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Evaluation of patient reported outcome measures and costs of managing osteoarthritis of the hip

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The number of hospital admissions for a hip prosthesis increased by more than 91% between 2002 and 2019 in Belgium (1), making it one of the most common interventions in hospitals. The objective of this study is to evaluate patient-reported outcomes and hospital costs of hip replacement six months after surgery. Both generic (EQ-5D) and specific (HOOS) PROMs of general hospital patients undergoing hip replacement surgery in 2021 were conducted. The results of these PROMs were then combined with financial and health management data. The mean difference (SD) in QALYs between the preoperative and postoperative phases is 0.20 QALYs (0.32 QALYs). The average cost (SD) of all stays is €4,792 (€1,640). Amongst the five dimensions evaluated in the EQ-5D health questionnaire, the 'pain' dimension seems to be associated with the greatest improvement in quality of life. As regards Belgium, the 26,066 arthroplasties performed in 2020 might constitute a gain of 123,000 years of life in good health. The relationship between QALYs and costs described in this study posits a ratio of €23,960 per year of life gained in good health. Given that in Belgium more than 3% of the hospital healthcare budget is devoted to hip prostheses, it would seem relevant to us to apply PROM tools to the entire patient population to assess treatment effectiveness more broadly, identify patient needs and, also, monitor the quality of care provided.

Keywords: Hip, QALY, PROMs, value based healthcare.

INTRODUCTION

The number of hospital admissions for a hip prosthesis increased by more than 91% between 2002 and 2019 in Belgium[1], making it one of the most common interventions in hospitals. Given this growth rate, and the sizeable costs for Belgium, it has become necessary to review the financing and organisation of care around this type of intervention. As such, the Belgian health system is undergoing change, the aim being to promote a system based on the value of care. Value in healthcare is defined as the ratio of the best quality to the best cost[2]. According to international experience, the notion of hospital value translates, amongst other things, into a combination of reduced expenditure, fewer medical complications, and greater patient satisfaction[3]. Hence Patient Reported Outcome Measures (PROMs) have become a key component of clinical research and, in the future, may well be used to set payment rates for orthopaedic surgery, such as total arthroplasty. In the context of hip arthroplasty, quality of care is related to the evaluation of process and outcome indicators, in particular through the evaluation of pain, patient mobility after the operation, etc.[4]. However, there are still too few evaluations of this type for routine procedures within hospitals, despite their interest both for patients and for surgeons and their teams. In order to be able to measure the effects of a surgical procedure on patients' health, the collection and documentation of clinically relevant outcomes (using validated PROMs) before surgery, as well as at defined postoperative intervals, is essential.

As regards osteoarthrosis of the hip, PROM-based studies show that the average improvement in the physical function of patients after hip arthroplasty is 32%[5]. The OECD reports an improvement in quality of life of more than 21%. In other words, a 65-year-old patient gains an average of 4.3 Quality-Adjusted Life Years (QALYs)[6]. The QALY indicator was created in the 1970s and became an international tool in the 1990s. Its purpose was to measure usefulness as perceived by patients. This tool expresses the extent to which a patient prefers a given state of health[7].This approach is a viable option that health policies make

use of in order to measure health-related quality of life[8] however, is misguided because individual results get fed into generalised QALY league tables which ignore the context of specific studies and use results not performed on a common basis. Consequently, the state of the applied art of CUA is currently open to considerable question,"container-title": "Health Policy" (Amsterdam, Netherlands. Owing to a number of circumstances, Belgium has not yet set any threshold values determining the cost-effectiveness of healthcare[9]. However, influencing factors that affect our health system are now driving us to tackle this issue.

Until now, few studies have attempted to relate hospital costs to PROMs as well as to medical complications that patients may have experienced during their hospital stays. Yet in a lumbar spine study Chotal et al.[10] estimated that the cost-utility ratio was higher for patients experiencing complications within 90 days than for those without any: $70,822 and $45,831, respectively. This finding reinforces the usefulness of measures focused on preventing complications to increase the cost-utility ratio. In this regard, the objective of this study is to evaluate both the outcomes reported by the patient and hip arthroplasty hospital costs six months after the operation.

MATERIAL AND METHODS

The study sample is based on data from a Belgian general hospital. All patients over the age of 18 admitted for elective hip arthroplasty during the 2020-2021 period were included in the programme. All patients meeting these inclusion criteria were encouraged to take part in PROM data collection. Both oral and written information was provided to patients prior to seeking their explicit agreement to participate in this study. An agreement of the ethics committees has been obtained.

PROMs consist of questionnaires that measure a patient's physical, mental or functional health. Data collected through the questionnaire make it possible to gauge the outcomes and effectiveness of medical interventions or of treatments applied. Here, patients play an essential role since no measurement is possible without their participation[11].

Various types of PROMs were used in this study:

– Generic PROMs assess health-related quality of life using the five EQ-5D dimensions of health: mobility; self-care; usual activities; pain & discomfort; and anxiety & depression[12]. (authorisation from the EuroQol group (http://www.euroqol.org/), license agreement number: 160629 160629).

– Specific PROMs point to specific outcomes concerning osteoarthritis of the hip using the Hip Disability and Osteoarthritis Outcome Score (HOOS)[13]. PROM data were collected one month before surgery and six months after the date of surgery.

The questionnaire complies with the General Data Protection Regulation (GDPR) and was validated by the experts in charge of its implementation. Patients who participated in the study gave their informed consent. The study protocol was approved by the organisation's ethics committee.

Health economics data were extracted from the hospital's health management records. To enable a comprehensive analysis of the surveyed population, we identified patient safety indicators in line with the Agency for Healthcare Research and Quality (AHRQ) methodology, Version 5.0[14].

The Charlson index[15] 10th Revision (ICD-10 was to express the level of comorbidity of hospitalised patients. Readmissions within 30 days were also detected in the health management data.

In this study, 'costs' only take into account the services provided and the pharmaceutical resources used during hospital stays. In order to make a fair comparison of the costs of these stays, we pinpointed and subtracted the 'flat day rate' from the financial budget[16]. The analysis of the financial data presented in this article was carried out from the point of view of the social security system through invoices sent to insurers.

The statistical analyses were carried out using SPSS software, Version 28. We used 'median/mean/standard-deviation' descriptive statistics to provide a univariate description of all variables in our study. Kruskal-Wallis and Mann-Whitney tests were performed to check for significant differences between dependent variables and dichotomous or ordinal independent variables. In our study, hospital costs and PROMs are the dependent variables. The PROMs dependent variable reflects the difference in QALYs recorded between the preoperative phase and the postoperative phase.

Linear regression was then performed to identify the predictors of these dependent variables. We chose this statistical model to adjust the data according to the case mix of stays. We selected the above-mentioned independent variables on the basis of indicators in the literature[17,18] and of the significance of the univariate analysis data. We opted to use the Charlson index in the regression, rather than relative weight (case mix index), because the Charlson index includes comorbidities at admission, but not the complications experienced during hospital stay.

RESULTS

We have a total of 57 stays with an average patient age (SD) of 65.1 years (10.9 years); more than 54% of the surveyed population is male (Table 1). The complication rate during the hospital stay is estimated at 2% while the in-hospital mortality rate is 0% (Table 1). The 30-day readmission rate is 0%. More than 91% of stays are related to a severity of medical and economic condition Levels 1 and 2. The average Charlson index

Table 1. — Descriptive data concerning the surveyed population

Descriptive variables			Costs (euros)				PROMs (Postoperative versus preoperative			
	N= 57	%	Avg	SD	Sig		Avg	SD	Sig	
	57	100%	4792	3206			0.2	0.32		
Severity (n= 57)					0.034	**			0.984	**
1= Minor	24	42.1%	4134	1090			0.19	0.24		
2= Moderate	28	49.1%	4343	1668			0.19	0.39		
3= Major	5	8.8%	10466	8606			0.21	0.27		
Diagnostic (n= 57)					0.038	**			0.669	**
Chronic	54	94.7%	4368	1640			0.19	0.33		
Complication	2	3.5%	5979	371			0.18	0.01		
Trauma	1	1.8%	25299				0.45			
Age categories (n= 57) (years)					0.114	**			0.348	**
< 60	19	33.3%	3985	1644			0.23	0.29		
60-69	16	28.1%	3981	797			0.05	0.35		
70-79	18	31.6%	5271	1991			0.28	0.32		
> 80	4	7,0%	9714	10427			0.16	0.21		
Rehabilitation (n=57)					< 0.001	*			0.408	*
No	51	89.5%	3988	837			0.17	0.32		
Yes	6	10.5%	11630	6740			0.32	0.35		
Genre (n= 57)					1	*			0.098	*
Female	26	45.6%	5209	4408			0.27	0.33		
Male	31	54.4%	4443	1650			0.13	0.3		
Place before admission (n= 57)										
Home	57	100,0%	4792	3206			0.2	0.32		
Type of admission (n= 57)					0.02	**			0.452	**
Planned	55	96.5%	4402	1644			0.19	0.33		
Emergency	2	3.5%	15508	13847			0.32	0.17		
Exit Destination (n=57)					0.345	**			0.685	**
Home	55	96.5%	4797	3258			0.2	0.33		
Other hospitals	1	1.8%	3589				0,00			
Other	1	1.8%	5717				0.2			
Charlson categories (n= 57)					0.111	**			0.298	**
0	36	63.2%	4538	1787			0.19	0.34		
1	11	19.3%	6678	6338			0.31	0.35		
2	8	14,0%	3620	880			0.08	0.21		
>3	2	3.5%	3675	1337			0.07	0.1		
Life situation (n= 57)					0.027	*			0.509	*
Alone	20	35.1%	6288	4992			0.24	0.27		
With partner	37	64.9%	3984	962			0.16	0.35		
Education (n=57)					0.032	**			0.436	**
Primary	5	8.8%	10606	8607			0.11	0.23		
Secondary	32	56.1%	4311	1341			0.24	0.32		
Tertiary	20	35.1%	4108	1412			0.13	0.34		
Kruskall-Wallis **										
Mann-Whitney *										

(SD) is 0.67 (1.2) for the entire patient population; 63% of stays have no comorbidity at admission.

As shown in Table 1, more than 95% of patients were admitted for chronic conditions (osteoarthritis, etc.). The average length of stay (ALOS) (standard deviation) for surgical procedures was 5.3 days (3.5 days). The average length of stay (standard deviation) including transfer to rehabilitation was 9.9 days (18.8 days). Stays in the rehabilitation unit accounted for a length of inpatient stay of 45 days in some cases. ALOS (SD) ranged from 12 days (7 days) to 19 days (0 days) depending on whether the diagnosis of admission was a complication or a trauma. The PSI 09 indicator (postoperative bleeding/hematoma) appeared once in connection with one patient.

More than 97% of cases involved planned stays and more than 98% of inpatients returned home after hospitalisation. No transfers into the intensive care and geriatric units were recorded.

The average cost (SD) of all stays is €4,792 (€1,640). The synthetic material used for surgery constitutes 43% of the average total amount. In second place, services account for 31% of the average total amount.

The average time period (SD) between the first PROM questionnaire and the second one is 214 days (34.2 days). Finally, we can observe a difference between the average costs (SD) for a patient who lives alone and one living with a partner: €6,288 (€4,992) and €3,984 (€962), respectively ($p < 0.05$).

This cost differential is also significant as regards patients' education levels, with an average cost (SD) of €10,606 (€8,607) for the primary level, €4,311 (€1,341) for the secondary level, and €4,108 (€1,412) for the tertiary level (higher education) ($p < 0.05$). The QALY increase seems more pronounced for the secondary and tertiary levels, and least pronounced for the primary level (Table 1).

The evaluation of the difficulty in performing routine activities shows a change between the preoperative and postoperative phase as regards some HOOS items (Table 2). Indeed, we are transitioning from:

– 17% to 68% of patients who find it not at all or slightly difficult to climb stairs;

- 28% to 58% of patients who find it not at all or slightly difficult to get in or out of the bathtub/shower;

- 58% to 83% of patients who find it not at all or slightly difficult to remained seated; and

- 19% to 61% of patients who find it not at all or slightly difficult to turn around or rotate one leg.

On the other hand, running does not seem to have improved to the same extent as other activities. Moreover, between 15% and 26% of the sample still experience severe to extreme difficulty, respectively, in descending a staircase and entering the bathtub or shower (Figure 1).

Amongst the five dimensions evaluated along the EQ-5D scale, the 'pain' dimension seems to be associated with the greatest improvement in quality of life (Table 3). The percentage difference between the preoperative and postoperative situations as regards the absence of pain or presence of mild pain is of 49 points. The mobility of the surveyed population also seems to have improved, with a 38% increase in the 'no problem' to 'light problem' categories for moving. Performing routine activities seems to have improved for more than 33% of patients, who experience mild problems or none.

We find that the mean number of QALYs (SD) as regards patients in the preoperative phase is 0.49 QALYs (0.36 QALYs), whereas the mean number of QALYs (SD) in the postoperative phase is 0.68 QALYs (0.37 QALYs) (Table 4). The mean difference (SD) in QALYs between the preoperative and postoperative phases is thus 0.20 QALYs (0.32 QALYs) (Table 4). This is an increase of 40% compared with the initial situation. On a scale of 0 to 100 (where 100 is the best state of health and 0 the worst state of health), patients in this study rated their health at 62.63 in the preoperative phase and 72.51 six months after surgery.

As regards the level of satisfaction observed before and after surgery, an increase can be noted: from 28% of satisfied to very satisfied patients (before the operation) to 75% of satisfied to very satisfied patients (after the operation).

If we combine the improvement in patient quality of life with hospital costs, we find a sum of €23,960 per year of life gained in good health.

Annexe 1 and 2 present the main results of the linear regressions. As regards hospital costs, the increase in costs seems to be explained by the following factors: transfer to a rehabilitation unit, patients over 80 years of age, and a severity of medical and economic condition Level 3.

As regards the PROMs, none of the independent variables appear to be significant in the following model. Only patient gender seems to have a slight downward effect. Variables such as the Charlson index, education level, and rehabilitation may explain QALY growth between the preoperative and postoperative phases.

DISCUSSION

The objective of this study was to jointly evaluate patient-reported outcomes and the hospital costs of

Table 2. — Preoperative and postoperative HOOS outcomes

In the past eight days, how difficult was each of the following activities?	Preoperative (1) percentage of population group					Postoperative (2) percentage of population group				
	Not at all	Slightly	Moderately	Very	Extremely	Not at all	Slightly	Moderately	Very	Extremely
Going down a staircase	12,3	7,0	43,9	33,3	3,5	45,6	22,8	15,8	12,3	3,5
Getting in or out of a bathtub	19,3	8,8	29,8	19,3	22,8	40,4	17,5	15,8	14,0	12,3
Remaining seated	33,3	24,6	31,6	10,5		61,4	21,1	8,8	7,0	1,8
Running	8,8	7,0	5,3	28,1	50,9	15,8	14,0	24,6	19,3	26,3
Turning around or rotating on one leg	12,3	7,0	17,5	29,8	33,3	38,6	22,8	17,5	15,8	5,3

Table 3. — Comparison of EQ-5D dimensions for patients in the preoperative and postoperative phases

	Preoperative (1) percentage of population group						Postoperative (2) percentage of population group					
EQ-5D-5L	1	2	3	4	5	Sig*	1	2	3	4	5	Sig*
Mobility	14,0	14,0	31,6	35,1	5,3	< 0.001	40,4	26,3	17,5	15,8		< 0.001
Self-care	36,8	24,6	22,8	14,0	1,8	< 0.001	59,6	22,8	8,8	8,8		< 0.001
Usual activities	17,5	19,3	40,4	15,8	7,0	< 0.001	42,1	28,1	15,8	10,5	3,5	< 0.001
Pain	5,3	21,1	38,6	21,1	14,0	< 0.001	22,8	52,6	8,8	8,8	7,0	< 0.001
Anxiety	43,9	28,1	17,5	8,8	1,8	< 0.001	64,9	8,8	12,3	10,5	3,5	< 0.001

hip replacement six months after surgery. The ultimate goal was to quantify the value provided to patients through hospital-based interventions. In this study, only one medical complication in the hospital (PSI 09 haemorrhage-hematoma) was reported. This is partly explained by the low number of stays involved in our analysis and, potentially, the completeness of the medical data, which allows for optimal coding.

However, this study reports interesting findings at the public health level. The use of HOOS made it possible to observe an improvement for the patient following surgery, for instance mobility on stairs and for personal hygiene, or rotating on the operated leg. Our findings are consistent with those of Paulsen et al.[19] in terms of improvement. However, a large population group still finds it difficult to climb stairs and manage personal hygiene, etc. In this regard, it would be essential to analyse the files to understand the underlying reasons, set minimum thresholds for providers, and monitor changes in these parameters after one year and after two years, as suggested by Paulsen[19] and Sabah et al.[20].

As regards generic PROMs, using the EQ-5D dimensions, our study reports significant improvement after six months. These trends are similar to those found in other studies, which assessed outcomes after one or two years. The 0.2 QALY increase between the preoperative and postoperative phases constitutes an increase of 40%. This makes this surgical intervention particularly interesting when it comes to improving the quality of life of patients. In view of the age of the patients and Belgian mortality statistics[21], this intervention is considered to have added a total of

Table 4. — Evaluation of the number of QALYs and of the state of health of patients

	Preoperative (1)	Postoperative (2)	Subtraction (2) - (1)
QALY score	0,49	0,68	0,2
IC 95%	0.39–0.58	0.58–0.78	0.10–0.28
EQ VAS	62,63	72,51	9,88
IC 95%	55.88–69.59	66.34–78.68	

269 years of life in good health (all other things being equal) for the patients in this study. This represents an average increase (SD) of 4.72 QALYs (5.74 QALYs) per patient. As regards Belgium as a whole, the 26,066 arthroplasties performed in 2020 might constitute a gain of 123,000 years of life in good health.

From a financial point of view, our hospital costs, assessed from a societal perspective, are close to figures obtained at national level[22]. The relationship between QALYs and costs described in this study posits a ratio of €23,960 per year of life gained in good health. If we include all the hospital costs identified in the INAMI's Feedback by Pathology report, this gain is multiplied by two, since it would add up to more than €42,386 per additional year of life in good health. However, it is important to point out that this calculation does not include costs incurred prior before and after inpatient care such as: physiotherapy sessions, home medication, provider consultations or, even, the patient's inability to work.

Despite the apparent progress that has been achieved in our ability to treat hip fractures, the overall level of patient-reported outcomes remains quite low in

Belgium. However, in view of steering healthcare with PROM tools, their lack of evaluation are a major obstacle to the implementation of Value Based Healthcare in Belgium[23].

The findings of our study also suggest that we should pay particular attention to patients with a primary education level, since the improvement in their quality of life following the intervention is smaller. It is also worth reporting that patients transferred to nursing homes and older patients (over 80) were not involved in our study. Yet this population group also deserves our attention when it comes to improving quality of life. In this regard, one would need to build a tool to engage this population group while being wary of the digital divide that may hinder them.

Given that more than 3% of the hospital healthcare budget is devoted to hip prostheses in Belgium, we would find it relevant to apply PROM tools to the entire patient population to assess treatment effectiveness more broadly, identify patient needs and, also, monitor the quality of care provided. All these efforts might lead to a review of hip prosthesis care management or, even, other care sectors.

The findings of this study demonstrate the need to introduce these tools into day-to-day Belgian healthcare in view of the impact that hip osteoarthritis has on patients' quality of life. An evaluation of our practices designed to translate them into outcomes has become essential in order to implement health policies that are consistent with limited budgets.

Despite the interesting perspective adopted by this approach, it does have some limitations. It was not possible to carry out the cost study from a hospital point of view.

As regards PROMs, we had started introducing a questionnaire (before and after hip replacement surgery) at three hospital sites in 2020. Unfortunately, restrictions on elective interventions related to the COVID-19 pandemic did not allow us to perform the analysis. This explains the low number of stays included in the study.

Only 'chronic' stays (osteoarthritis) were included in our sample. Hence this selection criterion does not make it possible to observe the impacts of fractures. Moreover, only hospital costs from the point of view of the social security system were included in this study. However, it would seem relevant to include all costs related to all elements of care such as follow-up, rehabilitation with all caregivers, etc.

Lastly, over- or underestimation of the quality of life of operated patients is probably biased. Indeed, in the QALY analysis, it is likely that pathologies influencing the quality of life of patients coexist, which are not totally attributable to the hip prosthesis.

CONCLUSION

This study's findings demonstrate the need for a more systematic assessment of the value of healthcare provided to Belgians. Given the country's complicated budgetary situation, this approach should be applied in order to ensure consistency between health policies and the expected outcomes of our care. The desire to identify costs and medical complications, and combine these with patients' reported outcomes may be considered to be the beginnings of Value Based Healthcare in Belgium. A perspective for further research would be to conduct this study with a larger number of patients and from the point of view of hospital costs.

Conflict of Interest: The authors declare that they have no conflict of interest. The manuscript is not currently under consideration by any other journal.

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Annexe

Annexe 1. Linear regression of hospital costs

Overview of models[b]

Model	R	R-squared	squared	Estimate
1	.869[a]	0,756	0,666	1852,136689553780000

a. Predictors: (Constant), MORTALITY, READMISSION_IND, dummy_@2_Q14education level_3, dummy_Charlson_category_3, DUMMY_AGE_CATEGORY_4, gender_code, dummy_AGE_CATEGORY_num_3, dummy_SEVERITY_2, dummy_Charlson_category_2, @2_Q17lifesituation, STAY_SP_IND, dummy_AGE_CATEGORY_num_2, dummy_Charlson_category_4, dummy_@2_Q14education level_2, dummy_SEVERITY_3

b. Dependent Variable: Hospital Costs

Annexe 2. Linear regression of PROMs

Coefficients[a]

Dimension	Model	Unstandardised coefficients		Standardised coefficients	t	Sig.
		B	Standard Error	Beta		
	(Constant)	6127,917	3227,76816		1,898	0,065
Severity	2	-6,340	544,961	-0,001	-0,012	0,991
	3	3268,930	2483,754	0,291	1,316	0,195
Charlson index	1	1034,152	758,110	0,128	1,364	0,180
	2	-566,069	785,734	-0,062	-0,720	0,475
	3	-844,910	1791,867	-0,049	-0,472	0,640
Education level	Secondary	-1869,408	1064,325	-0,292	-1,756	0,086
	Tertiary	-1925,745	1101,796	-0,289	-1,748	0,088
Age category	60–69 years	571,079	697,372	0,081	0,819	0,418
	70–79 years	-81,190	684,175	-0,012	-0,119	0,906
	> 80 years	3644,878	1127,779	0,293	3,232	0,002
Gender	Male	-528,812	578,236	-0,083	-0,915	0,366
Transfer	Rehabilitation	5205,428	1162,524	0,503	4,478	0,000
Readmission		926,218	846,683	0,096	1,094	0,280
Life situation		118,410	652,613	0,018	0,181	0,857
Mortality rate (medical and economic)		-580,758	1753,130	-0,069	-0,331	0,742

a. Dependent Variable: Hospital Costs