months post-intervention. The analysis considers the general patient population and a high-risk subpopulation (diabetes, small vessel, long lesion). The analysis simulates the results of the TAXUS-IV clinical trial, in a population with similar risks, with appropriate costs, and including budget impact analyses with alternative utilization scenarios.

Results. The expected average per patient hospital cost at 12 months was €6934 with Taxus and €6756 with bare-metal stent (and increase of 2.6%). At 24 months, per patient hospital cost was €6991 for Taxus and €6887 for bare-metal stent (an increase of 1.5%). In the high-risk subpopulation, Taxus was overall cost saving as compared to bare-metal stent both at 12 months (decrease of 3.0%) and 24 months (decrease of 4.7%).

Conclusions. Use of Taxus in the overall population slightly raises treatment costs, while in patients with greater risk of restenosis the treatment cost is reduced. Given the decrease in the number of repeat revascularizations with this stent, the cost-effectiveness relationship could be acceptable in the general patient population and is dominant in the high-risk subpopulation.

Key words: *Stent. Restenosis. Cost-effectiveness analysis. Coronary angioplasty.*

Impacto económico del stent coronario Taxus: implicaciones para el sistema sanitario español

Introducción y objetivos. En este estudio se analizan los costes asociados a la utilización del *stent* liberador de fármaco Taxus frente a un *stent* convencional en el tratamiento percutáneo de arterias coronarias, en el marco de hospitales españoles.

Métodos. Se ha desarrollado un modelo analítico de decisión para comparar los costes de la intervención y la rehospitalización en un período de 12 y de 24 meses tras la intervención. El análisis contempla a la población general y a una subpoblación de alto riesgo (con diabetes, vasos pequeños o lesiones largas). Se ha simulado el resultado del ensayo clínico TAXUS IV en una población de riesgo similar y se han analizado los costes propios, así como el impacto presupuestario con escenarios alternativos.

Resultados. Para la población general, la media del coste por paciente a los 12 meses fue de 6.934 € en el caso de Taxus y de 6.756 € en el caso de un *stent* convencional (incremento del 2,6%), y a los 24 meses de 6.991 y de 6.887 € (incremento del 1,5%). En la subpoblación de alto riesgo, la estrategia de tratamiento con Taxus fue menos costosa a los 12 meses (decremento del 3,0%) y a los 24 meses (decremento del 4,7%).

Conclusiones. Una estrategia de tratamiento generalizado con *stent* Taxus eleva ligeramente el impacto presupuestario, mientras que en los pacientes con mayor riesgo de reestenosis el coste neto se reduce. Dada la disminución en el número de revascularizaciones repetidas con este *stent,* la relación coste-efectividad puede ser aceptable en la población general tratada y es dominante en la subpoblación de mayor riesgo.

Palabras clave: Stent. *Reestenosis. Análisis coste-efectividad. Angioplastia coronaria.*

Full English text available from: www.revespcardiol.org

INTRODUCTION

In Spain, the number of percutaneous coronary interventions (PCI) has grown considerably in recent years. This is largely due to technological advances such as new stents, which have contributed to reducing

ABBREVIATIONS

TLR: target lesion revascularization.
CABG: coronary artery bypass grafting.
BMS: bare-metal stent.
DES: drug-eluting stent.
PCI: percutaneous coronary intervention.

the likelihood of restenosis after an intervention.[1] Restenosis remains, however, the major limitation of PCI with traditional bare-metal stents (BMS), occurring at a rate of 20%-40% in the total patient population.[2-4]

If restenosis of the coronary artery occurs, depending on the extent of the myocardial ischemia and symptoms, the PCI procedure must be repeated or coronary artery bypass grafting (CABG) surgery done.[5] In recent years, several types of drug-eluting stents (DES) have been developed, among them the paclitaxel-eluting stent (Taxus Express™,[2] Boston Scientific), that reduce the necessity for repeat revascularizations.

Due to their development and manufacturing costs, DES have a higher acquisition cost than BMS, and this higher acquisition cost has naturally led to a discussion as to their appropriate use.[6] Arguments against the systematic use of DES have often focused on concerns that the higher acquisition cost will lead to a significant, unacceptable increase in health care expenditure.[7] Arguments in favor of the systematic use of DES have focused on the potential of DES to offset the higher acquisition cost by possibly decreasing the number of repeat revascularizations (and their cost) due to restenosis, resulting in an acceptable net increase in health care expenditure.[8]

This study evaluates the health economic implications of Taxus utilization in the Spanish health care setting. The latest available Taxus clinical data and Spanish resource use data (from Boston Scientific Ibérica and the SOIKOS[9] Database) is applied to calculate clinical and economic outcomes. The primary of this study to evaluate the cost impact of the Taxus stent. The secondary aim is to evaluate the budget implications resulting from the uptake of DES in the Spanish hospital system.

METHODS

Model Structure

This study considers the choice between bare-metal stent and drug-eluting stent (Taxus), as well as between drug-eluting stents and CABG. The key parameters in the model are the initial costs for each procedure type, the probabilities of a repeat procedure, the type of repeat procedures, and the cost of repeat procedures. The incidence and associated costs of cardiac mortality and myocardial infarction are not taken into account, as no significant clinical differences have been reported between Taxus and BMS.[10]

Clinical Input Data

The paclitaxel-eluting stent has been tested in a series of clinical trials comparing it to a bare-metal BMS. The largest to date is the multi-center double-blind randomized TAXUS-IV trial, which enrolled 1314 patients with single, previously untreated coronary lesions in 73 U.S. clinical centers between March and July 2002. Inclusion and exclusion criteria as well as the baseline characteristics of patients enrolled have been previously reported.[11] In brief, diabetic patients formed 24.2% of the patient population; the average reference vessel diameter was 2.75±0.48; the average lesion length was 13.3±6.3; and type C lesions were 21.2%.

Rates of repeat revascularizations are referenced from the TAXUS-IV trial in the general population at 12 months[10] and 24 months[12] and in the diabetic population.[13] Reported target lesion revascularization (TLR) rates for the total population at 12 and 24 months are presented in Table 1. To account for
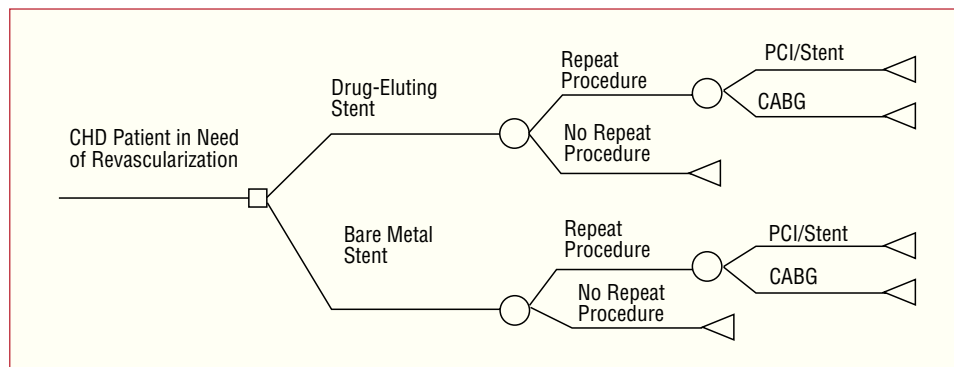

Figure 1. Decision Tree for drug-eluting stent versus bare-metal stent.
The square represents a decision node where there is a choice between different treatment strategies, and the circles represent chance nodes, where different outcomes are associated with probabilities.
CABG indicates coronary artery bypass graft; CHD, coronary heart disease; PCI, percutaneous coronary intervention.

TABLE 1. Reported and Calculated Target Lesion Revascularization Rates for Total Population at 12 and 24 Months*

TLR Rate	12 Months			24 Months		
	BMS TLR	Taxus TLR	RR (95% CI), Where Reported	BMS TLR	Taxus TLR	RR, Where Reported
Overall	15.1%	4.4%	0.27 (0.18-0.41)	17.4%	5.6%	0.32
Re-PCI	12.2%	3.7%	0.28 (0.18-0.45)	14.3%	4.8%	–
Re-CABG	3.7%	0.8%	0.20 (0.08-0.53)	3.9%	0.8%	–
Cumulative[†]	15.9%	4.5%	–	18.3%	5.6%	–

*BMS indicates bare metal stent; re-CABG, repeat procedure coronary artery bypass graft; re-PCI, repeat percutaneous coronary intervention procedure; TLR, target lesion revascularization.
[†]Value used in model calculation, i.e. TLR PCI+TLR CABG.

TABLE 2. Reported and Calculated Target Lesion Revascularization Rates for High-Risk Patients at 12 and 24 Months*

Patient/Type of Lesion	12 Months			24 Months		
	BMS TLR	Taxus TLR	RR, Where Reported	BMS TLR	Taxus TLR	RR, Where Reported
Diabetes patients	19.6%	7.1%	–	22.0%	8.0%	–
Small vessel	20.6%	5.6%	0.24	25.4%	6.1%	0.24
Long lesion	22.1%	5.5%	0.23	22.4%	8.9%	0.40

*BMS indicates bare metal stent; TLR, target lesion revascularization.
Long lesion: at 12 months >20 mm, 24 months ≥20 mm.
Small vessel: at 12 months ≤2.5 mm, 24 months <2.5 mm.

patients with more than one re-intervention after the initial procedure, the cumulative TLR rates are used as basis for the calculation.

The analysis of the high-risk subgroup, defined as medically treated diabetic patients, patients with small vessels (<2.5 mm), and patients with long lesions (>20 mm), is based on clinical data from TAXUS-IV, using the same methodology as for the total population (Table 2).

In terms of demographics, the TAXUS-IV trial is representative of the conditions in Spain. In Spain, the average age of PCI patients is 63[14] versus 62.5 in the TAXUS-IV trial. The proportion of males in the coronary heart disease population is 74% in Spain,[15] whereas males represented 72% of the TAXUS-IV population. The proportion of diabetics is about 25% in the Spanish population with coronary artery disease population[16] versus 24.2% in TAXUS-IV. The angiographic follow-up is a potential source of bias. Many patients in the TAXUS-IV trial underwent protocol-specified follow-up angiography, and if restenosis was found repeat revascularizations even if their heart disease these patients were asymptomatic. The close follow-up in a clinical trial setting may thus increase the TLR rates so that they do not reflect true clinical event rates. Symptom-free patients in clinical practice may not be as closely monitored. However, the TAXUS-IV investigators concluded that the TLR rates were reduced both in the angiographic follow-up and no-

follow-up cohorts, which suggests that closer monitoring of patients did not explain the benefit of the Taxus stent in reducing the TLR rate.[10]

Cost Input Data

Because the analysis is from the perspective of a Spanish hospital, all relevant in-patient costs are taken into account; outpatient and indirect costs, such as prescription drugs and work loss, are not considered in this analysis (Table 3). The inpatient costs for PCI and CABG procedures and coronary angiographies are taken from a Spanish database SOIKOS (the SOIKOS database is made up of Spanish healthcare intervention costs obtained through a systematic review of publications. The database consists of some 18 000 entries and is a paid subscription database.) The price difference between Taxus and a BMS is based on the prices for the Taxus drug-eluting stent (source: Boston Scientific Ibérica) and the average price for a BMS in Spain. The cost for PCI with Taxus is based on the cost of PCI with BMS plus the price difference between a DES and a BMS times 1.54 (assuming an average of 1.54 stents per intervention).[17] It is assumed that the use of IIb/IIIa is 38%. The cost for a repeat procedure is either the cost for PCI or the cost for CABG. It was also assumed that all CABG and 20% of PCI procedures would be preceded by a coronary angiography as a separate hospital visit (Table 3).

TABLE 3. **Resource Utilization and Cost Input Data**[*]

Item	Units	Cost/Unit, €
Material		
Additional cost of Taxus stent versus BMS†	1.54 stents (all procedures), 3 stents (multivessel)	712
Other material†	1.3 guidewires	
	1.3 catheters	
	1 balloon	
	3 vials llb/ll1a	
	% use of llb/ll1a=38%	1.069
Procedural cost		1.847
Hospital stay		
Cardiac ward	2 stays	340
General ward	1 stay	285
Other procedures		
CABG	1 procedure	14.068
Angiography	1 procedure	629

*BMS indicates bare metal stent; CABG, coronary artery bypass graft.
†Source: Boston Scientific Ibérica; all other costs from the SOIKOS database.[9]

Type of Analysis

The health economic analysis is in the form of a cost impact analysis, which compares the cost of PCI and BMS with PCI and Taxus. This analysis is performed for the general population and a subgroup at high risk of restenosis. The analysis is performed using a spreadsheet model in Microsoft Excel®. The full cost of each treatment arm in the model is calculated in 2 steps. In the first step, the initial procedure cost is calculated as the sum of all the resources used (unit cost multiplied times number of units used in the procedure). In step 2, the repeat revascularization cost is calculated by multiplying the rate of repeat revascularization times the cost of revascularization (already calculated in step 1). The full cost of each treatment arm is calculated as the sum of steps 1 and 2. This is calculated at both 12 and 24 months using the same initial procedure cost, but using the rates of repeat revascularization at 12 and 24 months.

A second health economic analysis, in the form of cost per revascularization avoided by Taxus compared with BMS, is calculated by dividing the difference in average hospital costs for Taxus and BMS by the difference in repeat revascularization rates.

Finally, the budget impact is calculated for a Spanish hospital over 1 year using hypothetical scenarios of uptake. The budget impact analysis presented here models the annual impact on coronary revascularization budgets (PCI with stent plus CABG) for an average Spanish hospital with 370 patients requiring revascularization per year (there is a wide variation in the number of patients treated with revascularization by hospitals in Spain, with many hospitals treating less than 200 patients a year, but some treating more than 1000[17]; we use 370 patients a

year as a representative average). In the baseline scenario (pre-DES), patients requiring revascularization over a 12-month budget cycle either receive PCI with BMS or receive CABG surgery. In the conversion scenarios, some high-risk and/or non-high-risk patients receive PCI with Taxus in instead of BMS, and some patients receive PCI with Taxus in place of CABG surgery. It is assumed that 40% of PCI patients in the baseline scenario are at high-risk of restenosis (this is an assumption that has been used in other studies).[18] In each budget scenario, a number of patients will receive treatment with BMS, Taxus, or CABG. By multiplying the number of patients receiving each type of treatment by the full cost of that treatment (as calculated previously), we obtain the total budget required for each treatment. The sum of these is the total budget for the hospital. We also measure the impact on the hospital capacity by multiplying the number of patients receiving each type of treatment times the repeat revascularization rate of that treatment. The sum of the initial and repeat revascularization procedures is the required capacity of the hospital.

These analyses are all done from the perspective of a Spanish hospital. Future costs have been discounted at an annual rate of 3%.

RESULTS

Total Population

The expected average per-patient treatment cost at 12 months is €6934 for the Taxus arm and €6756 for the BMS arm (Figure 2); that is, 2.6% higher for Taxus. Although the initial PCI procedure cost for Taxus was higher due to higher material cost, 84% of this higher cost was subsequently outweighed by a

lower probability of repeat revascularization. The cost for each repeat revascularization avoided due to the use of Taxus is calculated as €1568.

At 24 months, the expected average per-patient cost is €6991 for the Taxus arm and €6887 for the BMS arm, a difference of 1.5%. The lower probability of repeat revascularization in the Taxus arm outweighed by 91% of the cost the increase in cost from the initial PCI procedure. The cost for each repeat revascularization avoided due to the use of Taxus is €811 at 24 months.

High-Risk Patient Population

The cost for the initial PCI procedure is the same for the high-risk group (diabetes, small vessels, long lesions) as that for the total population; the costs of repeat revascularization are again higher for the BMS arm than for the Taxus arm due to a higher probability of repeat procedures (Figure 3). Expected costs at 12 months per high-risk patient is €7213 for the BMS arm and €6997 for the Taxus arm; 3.0% higher for BMS. At 24 months, the expected mean cost per high-risk patient is €7377 for the BMS arm and €7039 for the Taxus arm; 4.5% higher for BMS.

Within the high-risk patient population, the subgroups defined by diabetes, small vessels, and long lesions are not exclusive subgroups. However, since diabetes is of particular interest due to its frequency in patients undergoing PCI,[19] a separate analysis was done. Using the TLR rates for diabetes from Table 2, and otherwise calculating average per–diabetic patient treatment cost in the same way as for the whole patient population, the results at 24 months are €7125 for BMS and €7113 for Taxus.

Budget Impact Analysis

Two conversion scenarios are considered (Table 4). In the first, 90% of all high-risk PCI patients are assumed to receive Taxus in instead of BMS, whereas PCI patients at normal risk continue to receive BMS. No patients receive Taxus in instead of CABG surgery. The total budget for this scenario is similar to that of the base scenario (saving about 1%) because the lower repeat revascularization rate of Taxus more than outweighs the higher cost of the initial procedure for the high risk groups at 12 months. Although the same number of patients are treated in each scenario, for approximately the same budget, there could be a "hidden" benefit in the Taxus scenario, since for the 370 patients treated, 19 repeat revascularizations are avoided. For a hospital facing capacity constraints, this would represent an increased capacity to treat 5% more patients with the same fixed costs and infrastructure.

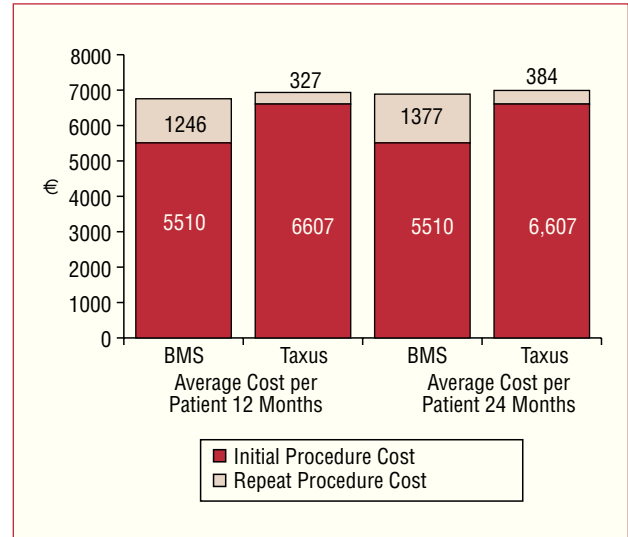In the second scenario, 90% of all PCI patients are assumed to receive Taxus in place of BMS. In

Figure 2. Total cost comparison: bare-metal stent versus Taxus at 12 and 24 months.
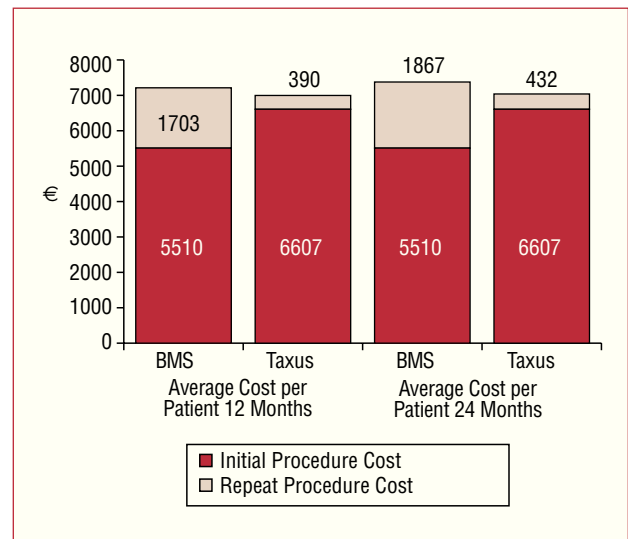BMS indicates bare-metal stent.

Figure 3. High-risk patient populations: total cost comparison bare-metal stent versus Taxus at 12 and 24 months.
BMS indicates bare-metal stent.

addition, it is assumed that 20% of patients who received CABG surgery in the base scenario instead receive PCI with Taxus (at least one retrospective study suggests that a 21% conversion rate from CABG to PCI with DES might be expected 1-2 years after the introduction of DES[20]; however, many cardiologists believe that the conversion rate will go as high as 30%[21] or even 50%[22]). The total budget impact for the second scenario is again similar to the base scenario (in this case, an increase of about 0.5%). This scenario, where 20% of CABG patients (9 patients) are converted to PCI, increases the capacity to treat more patients with surgery. In total, 32

TABLE 4. **Budget Impact Scenarios for Typical Hospital**[*]

	BMS	Taxus	Subtotal	CABG	Total
Current budget					
Number of patients	370	0	370	45	415
Initial procedure (in €000)	2039	0	2039	633	2672
Total revascularization (in €000)	461	0	461	12	473
Total cost (in €000)	2500	0	2500	645	3145
Scenario (1): 90% conversion from BMS to Taxus for high risk groups					
Number of patients	237	133	370	45	415
Initial procedure (in €000)	1306	879	2185	633	2818
Total revascularization (in €000)	234	52	286	12	298
Total cost (in €000)	1540	931	2471	645	3116
Scenario (2): 90% conversion from BMS to Taxus for total population; 20% conversion from CABG to TAXUS for multivessel disease					
Number of patients	37	342	379	36	415
Initial procedure (in €000)	204	2282	2486	506	2992
Total revascularization (in €000)	35	114	149	10	169
Total cost (in €000)	239	2396	2635	516	3161

[*]BMS indicate bare metal stent; CABG, coronary artery bypass graft.

revascularizations are avoided (41 repeat revascularizations avoided—9 CABG patients converted to PCI), representing an increased capacity to treat of 8.5% more patients with the same fixed costs and infrastructure.

Sensitivity Analysis

While the budget impact analysis is restricted to 2 hypothetical, but realistic, scenarios, it is clear that the conversion from BMS to DES will vary at all levels of the health system (individual doctors, hospitals, regions). Testing the sensitivity of the budget impact to the conversion rate from BMS to Taxus (assuming no conversion from CABG to Taxus) results in a +2.0% budget increase when 100% of PCI patients are converted to Taxus.

If we look at the health system as a whole, the aggregate costs in the different arms of the decision-3 model would not change due to equality in care and treatment, except for the longer duration of clopidogrel use by DES patients. There is no single recommendation regarding the duration of clopidogrel use; this varied in randomized studies there was variability, this and it was 6 months in the TAXUS IV study. In daily practice, 75 mg/day for 1 month is normal for BMS and at least 6 months for DES. If the cost of 1 month of treatment with clopidogrel is €40.12[23] and the patients with BMS are treated for 1 month and those with DES for 6 months, the total cost at 24 months per patient is €6933 for BMS and €7243 for Taxus. The percentage outweighed by minor repeat revascularization is 76% of the initial procedure's costs.

DISCUSSION

Due to its higher acquisition cost, it has generally been assumed that the systematic use of DES will greatly increase healthcare expenditures, and several authors have therefore suggested additional studies to evaluate the economics of DES in the Spanish hospital setting. Our analysis is therefore timely and will add new evidence to this discussion.

The analysis shows that for the total population the average per patient cost for DES is slightly higher than that for BMS at 12 and 24 months, since a high proportion of the initial cost is outweighed by savings through fewer repeat procedures. In patients with diabetes, long lesions, or small vessels, these savings were even greater, such that the net cost at 12 and 24 months is lower for the DES. The impact of Taxus is greater at the time of the initial procedure, and reduces progressively over time, with less of an impact on the final total cost. The incremental cost per repeat revascularization avoided is €1568 at 12 months and €811 at 24 months. There is no standard comparison for this measure in Spain; however, it should be noted that the cost effectiveness of BMS in the United States has been calculated at $10 000 (approx. €7700)[24] per repeat revascularization avoided. Using this threshold, the results obtained with Taxus are favourable.

An ongoing concern in interpreting economic evaluations is that the calculation of cost impact alone is not sufficient for decision-making.[25] An analysis per patient is limited to a direct comparison of alternatives, whereas in a budget impact analysis comparisons can be made in which different proportions of the total patient population undergo

different alternative treatments. Our budget impact analysis shows that the use of the drug-eluting stent does not necessarily impose a significant strain on health care budgets. Converting high-risk patients saves money over 12 months. A plausible scenario in which a large percentage of all patients are converted from BMS to the Taxus stent, in addition to some patients converted from CABG to Taxus, yields only a very slight (0.5%) rise in the 12-month budget requirement for coronary revascularization, with the additional benefit of increased capacity.

Several studies have been done recently to evaluate the cost-effectiveness of DES. A study done using data from RAVEL study which utilized a the sirolimus-eluting stent[26] found an increased cost per patient of €1286 initially and €166 after 1 year when comparing the DES with a BMS. A prospective study in the United States,[27] using clinical and cost data from a comparison of a sirolimus-eluting stent with BMS (1058 patients in 53 hospitals), found an increased initial cost of $2881 (approximately €2400) and $309 (approximately €250) after 1 year. The increased cost for DES after 1 year in these studies is similar to the €178 found in our study. The US study also calculated a cost per revascularization avoided after 1 year of $1650 (approximately €1375), which is comparable to the €1568 that we have calculated. A meta-analysis,[28] based on the clinical data of 11 clinical trials of DES from three different companies, and Spanish cost data, found an increased cost per patient of €819 after 1 year. The clinical inputs were similar to our study (TLR rates of 15% and 4% for BMS and DES respectively); however, the difference in cost between a BMS and a DES was €1000. We have used a difference of €712. Since we have assumed an average of 1.54 stents per patients, this can account for €444 of the variation between our study and theirs ([€1000–€712] ⏀ 1.54). Another study[29] of unselected patients in everyday practice has found an increased cost for DES versus BMS of €905 after 6 months. However, the difference in cost between the BMS and DES, €1100, is again much higher than in our study and would account for €598 of the increased cost for DES with our assumption of 1.54 stents per procedure. In addition, clinical trials of DES have shown increasing benefit in lower rates of repeat revascularization beyond 6 months, so it will be interesting to follow the study results when the authors publish their 18-month data.

This study naturally has limitations that should be taken account when drawing conclusions. The cost-effectiveness of the Taxus stent is highly sensitive to the TLR rates of both Taxus and BMS, as well as to the difference in cost of Taxus and BMS and, to a lesser extent, to the duration of clopidogrel treatment. This study, and almost all other existing studies, used TLR rates from clinical trials. These rates may change

in everyday practice. Since the Taxus stent is relatively new to the market, the difference in cost between this stent and the standard BMS could vary. In this study, a comparison of Taxus versus CABG was not done, since there are still very few results.

CONCLUSIONS

Results indicate that the paclitaxel-eluting stent is cost saving as compared to BMS for patients at high risk of restenosis, more favourable at 24 months of follow-up, and can be considered a cost-effective intervention in these patients. For the total patient population, the lower cost of repeat revascularization with Taxus at 24 months offsets over 90% of the higher initial acquisition cost. The incremental cost per repeat revascularization avoided for Taxus versus BMS compares favourably with that of BMS versus angioplasty without stent. Results from the budget impact analysis of 2 different scenarios (one focused on treating only high-risk patients with Taxus, and another in which most patients who could receive Taxus did so) indicate that both scenarios would be essentially budget neutral in comparison to the base scenario in which only bare-metal stents are used.

REFERENCES

1. Alfonso F, Bermejo J, Segovia J. Estado actual de la revascularización coronaria. Rev Esp Cardiol. 2005;58:194-7.
2. Kastrati A, Mehilli A, Dirschinger J, Pache J, Ulm K, Schuhlen H, et al. Restenosis after coronary placement of various stent types. Am J Cardiol. 2001;87:34-9.
3. Betriu A, Masotti M, Serra A, Alonso J, Fernández-Aviles F, Gimeno F, et al. Randomized comparison of coronary stent implantation and balloon angioplasty in the treatment of de novo coronary artery lesions (START): a four year follow-up. J Am Coll Cardiol. 1999;34:1498-506.
4. Martínez-Elbal L, Ruiz-Nodar JM, Zueco J, López-Mínguez JR, Moreu J, Calvo I, et al. Direct coronary stenting versus stenting with balloon pre-dilation: immediate and follow-up results of a multicentre, prospective, randomized study. The DISCO trial: direct stenting of coronary arteries. Eur Heart J. 2002; 23:633-40.
5. Popma JJ, Kuntz RE. Percutaneous coronary and valvular intervention. In: Braunwald E, editor. Heart disease: a textbook of cardiovascular medicine, 6th ed. Philadelphia: W.B. Saunders; 2001: p.1364-405.
6. Lazaro P. Stents recubiertos de fármacos: eficacia, efectividad, eficiencia, y evidencia. Rev Esp Cardiol. 2004;57:608-12.
7. Macaya C. ¿Está justificado el uso sistemático de stents con fármacos? Argumentos en contra. Rev Esp Cardiol. 2004;57:109-15.
8. Valdés M. ¿Está justificado el uso sistemático de stents con fármacos? Argumentos a favor. Rev Esp Cardiol. 2004;57:99-108.
9. Soikos SL. Base de datos de costes sanitarios. Barcelona, 2005.
10. Stone G, Ellis S, Cox D, Hermiller J, O'Shaughnessy C, Mann J, et al. One-year clinical results with the slow-release, polymer-based, paclitaxel-eluting TAXUS stent: the TAXUS-IV trial. Circulation. 2004;109:1942-7.
11. Stone G, Ellis S, Cox D, Hermiller J, O'Shaughnessy C, Mann J, et al. A polymer-based, paclitaxel-eluting stent in patients with coronary artery disease. N Engl J Med. 2004;350:221-31.

12. Stone GW. 2-year clinical results of the TAXUS-IV trial. Presentado en el congreso TCT (Transcatheter Cardiovascular Therapeutics); Washington DC, 29 September 2004. Available from: http://www.bostonscientific.com/templatedata/imports/collateral/Coronary/bsc_taxusIV_24month.pdf

13. Moussa I. Drug-eluting stents in diabetics. Presentado en el congreso TCT (Transcatheter Cardiovascular Therapeutics); Washington DC, 2004.

14. Permanyer C, Brotons C, Ribera A, Moral I, Cascant P, Alonso J, et al. Resultados clínicos y de calidad de vida de los pacientes tratados con angioplastia coronaria con balón o stent. Rev Esp Cardiol. 2001;54:597-606.

15. Muñoz M, Marrugat J. La prevención secundaria de la enfermedad coronaria es menos agresiva en los pacientes de más de 64 años. Rev Esp Cardiol. 2003;56:586-93.

16. Zamora A, Marrugat J. Pronóstico de los pacientes diabéticos con cardiopatía isquémica. Rev Esp Cardiol. 2002;55:751-62

17. López-Palop R, Moreu J, Fernández-Vázquez F, Hernández Antolín R. Registro Español de Hemodinámica y Cardiología Intervencionista. XIII Informe Oficial de la Sección de Hemodinámica y Cardiología Intervencionista de la Sociedad Española de Cardiología (1990-2003). Rev Esp Cardiol. 2004;57: 1076-89.

18. Mittmann N, Brown A, Jin Seung S, Coyle D, Cohen E, Brophy J, et al. Economic evaluation of drug eluting stents. [Technology report no 53]. Ottawa: Canadian Coordinating Office for Health Technology Assessment; 2005.

19. Dibra A, Kastrati A, Mehilli J, Pache J, Schühlen H, von Beckerath N, et al. Paclitaxel-eluting or sirolimus-eluting stents to prevent restenosis in diabetic patients. N Engl J Med. 2005;353: 663-70.

20. Ferreira A, Peter A, Salerno T, Bolooki H, de Marchena E. Clinical impact of drug-eluting stents in changing referral practices for coronary surgical revascularization in a tertiary care center. Ann Thorac Surg. 2003;7:485-9.

21. Kong D, Eisenstein E, Sketch M, Zidar J, Ryan T, Harrington R, et al. Economic impact of drug-eluting stents on hospital systems: a disease-state model. Am Heart J. 2004;147:449-56.

22. Thanikachalam M, Tehrani H, Salerno T. The clinical impact of drug-eluting stents in changing referral practices for coronary surgical revascularization. In: Long-Term Healthcare 2004. London: Touch Briefings; 2004; p. 124-8.

23. Medical Virtual Market, S.L. Available from: http://www.concursossanitarios.com/Material-Sanitario.xsql

24. Cohen D, Taira D, Berezin R, Cox D, Morice M, Stone G, et al. Cost-Effectiveness of Coronary Stenting in Acute Myocardial Infarction. Circulation. 2001;104:3039-45.

25. Birch S, Gafni A. The "NICE" approach to technology assessment: an economics perspective. Health Care Management Science. 2004;7:35-41.

26. van Hout B, Serruys P, Lemos P, van den Brand M, van Es G-A, Lindeboom W, et al. One year cost effectiveness of sirolimus eluting stents compared with bare metal stents in the treatment of single native de novo coronary lesions: an analysis from the RAVEL trial. Heart. 2005;91:507-12.

27. Cohen D, Bakhai A, Shi C, Githiora L, Lavelle T, Berezin R, et al. Cost-effectiveness of sirolimus-eluting stents for treatment of complex coronary stenoses. Circulation. 2004;110: 508-14.

28. Oliva G, Espallargues M, Pons J. Stents recubiertos de fármacos antiproliferativos: revisión sistemática del beneficio y estimación del impacto presupuestario. Rev Esp Cardiol. 2004;57: 617-28.

29. Kaiser C, Brunner-la Rocca H, Buser P, Bonetti P, Osswald S, Linka A, et al. Incremental cost-effectiveness of drug-eluting stents compared with a third-generation bare-metal stent in a real-world setting: randomized Basel Stent Kosten Effektivitäts Trials (BASKET). Lancet. 2005;336:921-9.