Equality of surgical fee schedule in Japan: a retrospective observational study

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Research Article

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Abstract

Background

The purpose of this study is to examine how the degree of inequality of Japanese surgical fee schedule changed during the study period by applying Gini coefficients for efficiency scores computed from data envelopment analysis.

Methods

All the surgeries that were performed in the main operating rooms of Teikyo University Hospital in 2013-18 were candidates used for the analysis of efficiency and equality of fee schedule. The decision making unit was defined as a surgeon with the highest academic rank in the surgery. Inputs were defined as (1) the number of assistants, and (2) the duration of operation. An output was defined as the surgical fee that was charged for reimbursement. Each surgeon's efficiency score was calculated using data envelopment analysis. Using the medians of efficiency scores in each surgical specialty, the authors inferred Gini coefficients and their standard errors in each year and in each surgical fee schedule by the Bootstrap methods.

Results

The authors analyzed 16,307 surgical procedures during the study period of 2013-18. There was no statistically significant difference in the Gini coefficients between the years and between the surgical fee schedules ($p > 0.05$).

Conclusions

The authors demonstrated that the degree of inequality of Japanese surgical fee schedule remained constant from 2013 through 2018.

Introduction

We previously reported three studies that evaluated the Japanese surgical fee schedule in terms of resource utilization using data envelopment analysis (DEA) [1–3]. We demonstrated that the Japanese surgical fee schedule failed to reflect resource utilization and was unequal among surgical specialties in spite of its biannual revisions in 2014 and 2016 [1–3]. However, we did not study how the degree of inequality changed during the study periods.

The fee schedule has a great impact on clinical quality and practice of surgery throughout Japan. Therefore, it is essential to evaluate its equality among surgical specialties. The Japanese people have been covered by the universal health insurance for over sixty years [4]. The surgical procedures have currently been reimbursed on a fee-for-service basis in Japan. The surgeries covered and the fees set for surgery have been uniform across the nation [4]. This nation-wide uniform fee schedule has been revised biannually in the central council. Japan is the largest economy in the world with the nation-wide controlled price system for healthcare [5]. In terms of the economic scale and the population size covered, the equality of this fee schedule greatly influences the quality and provisions of health services by physicians and surgeons.

DEA is a methodology for quantitative assessment of efficiency that assesses multiple inputs and outputs simultaneously. Its principal methods are to evaluate outputs while controlling the amount of inputs (i.e. resources), or to evaluate inputs while controlling the amount of outputs [6, 7]. We can evaluate the equality of the fee schedule in relation to healthcare resources utilization by comparing the efficiency scores [1–3]. If the surgical fee schedule were perfectly fair and equal in relation to resources utilization for all surgeries, all surgeons would be located on the efficiency frontier, and all their efficiency scores would be one. However, no study has ever used DEA to evaluate the equality of Japanese fee schedule except our previous ones [1–3].

The Gini coefficient is an index for the degree of inequality in the distribution of income and wealth. It is extremely relevant and widely used in a number of fields of practice and research such as economics, statistics, medicine, and so on. The success of Gini coefficient depends on its ease of interpretation due to its intuitive graphical relation with Lorenz curve [8–10]. The purpose of this study is to apply Gini coefficients for efficiency scores computed from DEA, and to examine how the degree of inequality of surgical fee schedule changed during the study period by using actual data.

Materials And Methods

This study was approved both by the Teikyo University Institutional Review Board (IRB No. 12-030-3) and by the Teikyo University Committee on Conflict of Interest (TU-COI 12–201). We conducted the present research in accordance with the guidelines set by the Ethical Principles for Medical Research Involving Human Subjects in DECLARATION OF HELSINKI. The consent to participate was waived because our present study was a retrospective observational study. The need for consent was waived by the Teikyo University Institutional Review Board (IRB No. 12-030-3) as above. Since the present study is based on our three previous ones, we intentionally used the similar methods in data collection and analysis framework to those described in our previous ones [1–3].

Data collection

We collected data from all the surgical procedures performed in the main operating rooms of Teikyo University Hospital from April 1 through September 30 in 2013-18. Teikyo University Hospital is located in metropolitan Tokyo, Japan, serving a population of ~ 1,000,000. It has 1,152 beds and has a surgical volume of approximately 9,000 cases annually. The necessary information for the present study was extracted from surgical records in its electronic medical record system [1–3].

Exclusion criteria for surgery were similar to our previous studies [1–3]. First, we excluded surgical procedures performed under local anesthesia by surgeons to equalize resource utilization. Second, oral, dermatologic and ophthalmic surgical procedures were excluded because most of their cases were minor surgeries. Third, the surgical procedures were excluded if the patients die within one month after surgery to maintain a constant quality outcome of surgery. Fourth, the surgical procedures which were not reimbursed under the surgical fee schedule were excluded. Fifth, the surgical procedures were excluded if their records were incomplete for any reason [1–3].

Analysis framework

Similar to our previous studies [1–3], output-oriented Charnes-Cooper-Rhodes model of DEA was used. This model was particularly relevant because of its ability to employ multiple inputs and outputs [11]. It can be applied for evaluating outputs while controlling multiple inputs (i.e. resources). In this analysis, we focused on the surgeons' activity and their clinical decision as we did in our previous studies [1–3]. A decision making unit (DMU) is defined as the entity that is regarded as responsible for converting inputs into outputs in DEA [12]. We defined in this study the DMU as a surgeon with the highest academic rank that scrubbed in the surgery. All the inputs and output are under the control of a DMU. Inputs were defined as (1) the number of medical doctors who assisted surgery (assistants), and (2) the time of surgical operation from skin incision to skin closure (surgical time). We defined the output as the surgical fee for each surgery [1–3]. It is classified as K000- K915 in the Japanese surgical fee schedule and is called "K codes." Each surgical procedure is assigned to one of the K codes which correspond with surgical fees [13–16].

Japan has maintained universal health insurance system for more than half a century. Most health care providers are reimbursed on a fee-for-service basis according to the fee schedule that set prices uniformly at the national level [4]. This fee schedule is revised every two years at the Central Social Insurance Medical Council [13–16]. Our study periods represented four surgical fee schedules because the fee schedule was revised in Japan on April 1st of 2014, 2016 and 2018. We also compiled the data in four periods; 2013; 2014/2015; 2016/2017; 2018.

We added all the inputs and outputs of the surgical procedures for each DMU during the study period in each year and in each surgical fee schedule, and calculated his/her efficiency scores using DEA-Solver-Pro Software (Saitech, Inc., Tokyo, Japan) [17]. The efficiency scores must take a value greater than zero and less than or equal to one, and the most efficient surgeons are given the score of 1 [6].

All the surgeons analyzed were members of one of the following ten surgical specialties; cardiovascular surgery, emergency surgery, general surgery, neurosurgery, obstetrics & gynecology, orthopedics, otolaryngology, plastic surgery, thoracic surgery and urology [1–3]. We compiled their efficiency scores in their surgical specialties in each year and in each surgical fee schedule. By comparing the median efficiency scores of surgical specialties, we inferred Gini coefficients. We inferred Gini coefficients and their standard errors in each year of the median of efficiency scores in each surgical specialty using Bootstrap methods [10].The Gini coefficients all lie between 0 and 1, and the most equal distribution of efficiency scores are given the Gini coefficient of 0.

Statistical analysis

We used Stata Data Analysis and Statistical Software (Stata 14, StataCorp LP, College Station, Texas, U.S.A.) for our statistical analysis. We compared the Gini coefficients between the years and between the surgical fee schedules using the methods described by Davidson [10]. Briefly, if the independent samples are drawn from two populations by Bootstrap methods, they are assumed to distribute normally. Therefore, the Gini coefficients were compared by one way analysis of variance. A p-value < 0.05 was considered statistically significant.

Results

We analyzed 16,307 surgical procedures during the 42-month study period from 2013 through 2018. The numbers of surgeons and surgical procedures analyzed in this study were stable over the study periods (Table 1).

Table 1
Demographic data

Year	DMUs	Surgical Cases
2013	144	2873
2014	137	2825
2015	147	2577
2016	138	2567
2017	130	2678
2018	129	2787

Characteristics of the sample in each year. DMU represents a number of decision making units who are the senior surgeons.

Figure 1 showed the change in Gini coefficients by year. The bar graphs and error bars represented inferred Gini coefficients and their standard errors, respectively. The Gini coefficients ranged from 0.231 to 0.312. There was no statistically significant difference between the years ($p > 0.05$).

Figure 2 showed the change in Gini coefficients by surgical fee schedule. The bar graphs and error bars represented inferred Gini coefficients and their standard errors, respectively. The Gini coefficients ranged from 0.235 to 0.310. There was no statistically significant difference between the surgical fee schedules ($p > 0.05$)

Discussion

We demonstrated that the degree of inequality did not significantly change during the study periods of 2013–2018 despite three revisions of surgical fee schedules. This means that the Japanese surgical fee schedules remain unequal among surgical specialties in terms of resource utilization; surgeries that utilize a large amount of resources have not been reimbursed highly accordingly since 2013. In addition, our previous three studies demonstrated statistically significant differences in efficiency scores among surgical specialties [1–3].

It is unclear which cost components are covered by the surgical fees [18]. This lack of details gives surgeons the impression that the fee schedule is unfair. In fact, it is uncertain whether the prices are appropriate or not [18]. Although it is expected that the revision will correct the inequality of the fee schedules, there are no follow-up studies that have quantitatively examined the current Japanese surgical payment system from the viewpoint of resource utilization. This is the first study that demonstrated that the degree of inequality in surgical fee schedules remained constant from 2013 through 2018.

This study has several limitations. First, this study was conducted in a single large teaching medical center in Tokyo, Japan. The surgeons studied in this research may not be representative of those in other hospitals. However, there is an advantage to conducting a research in a single hospital. One of the significant resource inputs that may affect surgeons' efficiency scores is ancillary services. The surgeons in the same hospital all face the same systemic advantages and disadvantages of the ancillary services. Comparing surgeons in different hospitals can be misleading if some ancillary services are more efficient than others [19]. Second, it is difficult to assess an appropriate, fair fee schedule. The costs of each devices and medical supplies are available, but the prices of surgeons' clinical skill and judgment are impossible to evaluate monetarily. Even cost-plus-markup pricing may not reflect the price at the equilibrium point between supply and demand for surgery [20, 21]. The utility of the nation-wide controlled fee-for-service price may play a limited role in determining fair surgical reimbursements [2]. Therefore, the competitive market price may be the only fair and rational fee schedule [22]. Third, the inferential analysis of the Gini coefficients has been neglected for a long time because of Corrado Gini's criticism toward the statistical inference [8]. However, the methodology of estimating standard errors of the Gini coefficients using Bootstrap methods were well-established in econometrics [10], and it is widely in different fields [8]. Our methods of comparing the Gini coefficients are unusual but reliable in healthcare literature. Fourth, there is no known threshold for acceptable inequality of efficiency scores. The Gini coefficients ranged from 0.23 to 0.32, which may suggest that the distribution would be reasonably equal [9]. However, we previously demonstrated that the Japanese surgical fee schedule failed to reflect resource utilization and was unequal among surgical specialties [1–3]. The present results should be interpreted that the inequality persisted throughout our study period.

Conclusions

We demonstrated by DEA that the Japanese surgical fee schedules continue to fail to reflect resource utilization despite the revisions of surgical fee schedule since 2013. The degree of inequality remained constant from 2013 through 2018. These results might suggest that a nation-wide uniform controlled price system is unable to achieve equality in terms of resource utilization even with frequent revisions of fee schedules.

Declarations

Ethics approval and consent to participate

This study was approved both by the Teikyo University Institutional Review Board (IRB No. 12-030-3) and by the Teikyo University Committee on Conflict of Interest (TU-COI 12-201). The consent to participate was waived because our present study was a retrospective observational study. The need for consent was waived by the Teikyo University Institutional Review Board (IRB No. 12-030-3) as above.

Consent for publication

Not applicable.

Availability of data and materials

The *data* that support the findings of this study are available from the corresponding author upon reasonable request.

Competing interests

The authors declare no conflicts of interest associated with this manuscript.

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Authors' Contribution

Y.N.: Conceptualization, Methodology, Investigation, Writing- Original draft preparation, Writing-Reviewing and Editing, Project Administration

Y.W.: Data Curation, Software, Formal Analysis

H.O: Validation, Supervision

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Not applicable.

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Figures

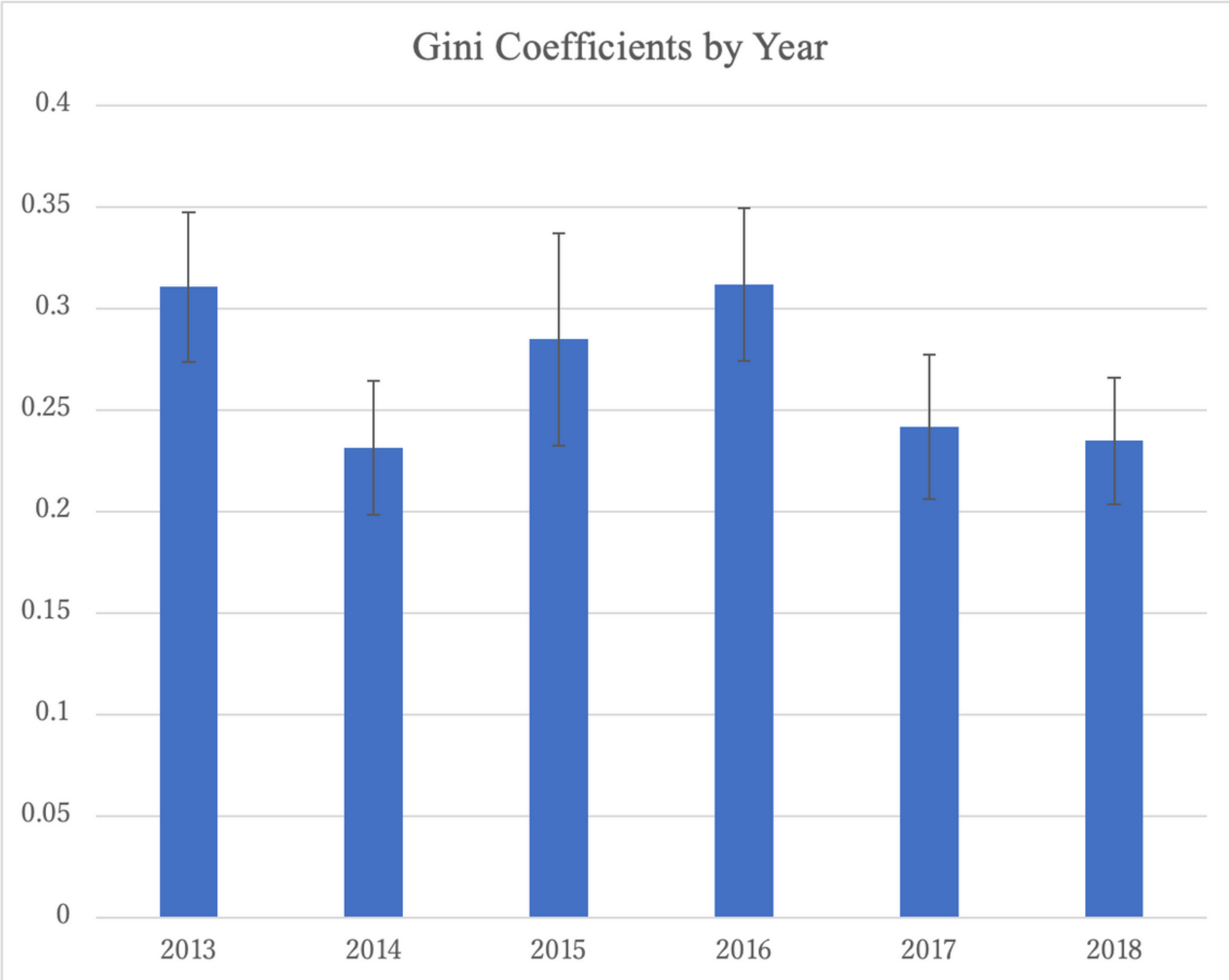

Figure 1

Gini coefficients by year. Values represent inferred Gini coefficients ± standard errors. There was no statistically significant difference between the years ($p > 0.05$).

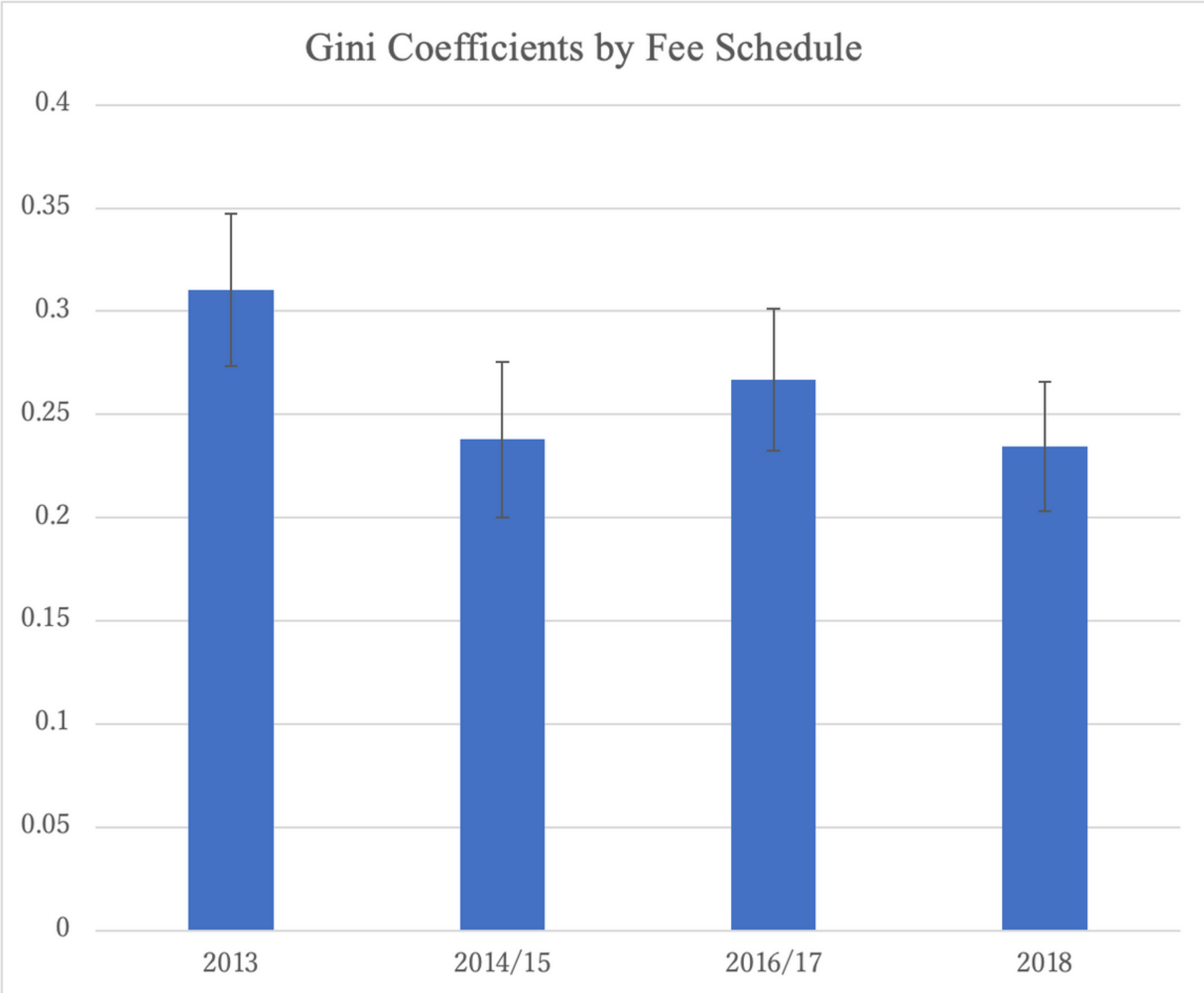

Figure 2

Gini coefficients by surgical fee schedule. Values represent inferred Gini coefficients ± standard errors. There was no statistically significant difference between the surgical fee schedules ($p > 0.05$).