Does better information about hospital quality affect patients' choice? Empirical findings from Germany

Wübker, Ansgar and Sauerland, Dirk and Wübker, Achim

Witten/Herdecke University, Germany

8 May 2008

Does better information about hospital quality affect patients' choice?
Empirical findings from Germany

Organisation

Page

Abstract

Background: Economic theory strongly suggests that better information about the quality of care affects patients' choice of health service providers. However, we have little empirical evidence about the impact of information provided on provider's choice in Germany. **Problem:** In Germany, we recently find publicly available information about hospital quality. For example, 50 percent of the hospitals in the Rhine-Ruhr area do now publish their quality data voluntarily in a comprehensive, understandable and well prepared publication. Empirically, we see a strong demand for this publication. However, we do not have information so far, if – and how – this information affect patients' choice of hospitals. **Data and methodology:** We take cross sectional time series data from more than 700.000 patients in the Rhine-Ruhr area and in the Cologne-Bonn area (control group) for the time period 2003 to 2006, i.e. 16 quarters. We examine whether the publication of quality information affects market shares and number of cases of the hospitals as well as travelling distance that patients accept to get to the hospital of their choice. In order to account for hospital-specific heterogeneity, we use fixed and random effects models. **Results:** First: Hospitals, which publish their quality data voluntarily, do attract more patients – compared to such hospital, that do not publish their quality data. Second: In the group of the publishing hospitals, hospitals with a higher than average quality slightly increased their market shares, whereas hospitals with a lower than average quality lost market shares. **Conclusion:** The provision of quality data has a significant impact on hospital choice: a higher quality leads to a higher demand. Based on these finding decision makers in hospitals have strong incentives (i) to make quality information publicly available and (ii) to keep their quality of care high.

1 Introduction

Germany's health-care policy initially attempts to achieve quality in health care with the instrument of legal regulation. One of the reasons is the scepticism towards market regulations with regard to quality assurance. The scepticism refers to the uncertainty as to if and how the consumers react to quality information. The respond of patients to quality information by reallocating demand from low to high-ranked providers is the basic prerequisite for functional quality competition within a Diagnosis-Related-Groups-based payment system (Ma 1994), which was introduced in 2003 into the German hospital sector. If individuals “vote with their feet” and select hospitals with higher quality ratings, it may be possible to achieve quality improvements without assuring hospital quality with the instrument of legal regulation. How existing quality information in Germany influences the selection of the treating hospital is therefore the focus of this study.

Past evidence on this question is mixed, with some studies finding that more highly rated hospitals extend their market share and others finding a more marginal impact of report cards on hospital choice (Comp. section 2). Most studies refer to the USA, where the publication of quality information has been established for almost two decades (Marshall, Shekelle and Letherman 2000, Robinowitz and Dudley 2006). So far, there are no systematic studies in Germany assessing the influence of published quality information on hospital choice. With quality information only recently becoming available, an impact analysis as such has not been possible so far. However, since 2005 transparency in regards to quality of hospitals has increased due to legal regulation obliging every hospital to publish quality reports according to § 137 Social Code Book (SGB) V. So far, it has to be criticized that these reports are incomprehensive (insufficient process and outcome data) and badly prepared (Breckenkamp, Wiskow and Laaser 2007).

In contrast to these deficiencies of published quality data in Germany at a whole, a regional clinic guide in the Rhine-Ruhr-area known as “Klinikführer Rhein-Ruhr” published comprehensive, understandable and well prepared data on hospital quality in September 2005 (Initiativkreis Ruhrgebiet 2005). Every second regional hospital voluntarily participated in this report. Even though this information – available in printed form and on the Internet -

was in strong demand, its effects on patients' behaviour have hitherto not been examined. Therefore it is this study's objective to use the "Klinikführer Rhein-Ruhr" as a basis to examine whether information on the treatment quality has an influence on the selection of the treating hospital.

On top of first time delivering evidence for the impact of report cards on hospital choice in Germany, this paper offers two extensions to the existing literature on report cards. Firstly, we present a stochastic model generating new theoretical evidence that voluntary publishing hospitals attract additional patients even in the case that the hospitals quality correspondents to the expected quality before publication.[1] Secondly, we take advantage of a different in different estimation strategy for testing the causal impact of voluntary report cards on hospital choice: we assess not only market shares and case numbers of publishing and non publishing hospitals after relative to before the publication of the Klinikführer Rhein-Ruhr, but also we compare these results with the developments of hospital market shares and case numbers in the control-region Cologne-Bonn. This region serves as natural control group, since in Cologne-Bonn no adequate quality data were publicly available, yet.

The paper is structured as follows: Section 2 displays an overview of the current status of research regarding quality information's influence on patient behaviour (and that of referring physicians). Section 3 presents the stochastic model, serving as theoretical foundation for our empirical analysis. Section 4 leads to the empirical analysis, where we introduce the data record, perform first descriptive analyses and describe the used estimation processes. Section 5 presents the results of our analysis. The paper ends with a discussion on results and a conclusion.

2 What we know about the influence of quality information

2.1 How patients react to quality information

[1] In our model hospital choice depends among other factors on the expected quality and the uncertainty about the expected quality. The uncertainty itself is assumed to be reduced by the publication of quality data. The model basically shows that – ceteris paribus – not only good hospitals are preferred against bad hospitals, but also that voluntary publishing hospitals are on average preferred against non-publishing hospitals.

Studies examining the effect of quality information on patient demand behaviour usually have its setting in the USA. These can be divided into two groups on the basis of the selected methodical procedure.

The *first group* of examinations is based on surveys, whereby the patients are asked whether published information has influenced their decision to select certain service providers.

This method has already been used by Schneider and Epstein (1996) for the evaluation of the Pennsylvania Coronary Bypass Graft Surgery Report – which received a lot of attention in literature and from the press. The authors were able to show that only 14 of 474 questioned patients consulted information on the hospital for their selection of a clinic. However, only 56 of questioned patients had been aware of the reports in the first place. More recently patient surveys also refer – for the USA – to a low degree of utilization and awareness of patients to published quality reports (e.g. Schwartz, Woloshin and Birkemeyer 2005). In Germany, the Bertelsmann Foundation has evaluated the effect of the publication of obligatory quality reports acc. to § 137 SGB V and also determined a very low influence of quality reports on patients' choices in regards to hospitals (Geraedts (2006) showing that only 4 % of those questioned were aware of the reports. In Summary, surveys find a low impact of report cards on hospital choice.

The method of the *second group* of examinations is evaluating, how market share and case numbers of service provider changed after publication on information about its rendered services. This method has an advantage over the survey (first group) as it also displays the indirect effects of published data. Thus the published information could have been perceived by the role players, whose recommendations decisively influence the patients' selection of hospitals. The number of cases and market shares thus also reflect changes in referral behaviour and/or changed recommendations from friends and relatives on account of the published information. Past evidence for the impact of report cards on hospital choice is mixed, with some studies finding that more highly rated providers increase their market shares (e.g. Mukamel and Mushlin 1998, Wedig and Tae-Seale 2002, Romano and Zhou 2004, Cutler et al. 2004, Bundorf et al. 2008) and others finding a more marginal impact of quality information on hospital choice (e.g. Baker et al. 2003, Howard and Kaplan 2006, Jha and Epstein 2006). A series of these examinations (Mukamel and Mushlin 1998, Romano and Zhou 2004, Cutler et al. 2004 as well as Jha and Epstein 2006) referred to the New York State Cardiac Surgery Reporting System (CSRS), much heeded in the USA and considered as the Gold Standard in quality information publications (Jha and Epstein 2006, p. 844).

Methodically, one set of high quality studies examines market shares of providers after relative to before the adoption of report cards, just like we do (e.g. Wedig and Tai-Seale 2002 or Dafny and Dranove 2005). These studies define the effect of the report card as the difference in the change of market share, after versus before adoption and between highly rated providers and those who are poorly rated by the report card (Bundorf et al. 2008, p. 3f.). Another set of high quality studies analyses the relationship between market shares after the implementation of a report card (e.g. Cutler et al. 2004). These examinations define the effect of the report cards as the correlation between market shares and published quality over time holding constant hospital characteristics. Both types of studies take advantage of panel data using fixed-effects to allow for time-invariant correlation between reported and unobserved quality. More recently Bundorf et al. (2008) extend previous literature on report cards in the context of the market for assisted reproductive therapy (ART) services. Within an innovative approach using an unobserved quality measure – available before and after the release of the report card – the authors were able to control for unobserved time variant quality information. Using a difference in difference estimation strategy they found, clinics with higer birth rates had larger market shares after relative to before the adoption of report cards. Notwithstanding these recent results, to sum up evidence of the impact of report cards remains mixed indicating only a (weak) positive correlation between the published – i.e. discernable – hospital quality and the market share of a hospital.

2.2 Why patients do not always react to quality information

Apart from the lack of awareness regarding published data, an important cause for the insufficient utilisation of quality information is seen in the misalignment of existing quality information (Schaeffer 2006).

This result is also determined by Marshall et al. (2000) in their systematic literature evaluation of studies published according to a peer-review procedure: insufficient interest of patients to use quality data for decision making is mostly caused by the fact, that available information for patients is badly prepared and incomprehensible, not regarded as relevant, and that patients do not place their trust in the provided data. Similar findings for the insufficient use of quality information arise from more recent studies (Dealey 2005, Mannion and Goddard 2003). Finally, studies show that referring GP's display a large degree of scepticism towards published data, which are therefore hardly used. If asked for the causes, the reliability of quality data was doubted (53 percent of those questioned), insufficient risk adjustment of data (79 percent of those questioned) and the limitation of published quality variables on the "Mortality" indicator (79 percent) is criticised (Schneider and Epstein 1996, Casalino et al. 2007). Having in mind these deficiencies of published report cards we describe in the following section the quality measurement framework of the Klinikführer Rhein-Ruhr. Doing so we deliver arguments why we use the Klinikführer as an adequate object for evaluating the potential impact of report cards on hospital choice.

2.3 Evaluation object: the "Klinikführer Rhein-Ruhr"

The Klinikführer Rhein-Ruhr (Clinic Guide) was published in the Internet and as printed media in September 2005 by the Initiativkreis Ruhrgebiet and The Boston Consulting Group.[2] More than 30,000 copies were sold and with more than 2.5 million accesses (within two years), displayed a considerable interest in the information (Initiativkreis Ruhrgebiet 2007). 74 hospitals and thus more than half of the hospitals in the Rhine-Ruhr region voluntarily participated in the transparency initiative. In our opinion, the "Klinikführer Rhein-Ruhr" represents a well-suited examination object for the effectiveness analysis of quality information, as important theoretical and empirical findings on the use and increase of this influence of quality information were implemented. (Initiativkreis Ruhrgebiet 2005).

Firstly, the Klinikführer Rhein-Ruhr publishes comprehensive quality information. This is done by the questioning of patients (among others questions on satisfaction in the physician-patient relationship, treatment success, care) and referrers (Where would you refer yourself or your family for treatment?). Further the clinic guide contains the description of

[2] The Initiativkreis Ruhrgebiet is a consortium of 64 leading commercial enterprises (among others, EON-Ruhrgas, Deutsche Bank). Together, they employ almost 1.7 million people worldwide, with a turnover of almost 480 billion Euros. Comp. Initiativkreis Ruhrgebiet (2007).

the hospital's experience with certain operations (case numbers analysis) and the description of process and outcome indicators (Initiativkreis Ruhrgebiet 2005). Latter Data are measured by an independent service agency, the Federal Office for Quality Assurance (Bundesgeschäftsstelle Qualitätssicherung or BQS).[3] Secondly, we consider the data are prepared in a user-friendly manner (among others simple rating scales - 4-point system, highly aggregated indicators) and distributed through various channels (Internet, in book form, press releases). Thirdly, we observed that the conception of the Clinic Guide included important findings on the increased trust of patients and potential referrers in the published data. For example questioning of physicians and referrers was conducted under the management of an independent institute (Pickert Institute Germany). Fourthly, the survey directly included GP's as important referrers, which increased the awareness level of the Clinic Guide among the resident physicians (feedback quota of the survey 26 %). Fifthly, the Clinic Guide encompasses a region with a high population and hospital density, which denotes closely located treatment alternatives for the patients.

3 Theoretical modelling of hospital selection and hypotheses

3.1 Theoretical modelling

The following assumes that each enquirer of hospital services behaves like a utility maximiser and maximises the utility function N allocated to him. The following factors are assumed as determinants of the individual utility function N: N= f(q, D, a). The following applies: q = q(K) = actual quality of hospital K, D = D(K) = Distance to the hospital K, a =Age of patient, c > 0 = Weighting parameter and $\alpha < 1$ = Weighting parameter. For simplicity we restrict our model to the one disease case. We specify the individual utility function N_α through

$$(1)\quad f_\alpha(q, D, a) :=. \frac{q^\alpha}{D^{1+c*a}}$$

[3] The BQS tasks focus on the external comparative quality management which is obligatory for almost every hospital in Germany. The BQS was launched in 2001 and since then is coordinating the processes for obtaining and providing the benchmarking information for hospitals. All German hospitals are participating in the external Quality Assurance procedures organised along federal and state based offices. Comp. Breckenkamp, J. et al. (2007). Generally the BQS data are not published, but used for external quality assurance.

The utility function gives the enquirer-patient a different value for each hospital, as variables q and D depend on the hospital K. We assume that the actual quality of the hospital positively influences the utility of the enquirer-patient, but that the marginal utility with regard to q is reduced (as $\alpha < 1$). As the distance of the patient from the hospital grows, the utility is reduced depending on the age. According to our assumptions, the utility function of older patients reacts - according to empirical experience (Varkevisser and van der Geest 2007, Tai et al. 2004) – more sensitive to increasing distance, i.e. the distance parameter is given a higher weighting in the utility function.

The recently displayed utility function refers to the situation, in which the enquirer-patient is provided with the complete information on the quality of the respective hospital. However, this assumptions cannot be confirmed in reality, as quality information in health care is usually only available to a limited degree and not accessible to a large majority of the public. Thus, in a utility function adjusted to reality, the "actual quality q" must be replaced by the "evaluated Q". This "evaluated quality" (= perceived or realised quality) therefore represents, from the mathematical point of view, the realisation $Q(\omega)$ of a random variable Q, as information on the properties of hospitals is supported by own experiences or reports from friends, acquaintances and relatives trusted by the patients (e.g. Sauerland 2003, p. 265f.). However, this information does not need to comply with the actual quality, because at the time of transmission of information, the respective assessments of actual information are interrupted by the given quality on account of subjectivity.

Below it is assumed that the enquiring patients are able to assess the extent of uncertainty with regard to the quality achieved by them and attach less importance to the quality in the utility function sensed (perceived) by them in the event of growing uncertainty. We therefore recommend the following utility function:

$$(2) \qquad f_{\alpha}(Q, D, a) := \frac{Q^{\alpha(\sigma^2(Q))}}{D^{1+c*a}}.$$

The weaker weighting of the perceived quality associated with the larger uncertainty is modelled, assuming that the $\alpha = \alpha(\sigma^2(Q))$ function drops monotically in $\sigma^2(Q)$ (variance). To ensure reducing marginal utility with regard to the perceived quality, we demand that

(3) $$\lim_{(\sigma^2(Q)) \to 0} \alpha(\sigma^2(Q)) < 1.$$

As a function of Q, the utility function defined above is a random variable. However, every economic entity experiences a realisation of these random variable over the perceived quality, whereby there is uncertainty regarding the representation of the realisation. The thus defined utility function now fulfils the economically expedient assumptions ($f'(Q) > 0$ and $f''(Q) < 0$) and complies with the empirical evidence: a positive, age-dependent overproportional distance aversion. We will use the above-mentioned utility function to describe the effect of quality information on the above-mentioned utility function, whereby we assume that quality can be measured to a certain extent with the help of objective criteria (Sauerland 2003, p. 265ff). The publication of quality-related data in a generally comprehensible manner results in the presence of objective information on the random variable Q. The enquirer-patient can therefore use this information and experiences a new realisation of quality perceived by him, which is, however, based on scientific data and is less subjective, thus seemingly more representative.[4]

Therefore the uncertainty with regard to perceived quality is reduced. Now we would like to include the publication of quality-related data in our utility function. The utility function from (2) is then given the form:

(4) $$f_\alpha(Q, D, a) := \frac{Q^{\alpha(E(\sigma^2(Q)|I))}}{D^{1+c \bullet a}},$$

whereby $E(\sigma^2(Q)|I))$ is the expected value of the conditional variance and is defined by

(5) $$E(E(\sigma^2(Q)|I)) := E(Q^2) - E(E(Q|I)^2).$$

From a mathematical point of view, the Q variance drops in average by giving rise to the information I and is explained in the following models of the expectancy value of the conditional variance. The right side of (5) can be written as

(6) $$E(Q^2) - E(E(Q|I)^2) = \sigma^2(Q) + E(Q)^2 - E(E(Q|I)^2)$$

In the case of unavailable objective quality information, the mathematical rules for conditional expectations can be used to verify the following:

(7) $$E(E(Q|I)^2) = E(Q)^2.$$

[4] This especially applies to technical quality, which can be measured on the basis of objective criteria (e.g. Complication Rates).

If (7) is now entered in (6) and this in turn in (5), one will receive:

$$(8)\qquad E(E(\sigma^2(Q)|I)) = E(Q^2) - E(Q)^2 =: \sigma^2\,(Q).$$

This means that in the case of unavailable quality information, the expectation value of the conditional variance complies with the variance itself. The amount of information required to reduce the uncertainty about the perceived quality can be deduced from Equation 6. This shows: The expectation value of the conditional variance is smaller than the variance (and the uncertainty is lower), if

$$(9)\qquad E(Q)^2 - E(E(Q|I)^2) > 0.$$

The case of unavailable quality information has already been considered. We will now discuss the case of complete quality information. This formally means that the σ -Algebra A created from I is equivalent to σ -Algebra created from Q. This makes Q measurable related to A in equation (9). However, applying the arithmetic rules for conditional expectations, the consequence is

$$(10)\qquad E(E(Q|I)^2) - E(Q)^2 = E(Q^2) - E(Q)^2 = \sigma^2(Q).$$

If this is in turn integrated into (5), one will receive

$$(11)\qquad E(E(\sigma^2(Q)|I)) = E(Q^2) - E(E(Q|I)^2) = 0.$$

This is what is expected from the model, as in the case of complete quality information, the perceived quality complies with the actual quality and there is no uncertainty. Furthermore, our defined factor of the conditional variance's expectation value can be used to show, that uncertainty is reduced in the case of increasing quality information, i.e. for two σ –Algebra I and J with $I \subset J$ the following is valid:

$$(12)\qquad E(E(\sigma^2(Q)|J)) \leq E(E(\sigma^2(Q)|I)).$$

Proof: Definition 5 and the mathematical regulations for conditional expectations result in:

$$(13)\qquad E(E(\sigma^2(Q)|I)) = E(X^2) - E(E(X|I)^2).$$

$$E(E(\sigma^2(Q)|J)) = E(X^2) - E(E(X|J)^2).$$

Therefore the argument is logical if we can show that

$$E(E(X|J)^2) \geq E(E(X|I)^2).$$

This would be:

$$(14)\quad E(E(X|J)^2) = E(E(E(X|J)^2)|I) \overset{Jensen}{\geq} E(E(E(X|J)|I)^2) = E(E(X|I)^2)$$

3.2 Hypotheses

The following hypotheses in the empirical analysis below will be tested on the basis of this theoretical consideration:

Hypothesis 1: *The publication of quality information has reduced patient uncertainty. Therefore published hospitals extend their market share or case numbers when compared with competing – non-publishing – hospitals.*

Hypothesis 2: *From the total of publishing hospitals, those hospitals with over-average quality tend to be preferred to competing hospitals with a quality below average. In other words: "good hospitals" should be able to extend their market shares or case numbers in comparison to "poor hospitals".*

4 Data and estimation method

4.1 Data

We revert to a pooled data record containing cross-sectional and longitudinal data, which was basically fed from two sources. Patient data from the data base of the "Allgemeinen Ortskrankenkassen (AOK)" [General Medical Insurance Plans] were specifically used to calculated the dependent variables (A. Case Numbers, B. Market Shares).[5] Quality variables from the Klinikführer Rhein-Ruhr 2005/2006 were then deduced and included in the patient data.

The period from 2003 to 2006 was selected as the analysis period to analyse data before and after publication of quality information and to specifically examine the influence of publication activity. The Clinic Guide was published in September 2005. The regional focus of the analysis is on the Rhine-Ruhr region as well as on the metropolitan area of Cologne-Bonn, which was included as the control group.

Dependent variables

WIDO supplied data of 700.000 patients from the AOK database for the quarters I/2003 to IV/2006.[6] Apart from information on the treatment venue and patient residence - each with specification of the 5-digit postal code - this data also contained information on age, sex and the time of treatment. Not only AOK-specific case numbers, but also the market shares of the examined hospitals were distinguished according to quarters, age groups (5-year age groups) and sex with the help of this data. The calculation of market shares for alternative spatial market delineation was conducted as follows: during a first step, the Pythagorean Theorem - and the use of postal code-specific geographical coordinates - was used for each hospital to determine the distance to the other hospitals. Then we determined those hospitals within a radius of 35 and 50 km. These radiuses were also recommended and referred to for spatial market delineation in other studies, which included market share calculations (Siciliani and Martin 2007). During a third step we calculated the market shares of the hospital for the alternative market share delineation, in which the number of patients treated in the hospital were divided by the total number of hospital cases in the spatial environment of the hospital.

Explanatory variables and control variables

Various 0-1-coded dummy variables were formed to examine whether the voluntarily published hospitals, compared to the competing non-publishing hospitals in the Rhine-Ruhr region, were able to expand their case numbers or market shares. One dummy variable was formed for the period before and after the publication of the Clinic Guide ("After Publication"). A further dummy variable was formed to differentiate between the Rhine-Ruhr re-

---

[5] This data was made available by the "Wissenschaftliche Institut der Ortskrankenkassen (WIDO)" [Scientific Institute of the General Medical Insurance Plans].

[6] With 36 %, AOK is market leader among the public medical aids, which in turn denote approx. 90 % of policy holders. Comp. AOK-Bundesverband (2007).

gion ("Rhine-Ruhr") and the control group Cologne-Bonn as well as a further dummy variable to identify the voluntarily publishing hospitals in the Rhine-Ruhr region ("Published"). Table 1 displays the most important variables taken into consideration in the assessment models.

Table 1: Dependent, descriptive and control variables

Variable	**Description**
Dependent variables	
Case numbers	= Hospital case numbers
Market share35	= Hospital market share for the market delineation of 35 km
Market share50	= Hospital market share for the market delineation of 50 km
Log_Distance	= average logarithmized distance of the treated patient to the hospital
Descriptive variables (measured on hospital level)	
Rhine-Ruhr	= 1, if hospital in Rhine-Ruhr region, otherwise 0
After Publication	= 1, if treatment took place from III quarter 2005, otherwise 0
Publishing Hospital	= 1, if quality information is published, otherwise 0
Good hospitals	= 1, if the hospital counts as one of the relatively goods hospitals, otherwise 0
Good outlier	= 1, if the hospital counts as one of best 25%, otherwise 0
Bad outlier	= 1, if the hospital counts as one of worst 25%, otherwise 0
Time trend	= Trend variable for the considered quarters (from 1 to 16)
Control variables (measured on hospital level)	
Patient attributes	
Age group	= Age group of the treated patient (at 5-year intervals)
Male	= Sex of the treated patient, 1 if male, otherwise 0

Further 0-1-coded dummy variables were formed to answer the question of whether the performance of the published quality could further influence patient behaviour. A "Total Rating" was calculated on the basis of information published in the Clinic Guide. Those hospitals (number), for which WIDO was able to supply patient data, were considered in this calculation. An average point figure was determined for every hospital, by summing up the points (four points: very high recommendation rate in the evaluated area; one point: very low recommendation rate in the evaluated area) for each professional department and each of the four evaluation areas (patient satisfaction, physician recommendation rate, number of operations, treatment quality) from the Clinic Guide and then divided by the number of evaluation fields. The dummy variable "good" was formed on the basis of this "Total Rating", whereby the dummy variable "good" was set to 1, if the hospital was counted as one of the relatively good hospitals (best 50% of the participating hospitals), otherwise it was set to 0.

The dummy variations "good outlier" and "bad outlier" were formed to control positive and negative outliers. Thus the dummy variable "good outlier" was set to 1, if the hospital was counted as being one of the best 25% of participating hospitals contained in the database. Finally, we consider data on age and sex to control for these patient attributes.

Table 2 provides information on the average value and standard deviation for the case numbers and market shares for selected hospital groups, which will be discussed in the following econometric models. It becomes apparent that good hospitals achieve higher average case numbers and higher market shares than mediocre hospitals. Furthermore the data reveal that the average case numbers of the hospitals has increased since the publication of the Clinic Guide. It further becomes apparent that since publication the good hospitals were able to realise a higher case numbers growth (+ 5 %) than relatively poor hospitals (+ 3.24 %). These in turn could achieve a larger average growth rate than non-publishing hospitals from the Rhine-Ruhr area (+2.23 %).

Table 2: Descriptive statistics

Variable	Observations	Average value	Standard deviation	Average value before Publication	Average value after Publication	Growth rate in %
Case numbers analysis						
Case numbers	2512	640.67	521.32	631.08	656.64	+ 4.04
Case numbers of publishing hospitals	960	760.89	447.55	748.61	781.34	+ 4.37
Case numbers of non-publ. hospitals in the Rhine-Ruhr region	848	464.70	529.28	460.84	471.14	+ 2.23
Case numbers of non-publ. hospitals from the metropolitan area Cologne-Bonn	736	691.81	544.45	679.02	713.13	+ 5.00
Case numbers of good hospitals	480	833.95	513.12	818.58	859.56	+ 5.01
Case numbers of poor hospitals	480	657.38	305.26	649.49	670.54	+ 3.24

Further statistical processes now show whether the publication contributed to a change in market shares and case numbers.

4.2 Estimation method

We use a panel data structure to analyze the effects of quality information.[7] The level which we observe is the hospital per quarter. 16 quarterly examinations from 2003 to 2006

[7] For panel analysis, comp. e.g. Wooldridge, J.M. (2002).

are available for 157 hospitals from the Rhine-Ruhr region as well as from the metropolitan area of Cologne-Bonn. As we are interested in the effect of publishing quality information on hospital choice we apply a difference in difference estimator (Before-After-estimation and considering a natural control group of hospitals from the region Cologne-Bonn). Nevertheless we have to consider, that the endogenous variables possibly display heteroscedasticity and auto-correlation. In order to reduce a potential underestimation of the standard error due to heteroscedasticity, we calculate robust standard errors, which are relatively insensitive to heteroscedasticity (Kohler and Kreuter 2005, p. 232). We take the potential problem of auto-correlation into account by including a first order auto-regressive process within the scope of a sensitivity analysis. Diagnostic tests were used to determine the functional form. STATA Version 9.0 was used as software for the econometric analyses,

4.3 Estimation models

Against this background we use two basic models to review the previously listed hypotheses.

Model I: This tests the relation between the publication of quality information and the market shares or case numbers within the scope of a Fixed Effects estimation.

Model II: Like Model I; additionally explanatory variables for the performance of the publishing hospital quality are included to test their influence on market shares and case numbers.

Equation (15) presents the specification of Assessment Models I - III.

$$(15)\ y_{it} = ß_1 + ß_2 c_{it} + ß_3 x_{it} + u_i + \varepsilon_{it,}$$

whereby y_{it} stands for the dependent variable (depending on model, market share or case numbers) and the indices t and i for quarters (t) and hospitals (i). The coefficient of the intercept is displayed by $ß_1$. $ß_2$ contains a vector for the coefficients of the explanatory variables x (Rhine-Ruhr, Published, Good, Bad, …, comp. Table 2) and $ß_3$ represents a vector for the coefficients of the control variables c (sex and age group, comp. Table 2). Finally, hospitals fixed effects are specified by the parameter u_i and ε_{it} stands for the error term.

In order to test the robustness of the determined results, the effects of alternative markets delineations as well as other coding of quality variables are examined for dependent variables within the scope of a sensitivity analysis.

5 Results

5.1 Core results

Table 5 represents the estimation results of Model I and II. The estimation coefficients of the fixed effects estimation are presented in the table, because the Hausmann test has indicated the advantage of this method for the investigation on hand. The correlation between publication of quality information and the development of hospital case numbers was tested in Model I. In order for the interpretation of the dummy variables to remain comprehensible, a sequential approach was followed for the regressions and the presentation of the regression results.

Initially the explanatory variables "Time trend" and "After Publication" were taken on, besides the control variables (left column). It becomes evident, that the hospitals have on average treated 2.97 more cases per quarter. After controlling for the time trend, the "After Publication" dummy indicates that no systematic differences between the period before and after publication of the Clinic Guide could be established. The interaction dummy "Published * After Publication" does, however show that significant differences do exist between hospitals which publish and hospitals which do not publish. Compared to the reference group of non-publishing hospitals, publishing hospitals can on average gain almost 10 cases after publishing the Clinic Guide.

In column 3 a test is finally done with the aid of the interaction variable "Rhein-Ruhr* After Publication", whether the publishing hospitals can expand case numbers against all hospitals, or only against competing hospitals form the Rhine-Ruhr region. The results show that publishing hospitals from the Rhine-Ruhr region could make statistically significant gains of 20.27 cases against non-publishing hospitals from the Rhine-Ruhr region (reference group). These have lost an average of 22.14 cases against the non-publishing hospitals from the Cologne-Bonn control group (reference group).[8] This result leads to the presumption that publishing hospitals gain case numbers from competing hospitals. [9]

Table 5: Effects of the quality information on case numbers and market share

Variable	(Model I)			
	Case numbers	**Case numbers**	**Case numbers**	**Market share50**
Explanatory variables				
Time trend	2.97 (0.44)***	2.97 (0.44)***	2.97 (0.44)***	
After Publication	1.78 (3.74)	1.89 (4.17)	9.95 (5.52)*	0.044 (0.014)***
Rhine-Ruhr * After Publication			-22.14 (5.30)***	-0.747 (0.013)***
Published * After Publication		9.96 (4.47)**	20.27 (5.11)***	0.029 (0.008)***
Control variables				
Age Group	-28.56 (3.63)***	-28.30 (3.61)***	-27.72 (3.60)***	-0.047 (0.0069)***
Male	37.99 (13.55)***	36.64 (12.84)***	37.79 (12.87)***	0.098 (0.0285)***
Number of observations	2512	2512	2512	2512
Axis intercept	614.74 (3.10)***	614.74 (3.096)***	614.73 (3.077)***	1.102 (0.006)***
F-value	45.64	37.16	32.16	30.27
Prob > F	0.0000	0.0000	0.0000	0.0000
R^2 (within)	0.0928	0.0972	0.1004	0.0990

Standard error in brackets, significance level: ***P < 0,01, **P < 0,05, *P < 0,10.

In Model II an additional test was performed to establish the effect of quality of the published data on the development of case numbers of the hospitals. The results in Table 6 show – again after integration of the control variables – that relatively good hospitals could on average expand their case numbers by 19.50 cases compared to relatively poor hospitals.

Table 6: Effects of good and poor quality on case numbers and market shares

[8] Special care must be taken when interpreting the coefficients, because two interaction variables have been taken on and the reference groups for the explanatory variable "After Publication" and the interaction variable "Published * After Publication" change accordingly. The positive value of the variable After Publication shows in this case that hospitals from the greater region Cologne-Bonn could realise relative case increases compared to the period before the transparency initiative. The hospitals could on average expand their case numbers by 9.95 cases compared to the reference (all hospitals before the publication of quality information).

[9] The time invariant variable "Region" was taken on into the estimation within the framework of the random effects specification. This variable turned out to be insignificant.

Variable	(Model II)	
	Case numbers	Market share 50
Explanatory variables		
Time trend	2.97 (0.44)***	
After Publication	9.94 (5.51)*	0.044 (0.014)***
Rhine-Ruhr * After Publication	-22.14 (5.30)***	-0.075 (0.013)***
Published * After Publication	8.84 (5.27)*	0.009 (0.008)
Good* After Publication	19.50 (7.92)**	0.033 (0.012)**
Rhine-Ruhr		
Control variables		
Age Group	-27.67 (3.58)***	-0.047 (0.007)***
Male	37.79 (12.83)***	0.098 (0.028)***
Number of observations	2512	2512
Axis intercept	614.73 (3.072)	1.102 (0.006)***
F-value /Wald Chi2	28.21	26.66
Prob > F / Prob > Chi2	0.0000	0.0000
R^2 (within) / R^2	0.1030	0.1008

Standard error in brackets, significance level: ***P < 0,01, **P < 0,05, *P < 0,10.

Relatively poor and publishing hospitals are mirrored in the interaction variable “Published * After Publication”. These hospitals expand their relative case numbers by 8.84 compared to their reference group – the non-publishing hospitals in the Ruhr region. If one additionally looks at the control variables which taken on in Model I and Model II, it becomes evident that the age structure of treated patients shows a negative correlation and the portion of male patients shows a positive correlation with the number of treated cases regarding market share development.[10]

It also becomes evident from Table 5 and Table 6, that similar statistical coherences could be established for relative market share of the hospitals. These results also show that publishing hospitals could gain relative market share compared to competing non-publishing hospitals. These hospitals could on average expand their market share by an absolute 0.029% compared to non-publishing hospitals. If one observes the average market share of a hospital of 1.102%,[11] then this corresponds to an average market share increase of 2.63% (increase from 1.102 to 1.131). It furthermore becomes evident, that the relative good hospitals are the winners among the publishing hospitals. Publishing hospitals with above average quality could on average expand their market share by an absolute 0.033% against

[10] Furthermore it becomes apparent that the observed hospitals on average treated 614.73 AOK patients in the first quarter. The variables gender and age group were centred on their medians, which allow the axis intercept to be interpreted as average value.

above average poor hospitals. This corresponds to an average increase of 3.00% (increase from 1.102% to 1.135%).

5.2 Results of the sensitivity analysis

Various sensitivity analyses were conducted in order to test the robustness of the results. Table 7 present a selection of the analyses that were conducted. The left hand column shows that hospitals belonging to the best 25% of published hospitals could expand their market share by an absolute average of an additional 0.031% against their reference, those which are relatively good, but not among the best 25% (corresponds to an increase of market share by 2.8%, from 1.103 to 1.134). However, this value is just marginally too low, to be of statistical significance. A value of statistical significance could also not be established for the worst 25% (not shown in Table 7).

The next column shows the result of an alternative market demarcation. This shows that the results in relation to market demarcation have proven to be robust, because only minor deviations from previous analyses have occurred (compare Table 6). An auto-regressive process of the first order was taken on in the estimation equation in column three, in order to address the autocorrelation problem. In this case, however, no statistically significant difference between publishing and non-publishing hospitals in the Ruhr region can be identified any more (not shown in Table 7). The "good hospitals" do, however, gain statistically significant more cases than their reference, the other hospitals in the Rhine-Ruhr region.

Table 7: Selected results of the sensitivity analysis

Variable	**Market share50**	**Market share35**	**Market share50 (AR)**
Explanatory variables			
After Publication	0.044 (0.014)**	0.057 (0.018)**	-8.33 (6.82)
Rhine-Ruhr * After Publication	-0.074 (0.013)***	-0.094 (0.017)***	-10.56 (7.50)
Published * After Publication	0.009 (0.008)	0.010 (0.013)	
Good * After Publication	0.017 (0.017)	0.048 (0.018)**	15.58 (8.28)*
Good outlier * After Publication	0.031 (0.020)		

[11] In this case too, the variables gender and age group were centred on their medians, which allow the axis intercept to be interpreted as average value.

Control variables			
Age group	-0.046 (0.007)***	-0.07 (0.01)***	-12.09 (3.72)***
Male	0.095 (0.028)***	0.15 (0.04)***	12.08 (19.27)
Axis intercept	1.103 (0.006)***	1.6410 (0.009)***	601.40 (2.820)***
Number of observations	2520	2520	2355
WaldChi2 / F	23.40	28.10	12.98
Prob > Chi2 / Prob > F	0.0000	0.0000	0.0000
R^2	0.1018	0.1016	0.038

Standard error in brackets, significance level: ***P < 0,01, **P < 0,05, *P < 0,10.

6 Discussion and conclusion

The quantitative-empirical analysis provides two fundamental results. Firstly: Hospitals voluntarily publishing their quality data measured on the basis of case numbers and market shares are in stronger demand than those not publishing their quality data while competing with the publishing hospitals. Consequentially, the non-publishing hospitals in the Rhine-Ruhr region lose relative case numbers and market shares to their publishing competitors. Secondly: In the group containing publishing hospitals, the publication of quality information results in hospitals with below average quality to be selected less often than hospitals with above-average quality.

As Section 5 has shown, these results are statistically significant. At the same time we should note that the effects are relatively low. For example, good hospitals were able to extend their market shares when compared to poor hospitals with an average of 3 % (absolute growth by 0.033 %). This may be caused by various reasons: firstly, patients and their referrers may not have been aware of the published data despite public relations at the time of decision (Section 2, Schneider and Epstein 1996 as well as Schneider and Epstein 1998). Secondly, the use of the data could have been affected by the GP's or friends', relatives' and acquaintances' contradictory recommendations. Thirdly, the published data could have only confirmed already existing expectations. In this context recent studies were able to show, that in particular deviations from expected quality lead to changes in case numbers and market shares (Dafny and Dranove 2005, Chernew et al. 2007 as well as Mukamel 2004/2005). As an example, Mukamel (2004/2005) could show that hospitals displaying a positive (negative) deviation of the expected quality were able to increase case numbers (had to cope with losses). Fourthly, the patients and their referrers may not have trusted the data, misinterpreted them or not have understood them and thus not have used them as a decision tool (Marshall 2000). Fifthly and finally, a further reason for the small reaction of the patients to the data may be that patients were unable to use the data due to an existing emergency, even if they were aware of the information.

Integration into existing literature

The results of the quantitative analysis comply with a number of studies existing in the Anglo-Saxon area, according to which "good hospitals" were able to achieve a significant but low growth rate of market shares after the publication of quality information and "poor hospitals" had to handle slight losses respectively (Section 2). However, the study does provide additional information over and beyond the findings of existing examinations. Thus this relationship is found empirical in Germany for the first time. Furthermore, it is shown for the first time that non-publishing, competing hospitals also have to accept relative losses and even do slightly worse (statistically insignificant) than over-average badly evaluated hospitals. This result supports the model-theoretic considerations, that voluntary publication explicitly contributes to a reduction of uncertainty and that, in consequence, publishing hospitals are selected with a larger probability than non-publishing, competing hospitals.[12]

Apart from the generated new findings, this study displays two further significant strengths when compared to most existing studies.

A large strength of the examination lies within the "Clinic Guide Ruhr Region" examination object. In the case of this transparency initiative high methodical standards were applied during quality measurement.[13] Not only structural but also process and outcome indicators were reported, which complies with the information preferences of the patients.[14] At the same time, the resident physicians significant for referral were included within the scope of a survey, which presumably increased the acceptance of the transparency initiative from the referrer but also from the patient side. These factors are discussed in literature as important ancillary conditions for the effectiveness of the publication of quality infor-

[12] Interpreted differently, the lack of data publication is negatively perceived by the patients.
[13] Comp. to the various methods of risk adjustment applied by the BQS (2007), which measured the outcome data.

mation (Schaeffer 2006 or Section 2). Finally, we are of the opinion that cognitive-psychological findings were implemented in the display of the Clinic Guide data using simple star ratings, etc..

The second significant strength of the examination can be found in the study design and in the data record. Analyzing the case numbers and market share after relative to before the adoption of the Klinikführer-Ruhrgebiet using fixed-effects-estimation allows for time invariant correlation between reported and time invariant, unobserved quality. Furthermore, unobserved dynamic aspects were respectively considered by including a first order auto-regressive process within the scope of a sensitivity analysis. On top of that, the formation of a control group for the Cologne-Bonn area aided in generating a quasi experimental design, which is deemed the gold standard for the determination of causality between the endogenous and exogenous variable in empirical assessment models and increases the probability of achieving valid assessment results (Holland 1986). This strategy requires fewer restrictive assumptions than other existing analyses, which rely on untestable assumptions to identify the effect of interest (Bundorf et al. 2008).

Apart from the existing strengths of the examination, it is also important to indicate limitations. Firstly, only data of patients from the General Medical Insurance Plans could be used for this examination. We are of the opinion that this underestimates the effect of quality information. Private patients are not considered which usually originate from higher educational and income levels as well as from younger age groups and which are thus more likely to react to published information (Mukamel and Mushlin 1998 or Romano and Zhou 2004). Furthermore, the results cannot be transferred to other German regions in an unlimited manner, as the Ruhr Region is characterised by a high degree of urbanisation and high hospital density. As other studies were able to show, the possibility of changing to closer located alternative providers is of high significance in the patients' decision to select the respective hospital (Varkevisser und van de Geest 2007 or Tai et al. 2004). Finally, we were not able to use the data to perform a disease-specific analysis. A respective analysis would have been able to provide additional differentiated findings.[15]

[14] Comp. ibidem.
[15] Comp. e.g. Varkevisser, M. and S. van der Geest (2006) within the scope of a Mobility Analysis.

Political decision makers, hospitals and financing bodies should basically expect that the publication of quality data will influence the patients' and/or the referrer behaviour. The consequences drawn by the political decision makers basically depend on whether the quality measurement of hospital quality can be adequately displayed. An important prerequisite is that the quality measurement is able to correctly consider patient differences in illness severity (Key word: Risk adjustment).[16] If this is possible, the hospitals should (i) have an incentive to make quality information accessible and (ii) maintain the quality of the rendered services at a high standard. The patients would then regard such information as an aid for better orientation. In this case, politics should set adequate frame conditions, so that the publication of quality information does actually take place.

[16] Critically compare the hazards associated with the publication of quality information, insofar as risk adjustment does not function correctly, e.g. Cutler, D.M., Huckman, R.S and M.B. Landrum, Schneider, E.C and A.M. Epstein (1996) as well as Dranove, D. et al. (2003). In this case an empirical examination is used to indicate the danger of an existing tendency to refuse patients with higher risks.

References

AOK – BUNDESVERBAND (2007), Website, in: http://www.aok-bv.de/aok/daten/index.html [abgerufen: 28.11.2007].

BAKER, D.W ET AL. (2003), The effect of publicly reporting hospital performance on market share and risk-adjusted mortality at high-mortality hospitals, in: Medical Care., Vol. 41, pp. 729–740.

BQS – BUNDESGESCHÄFTSSTELLE FÜR QUALITÄTSSICHERUNG (2007), Website, in: http://www.bqs.outcome.de [abgerufen: 28.11.2007].

BRECKENKAMP, J. WISKOW, C. AND U. LAASER (2007), Progress on quality management in the German health system – a long and winding road, in: Health Research Policy and Systems, Vol. 5, p. 1-11.

CASALINO, L.P. ET AL. (2007), General Internists' Views On Pay-For-Performance And Public Reporting Of Quality Scores: A National Survey., in: Health Affairs (Millwood), Vol. 26, pp. 492–499.

CHERNEW, M., GOWRISANKARAN, G. AND D. SCANLON (2007), Learning and the value of information: The case of hospital report cards, in: Journal of Econometrics, Forthcoming (Also: National Bureau of Economic Research, Working Paper 8589).

CUTLER, D.M., HUCKMAN, R.S. AND M.B. LANDRUM (2004), The Role of Information in Medical Markets: An Analysis of Publicly Reported Outcomes in Cardiac Surgery, in: The American Economic Review, Vol. 94, pp. 342–346(5).

DAFNY, D. AND D. DRANOVE, (2005), Do Report Cards Tell Patients Anything They Don't Already Know? The Case of Medicare HMO Report Cards, in: National Bureau of Economic Research, Working Paper 11420.

DEALEY, C. (2005), The factors that influence patients' choice of hospital and treatment, in: British journal of nursing, Vol. 14, pp. 576–579.

DRANOVE, D. ET AL. (2003)**,** Is More Information Better? The Effects of 'Report Cards' on Health Care Providers., in: Journal of Political Economy, Vol. 111, pp. 555–588.

GERAEDTS, M. (2006), Qualitätsberichte deutscher Krankenhäuser und Qualitätsvergleiche von Einrichtungen des Gesundheitswesens aus Versichertensicht, in: BÖCKEN, J. ET AL. (Hrsg.), Gesundheitsversorgung und Gestaltungsoptionen aus der Perspektive von Bevölkerung und Ärzten, Gütersloh, Bertelsmann-Stiftung, S. 154–170.

HOLLAND, P.W. (1986), Statistics and Causal Inference, in: Journal of the American Statistical Association, Vol. 81, pp. 945–960.

HOWARD, D.H. AND B. KAPLAN (2006), Do Report Cards Influence Hospital Choice? The Case of Kidney Transplantation, in: Inquiry, Vol 43, pp. 150–159.

INITIATIVKREIS RUHRGEBIET (2005), Klinikführer Rhein-Ruhr 2005/2006, Klartext Verlag, Essen.

INITIATIVKREIS RUHRGEBIET (2007), Website, in: http://www.i-r.de/Internet/DE/Initiativkreis/Mitglieder/ [abgerufen: 28.11.07].

JHA, A.K. AND A.M. EPSTEIN (2006), The Predictive Accuracy Of The New York State Coronary Artery Bypass Surgery Report-Card System, in: Health Affairs, Vol. 25, pp. 844–855.

MA, C.T.A. (1994), Health Care Payment Systems: Cost and Quality Incentives, in: Journal of Economics and Management Strategy, Vol. 3, pp. 93–112.

MANNION, R. AND M. GODDARD (2003), Public disclosure of comparative clinical performance data: lessons from the Scottish experience, in: Journal of evaluation in clinical practice, Vol. 9, pp. 277–286.

MARSHALL, M.N. ET AL. (2000), The public release of performance data – what do we expect to gain? A Review of evidence, in: Journal of the American Medical Association, Vol. 14, pp. 1866–1874.

MUKAMEL, D.B AND A.I. MUSHLIN (1998), Quality of Care Information Makes a Difference: An Analysis of Market Share and Price Changes Following Publication of the New York State Cardiac Surgery Reports, in: Medical Care, Vol. 36, pp. 945-954.

MUKAMEL, D.B. (2004/2005), Quality Report Cards, Selection of Cardiac Surgeons and Racial Disparities: A Study of the Publication of the NYS Cardiac Surgery Reports., in: Inquiry, Vol. 41, pp. 435–446.

ROBINOWITZ, D.L. AND R.A. DUDLEY (2006), Public reporting of provider performance: Can its impact be made greater?, in: Annual Review of Public Health, Vol. 27, pp. 517–536.

ROMANO, P.S. AND H. ZHOU (2004), Do well-publicized risk-adjusted outcomes reports affect hospital volume?, in: Medical Care, Vol. 42, pp. 367–377.

SAUERLAND, D. (2003), Gesundheitspolitik in Deutschland, Reformbedarf und Entwicklungsperspektiven, 2. Aufl., Gütersloh.

SCHAEFFER, D. (2006), Bedarf an Patienteninformationen über das Krankenhaus. Eine Literaturanalyse, Bertelsmann Stiftung (Hrsg.), Gütersloh, in: http://www.bertelsmann-stiftung.de/bst/de/media/xcms_bst_dms_20030_20031_2.pdf. [abgerufen: 28.11.2007].

SCOTT, I.A. AND M. WARD (2006), Public Reporting of Hospital Outcomes Based on Administrative Data: Risks and Opportunities, in: The Medical Journal of Australia, Vol. 184, pp. 571–575.

SCHNEIDER, E.C. AND A.M. EPSTEIN (1996), Influence of Cardiac-Surgery Performance Reports on Referral Practices and Access to Care. A Survey of Cardiovascular Specialists, in: New England Journal of Medicine, Vol. 335, pp. 251–256.

SCHNEIDER, E.C. AND A.M. EPSTEIN (1998), Use of public performance reports: a survey of patients undergoing cardiac surgery, in: The Journal of the American Medical Association , Vol. 279, pp. 1638–1642.

SCHWARTZ, L.M., WOLOSHIN, S. AND J.D. BIRKEMEYER (2005), How do elderly patients decide where to go for major surgery? Telephone interview survey, in: British Medical Journal, Vol. 331, p. 821.

SICILIANI, L. AND S. MARTIN (2007), The Impact of Choice on Waiting Times, in: Health Economics, Vol. 16, pp. 763–779.

TAI, W.C., F.W. PORELL AND E.K. ADAMS (2004), Hospital choice of rural Medicare beneficiaries: patient, hospital attributes, and the patient physician relationship, in: Health Services Research, Vol. 39, pp. 1903–1922.

VARKEVISSER, M. AND S. VAN DER GEEST (2007), Why do patients bypass the nearest hospital? An empirical analysis for orthopaedics care and neurosurgery in the Netherlands, in: The European Journal of Health Economics, Vol. 8, pp. 287–295.

WOOLDRIDGE, J.M. (2002), Econometric Analysis of Cross-Section and Panel Data, Cambridge.

WEDIG, G.J. AND M. TAI-SEALE (2002), The Effect of Report Cards on Consumer Choice in the Health Insurance Market.", in: Journal of Health Economics, Vol. 21, pp. 1031–1048.