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Use of the EQ-5D Instrument and Value Scale in Comparing Health States of Patients in Four Health Care Programs among Health Care Providers

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A B S T R A C T

Objectives: The main objective of this article was to explore the use of the patient evaluation of health states in determining the quality of health care program provision among health care providers. The other objectives were to explore the effect of size and status of health care providers on patient-reported outcomes. **Methods:** The EuroQol five-dimensional questionnaire was used in four health care programs (hip replacement, hernia surgery, carpal tunnel release, and veins surgery) to evaluate patients' health states before and after the procedure, following carefully prepared instructions. Data were collected for a single year, 2011. The number of questionnaires filled by patients was 165 for hip replacement, 551 for hernia surgery, 437 for vein surgery, and 158 for carpal tunnel release. The data were analyzed using linear regression model and the EuroQol five-dimensional questionnaire value set for Slovenia. Differences between providers were determined using the Tukey test. Potential quality-adjusted life-years (QALYs) gained for all four programs were calculated for the optimal allocation of patients among providers. **Results:** There are significant differences among health care providers in the share of patients who reported positive changes in health care status as well as in average improvement in patient-reported outcomes in all four programs. In the case of optimal allocation, each patient undergoing hip replacement would gain 2.25 QALYs, each patient undergoing hernia surgery would gain 0.83 QALY, each patient undergoing veins surgery would gain 0.36 QALY, and each patient undergoing carpal tunnel release would gain 0.78 QALY. **Conclusions:** The analysis exposed differences in average health state valuations across four health care programs among providers. Further data on patient-reported outcomes for more than a single year should be collected. On the basis of trend data, further analysis to determine the possible causes for differences should be conducted and the possibility to use this approach for measuring health care providers' performance and its use in contracting should be explored.

Keywords: carpal tunnel release, EQ-5D, health care providers, hernia, hip replacement, HRQOL, PROM, vein surgery.

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Introduction

Health care expenditure (as % of gross domestic product) in the European Union in 2011 ranged from 5.75 in Estonia to 11.19 in France [1]. In Slovenia, 8.55% of the gross domestic product was spent for health care in 2011 [1]. Although the percentage is high, it is not high enough to satisfy all the demand that is increasing because of demographic trends, development, and introduction of new health care technologies and wishes of globally informed patients. This is why it is of utmost importance to spend the money on those health care programs that ensure high value for money [2].

To spend available funds cost-effectively, we need to follow and measure the outcomes of health care services. Although this is easier to do in sectors in which it is possible to count the units of physical output such as car productions, this is more difficult in sectors such as health care in which counting of patients treated is done without considering the subjective value attached to the outcome. In Slovenia, clinical outcomes of health care are

routinely collected and, above all, are focused on collecting data on death. None of these data led to information about the final outcome of treatment for the patient unless illness development leads to death. This means that data on outcomes in a form of change in health status are not collected for most patients. For most of the patients, their health status becomes better, but no data regarding the quantity and cost exist.

In 2009, the Health Insurance Institute of Slovenia (HIIS) decided to introduce the national tender for health care programs. The goal of the national tender was to increase access to health care services to patients by introducing price competition among health care providers for defined programs. To ensure the quality of health care programs, despite the anticipated lower prices, the measurement of quality of health care service provision was introduced simultaneously. Funds for the national tender were provided through already signed yearly contracts between health care providers and the HIIS, whereby the planned volume of health care programs in the year 2010 was decreased

by 30% for each provider that carried out programs included in the national tender. To ensure the financial stability of the health care providers, this decrease could, in any case, not be higher than 3% of the total planned inpatient or outpatient budget of the provider. After the tender, the health care programs were redistributed among the providers, depending on their offer regarding the price and the date of provision of health care services [3].

Since the first national tender improved accessibility to health services (13% more services were provided for the same budget because of lower prices), the HIIS decided to repeat the national tender in 2010 also. The second tender included 10 health care programs, of which 4 health care programs were included in the first tender [3]. The programs that were repeated in the tender in 2010 were hip replacement, hernia surgery, vein surgery, and carpal tunnel release. The value of the hip replacement program amounted to 3.9 mio euro, hernia surgery to 1.3 mio euro, vein surgery to 0.7 mio euro, and carpal tunnel release to 0.12 mio euro [4].

Methods

In the process of carrying out the health care programs by health care providers, the HIIS demanded from the providers to provide clinical pathway or at least three indicators for measuring the quality of health care procedures. The definition of indicators was in 2009, for example, first year, left to the providers for the programs that were included in the tender for the first time. The data according to the self-defined indicators were sent to the HIIS for each patient in the health program in a national tender. Indicators had to cover the most critical phase of the procedure, and clinical issues, not only economic, should be reflected in the indicators. After analyzing the various indicators proposed by providers, the HIIS defined four common indicators for measuring quality and patient safety and made them obligatory to follow in 2010, again only for the part of the health care programs that were carried out under the national tender. In addition, the EuroQol five-dimensional questionnaire (EQ-5D) was added to the indicators to include a subjective valuation of health states.

In this article, only four programs that were carried out within the national tender for the second time were taken into account because of a unified set of indicators and collection of EQ-5D patient values.

Although the source of data for the first four indicators is the providers, the data for the last indicator come from the patients. Patient-reported outcome measurement (PROM) has gained its value in the last years and is a valid way of collecting information on the effectiveness of health care offered to patients within the health care system [5].

PROM is about comparing a pair of the same questionnaires that are filled out by the patient. The first questionnaire in a pair is filled out before the procedure and the second after the procedure. To gain an insight into the patient-reported outcomes, different questionnaires are being used. They could be divided into seven basic groups [5], and they differ in content as well as according to their purpose and use. In our case, we used the EQ-5D, which belongs to the group of questionnaires that measure health state values and utility weights. They aim to elicit the preferences of the population or values that individuals give to defined health states. Such a value can be in the EQ-5D expressed in a single index. Such an expression is very useful because it enables the comparison of various health states across different health care programs and can also be used in economic analyses in cost-effectiveness comparisons across illnesses. Such measures are usually very widely defined because they must include all health states and are therefore sometimes criticized as being unresponsive to changes in health status [5–7].

The EQ-5D is built of five dimensions: mobility, self-care, usual activities, pain/discomfort, and depression/anxiety. Each dimension is divided into three (or five in the EQ-5D-5L) levels. These are levels on which patients have no problems, levels on which patients have some problems, and levels on which patients have extreme problems. For each dimension, the patient chooses a level, and consequently, a five-digit patient profile is obtained, for example, 12312 (patient has no problems with mobility, has some problems with taking care of self, has extreme problems with usual activities, has no pain or discomfort, and has some problems with depression/anxiety). There are 243 possible patient profiles in the EQ-5D-3L definition of health states and for each health state value if calculated [8]. The values are calculated in a separate study using one of the possible techniques for preference elicitation (time trade-off, standard gamble, visual analogue scale, or discrete choice experiment). The Slovenian value scale was calculated on the visual analogue scale basis in 2011 [9]. For its calculation, the spatial econometric method was used in which one of the independent variables was space, through which the issue of contextual bias was eliminated. Such bias is present in most of the European value scales and remains unsolved [10]. The EQ-5D is validated in Slovenian language [11].

In the national tender, all the providers that acquired any health care program in the tender collected patients' valuation of their own health states before and after the surgery. The patients were given the EQ-5D in a paper format at the point of coming to surgery as well as at the point of the first control visit after the surgery. The purpose and instructions for filling out the questionnaire were enclosed. The questionnaires were then returned to the nurse, who was responsible for keeping a pair of questionnaires together and sent them to the HIIS separately for each health care program. The questionnaires were anonymous, and the individuals could not be identified. The number of questionnaires filled by patients was 165 for hip replacement, 551 for hernia surgery, 437 for vein surgery, and 158 for carpal tunnel release. Data were collected by the HIIS. The data were then entered into an MS Excel spreadsheet and statistically analyzed in R. Values of health states for each health care program among health care providers were compared as reported by patients. In a linear regression model, variables that could affect the improvement in the health states of the patients were the status of the provider (public/private) and the size of the provider, measured in the number of procedures in the selected health care program in 2010. Sex and age of patients were controlled for as well as the initial value of the health state (before the procedure). We assumed that the improvement in health state values could also differ according to the initial value of the health state before the procedure. It is possible that the patient would see the improvement in his or her own health state differently in a case that before the procedure, his or her health state was very bad in comparison to a case when his or her health state before the procedure was not that bad [2]. Comparison of average changes in health state among providers was conducted using the Tukey test. If we take into account patients' age and sex, it is possible to calculate quality-adjusted life-years (QALYs) gained because of optimal patient allocation. QALYs gained for each patient were determined by multiplying expected life-years (given the patient's age and sex) by the increase because of the patient's optimal allocation and applied a discounting factor of 0.03 per annum. Data on life expectancy were obtained from the Statistical Office of Slovenia [12].

Results

Results of the analysis [13] indicate that health state values assigned from the value set provide better prediction of the

patient-reported outcome, compared with self-reported patients' scores (Table 1). Adjusted R^2 (and F statistics) is much higher in the case of the value set of statistical models compared with the "self-assessed model."

Figure 1 shows the results for the hip replacement program. It depicts a share of patients who experienced either decrease or increase in health, where changes in health are defined as the difference in values of the health from the Slovenian value set.

Based on the EQ-5D–defined health states, the largest differences among the providers were detected in the case of hip replacement. The highest share of patients reporting positive change was treated in GH Slovenj Gradec, whereas the highest share of negative change (decrease in health) was reported at Kirurški Sanatorij Hospital.

In the second phase, the size of the positive or negative change was examined. In hip replacement, we could notice that the worst result was achieved by GH Izola, which, on average, achieved decrease in health by 0.06 on a 0 to 1 scale. All other providers reported increases, with the highest average increase of 0.37 at GH Slovenj Gradec.

Table 1 – Results of the regression models.

Variables	Hip	Hernia	Vein	Carpal tunnel
Intercept	−0.2034 ± 0.1112	0.02571 ± 0.07756	−0.09481[*] ± 0.03715	−0.1419 ± 0.07903
Sex	−0.02381 ± 0.02241	0.00041 ± 0.00949	−0.00736 ± 0.0067	−0.00798 ± 0.0129
Age	−0.00037 ± 0.00094	−0.00008 ± 0.00027	0.00021 ± 0.00024	−0.00058 ± 0.00046
Mobility—Some problems	−0.1123 ± 0.06049	0.05189[†] ± 0.01003	0.04473[†] ± 0.00789	−0.01971 ± 0.01818
Mobility—Extreme problems	0.1242 ± 0.0811	0.08556 ± 0.06996	–	0.4721[†] ± 0.0687
Self-care—Some problems	0.1065[‡] ± 0.03249	0.02913[*] ± 0.0113	0.00054 ± 0.0113	0.05886[‡] ± 0.01841
Self-care—Extreme problems	0.0361 ± 0.05395	0.1031 ± 0.06916	−0.06887 ± 0.05971	–
Usual activities—Some problems	0.05379 ± 0.05263	0.00973 ± 0.01046	0.01256 ± 0.00811	−0.02589 ± 0.01693
Usual activities—Extreme problems	0.1594[*] ± 0.06199	0.1285[†] ± 0.03869	0.06782 ± 0.04621	–
Pain/discomfort—Some problems	0.11[*] ± 0.04945	0.0361[†] ± 0.00999	0.03781[†] ± 0.00692	0.03855[‡] ± 0.01429
Pain/discomfort—Extreme problems	0.363[†] ± 0.05376	0.31[†] ± 0.03345	0.1027[‡] ± 0.03534	0.1687[*] ± 0.07356
Anxiety/depression—Some problems	0.0544[*] ± 0.02473	0.06028[†] ± 0.0099	0.02111[‡] ± 0.00757	−0.00403 ± 0.01554
Anxiety/depression—Extreme problems	0.09571[*] ± 0.04472	−0.00364 ± 0.045	−0.01334 ± 0.03788	−0.1223 ± 0.06859
Size	0.00389[*] ± 0.00173	−0.00155 ± 0.001	0.00068[*] ± 0.00032	0.03109[*] ± 0.01273
Square of size	−0.0001[*] ± 0.00001	0 ± 0	0 ± 0	−0.00018[*] ± 0.00007
Private institution	−0.0693 ± 0.07458	0.09696[†] ± 0.0311	−0.01056 ± 0.01322	–
Institution dummy variables	Yes	Yes	Yes	Yes
Residual standard error	0.1277	0.08439	0.05857	0.06736
Number of observations	165	551	437	158
Mulitple R^2	0.7514	0.5385	0.3694	0.3872
Adjusted R^2	0.7159	0.5176	0.34	0.3319
F statistics	21.15[†]	25.77[†]	12.58[†]	7.004[†]

[*] Statistical significance at the 5% level.
[†] Statistical significance at the 0.1% level.
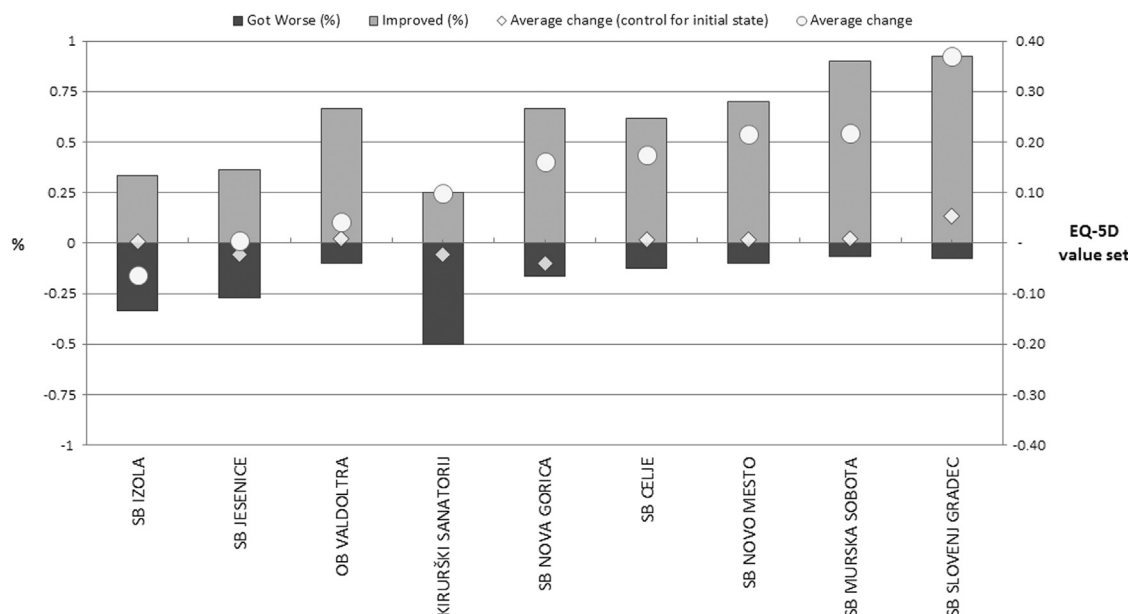[‡] Statistical significance at the 1% level.

Fig. 1 – Results of the hip replacement program. EQ-5D, EuroQol five-dimensional questionnaire.

A more accurate insight into the differences among providers was gained through the inclusion of the initial health state. Patients with different initial health states might value their improvement in health because of a given procedure differently [2]. In every case, we used a statistical model containing patients' profile and two sets of variables. The first set contained patients' information (sex, age), whereas the second one contained information on the providers (size, status [public/private]). The dependent variable in each case was difference in health before and after the procedure.

Figure 1 also portrays differences in health after hip surgery after controlling for the initial health state. These differences are significantly lower because the average change in health is captured in the intercept term of the regression model. Compared with the average increase, excluding the initial health state, the highest positive change in the outcomes can be seen at SB Izola. The highest score is again visible at the GH Slovenj Gradec, whereas the lowest is at GH Nova Gorica.

The Tukey test showed that statistically significant differences ($P < 0.05$) exist only between two pairs of providers: GH Slovenj Gradec and GH Nova Gorica (0.43) and GH Slovenj Gradec and GH Jesenice (0.37).

Results of the linear regression model for the hip replacement program show that the size of the provider (measured as a number of procedures per annum) has a positive effect on the changes in health. The effect is not linear but takes a quadratic form, which indicates that the positive effect diminishes as size increases.

In contrast to the hip replacement program, results of other programs show more diverse effects. In hernia surgery, average changes in health are mostly negative. Positive changes can be seen in only 4 of 12 providers: GH Jesenice, Marko Bitenc, ZdravSplet, and IATROS. Results of the statistical model indicate that status (public/private) is an important factor in explaining changes in the health state after the hernia surgery because private providers seem to have a positive effect (0.096). Statistically significant differences (at the 5% level) among the providers, shown by the Tukey test, were always in favor of IATROS. Differences with other providers were as follows: 0.05, GH Izola; 0.10, GH Novo Mesto; 0.12, GH Ptuj; 0.17, GH MurskaSobota; and 0.21, GH Jesenice, whereas comparison with other providers did not show significant differences.

In the area of vein surgery, all patients at GH Jesenice reported a negative effect on health state; however, some providers (GH Celje, Marko Bitenc, and Toš) reported only positive outcomes/ changes in the health state. The average change in health was positive, with almost all providers, with the exception of GH Jesenice and GH Nova Gorica. The status or size of the provider did not appear to have a statistically significant effect on the outcome. Comparison of average changes in health among the providers revealed only one statistically significant difference between "Zdravstveni zavod za kardiovaskularno dejavnost, IZOLA" and AVELANA, in favor of the AVELANA, with an average difference of 0.036.

In carpal tunnel release surgery, all providers showed an average increase in health state after surgery. All providers were private, where the size of the provider had a positive effect on the outcome. Although SIMED exhibited the highest share of patients reporting positive outcome, its average increase was smallest, whereas the estimated effect after controlling for the initial health state was negative. However, the Tukey test revealed no statistically significant differences among providers' average outcome.

Based on the results of the linear regression models, we predicted the health-related outcome of optimal patient allocation as if each patient visited "the best provider." The best provider was chosen on the basis of the highest regression coefficient for each selected program. Comparing reported average increases in health with predicted outcomes in the case of the best provider reveals the following picture (Fig. 2).

The largest absolute increase is revealed for hip replacement surgery, where the average change in health increased from 0.17 to 0.29, which equals the relative increase of 66.6%. The largest relative increase is found for hernia surgery (101.1%), where the average change in health increased from 0.03 to 0.06. In the case of vein surgery and carpal tunnel release, relative increases accumulated to 37% and 84%, respectively. It was found that the optimal allocation would have the strongest effect on hip replacement patients. On average, each patient undergoing hip replacement would gain 2.25 QALYs because of optimal allocation alone. Values for the other three procedures were lower and contributed to 0.83 QALYs for hernia surgery patients, 0.36 QALYs for vein surgery patients, and 0.78 QALYs for carpal tunnel
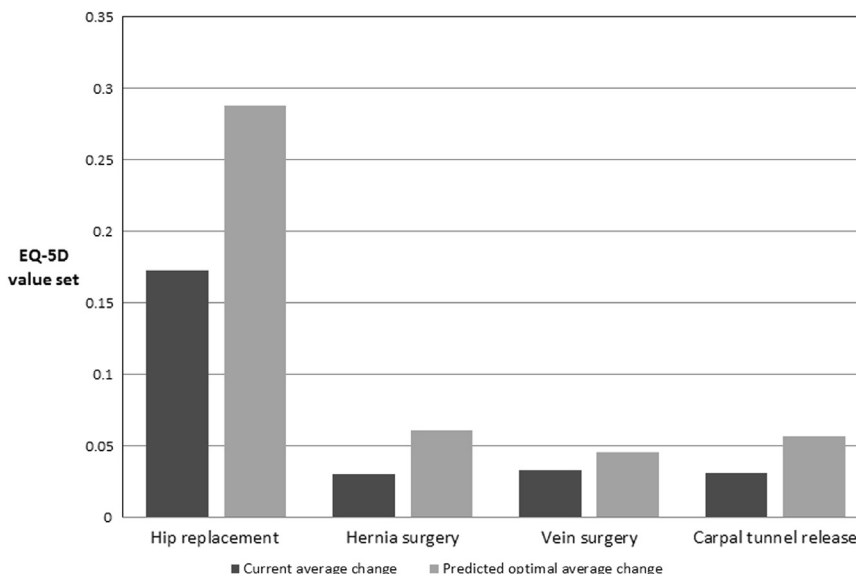

Fig. 2 – Comparison of average increases in health between current and predicted "best" outcome. EQ-5D, EuroQol five-dimensional questionnaire.

release patients. Altogether, the total effect because of optimal patient allocation is estimated at 1086 QALYs or 0.84 per patient.

Conclusions

It is important to stress that the interpretation of the results at the institutional level is only an initial analysis of the causes of differences and not a final conclusion of the quality of interventions within a given institution. Some (extreme) results are not necessarily because of the poor quality of procedures but can be random effects that cannot be attributed to any variable in the cross-section regression analysis. A better insight in explaining the differences in the quality of interventions would be through the panel data analysis, which is currently unfeasible because only the set of data from a single year is available.

The results of this study are therefore only the first insight into patients' valuation of health-related changes in their health because of medical interventions in Slovenian hospitals. It is important to realize that PROMs were collected for the first time in Slovenia for only a small number of procedures. Also, it is not guaranteed that data were collected following the same protocol by all the above-mentioned providers.

In accordance with scientific evidence on high correlation of patients' subjective assessment of health status and health assessment by a physician, it is becoming evident that the role of PROMs is increasing. Free choice of provider is one of the basic rights of the patient in the Slovenian health system. Patients' experiences in health care are one of the basic indicators of quality of care. PROMs are becoming one of the basic measures of how patients perceive their health and how they evaluate the effect of treatments on their quality of life and the adjustments they have to make after medical interventions.

The Slovenian health care system attempts to put the patient in the center [14]. Taking into account the patients' health status, assessment is therefore an important source of information for both the payer and the provider as well as for policymakers. We believe that it is necessary to start collecting data on health assessment for all the programs, upgrade paper methods of collection to electronic data capture, and analyze potential differences in the quality of providers.

In this study, PROMs were used to show changes in health status. Evaluations were related to four health programs (hip replacement, hernia surgery, carpal tunnel release, and vein surgery), which had been competing through a national tender in 2010, carried out by the HIIS. Analysis of individual programs has shown that there are certain differences among health care providers in the quality of health interventions from the patient perspective. We did not, however, try to determine the causes of differences in quality because we believe that we would need a longer time horizon for such an analysis.

The mere insight into the assessment of health status by the program can provide providers of health care with a comparative assessment and give them feedback on how their patients evaluate the implemented interventions. Routine use of PROMs has the potential to help transform health care; they can not only help patients and clinicians make better decisions but also enable comparisons of providers' performances to stimulate improvements in services [15]. PROMs can be helpful in aiding a decision on the choice of the contractor by patients.

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