Analysis of Factors Affecting Willingness to Pay for Cardiovascular Disease-Related Medical Services

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SUMMARY

Recently, application of the contingent valuation method (CVM) to health care is increasing to measure the willingness to pay (WTP) for specific medical services. In this study, we measured WTP for the outpatient treatment of hypertension and inpatient treatment of myocardial infarction (MI) in Japan’s healthcare system, using CVM via an Internet questionnaire survey in 547 citizens aged 40 to 49 years. WTP was measured with the payment cards method from an ex post consumer based perspective. The payment vehicle was out-of-pocket copayment under public medical insurance. The participants were asked their preferences with respect to medical institutions, and 3 comprehensive characteristics were extracted from the requested information by principal component analysis. Categorical regression was performed to analyze the factors affecting WTP. The mean WTP for hypertension treatment was $75.03/month, and that for the treatment of MI was $8,928.70 ($1 = 105 Japanese yen). WTP for hypertension treatment was significantly high in married males and the group without symptoms, but was not associated with income. WTP for the treatment of MI was significantly high in the high-income group, married males, and the group with symptoms. Among the 3 principle components, “objective evaluation” was significantly associated with WTP for the treatment of MI. As for serious diseases such as MI, the income-associated differences in WTP suggest the necessity for reinforcement of the safety net for the low-income group. Although asymptomatic, hypertension requires continuous treatment. For such diseases, uniformly low copayment should be established irrespective of annual income. (Int Heart J 2006; 47: 273-286)

Key words: Willingness to pay, Contingent valuation method, Hypertension, Myocardial infarction

Essential hypertension is the most common disease affecting Japanese people. A survey conducted in 2002 by the Ministry of Health, Labour, and Welfare showed that the estimated number of patients with hypertension undergoing continuous treatment is approximately 6,985,000, which accounts for about 5.5% of the total population in Japan.1) Another survey (Comprehensive Survey of Living
Conditions of the People on Health and Welfare) in 2004 showed an overall outpatient rate of 325.4 (per 1,000 population) and the highest outpatient rate for hypertension (males, 76.3; females, 85.4).2)

Hypertension is a risk factor for serious diseases such as cerebrovascular disease and ischemic heart disease. As a preventive measure against these serious diseases, blood pressure control is very important. Japan's national medical care expenditure in 2002 totaled $296.4 billion, and that for hypertension was $18.6 billion. This figure was second only to that for all malignant tumors ($21.1 billion). The expenditure for hypertension is characterized by a higher percentage for outpatient treatment (outpatient, $16.1 billion; inpatient, $2.5 billion). Total expenditure for cerebrovascular disease was $16.7 billion, and that for ischemic heart disease was $6.6 billion (exchange rate: 1 US dollar = 105 Japanese yen).3)

In Japan as in other developed countries, increasing medical expenditures accompanying the rapid aging of the population is a major political issue. In the Japanese universal health insurance system, introduced in the 1960s, patients can receive most standard medical services covered by the public insurance with copayments. Medical charges excluding copayments are covered by insurance premium and tax. To reduce governmental healthcare-related expenditures, the Japanese government increased the percentage of copayments in the employees' public medical insurance program in a stepwise manner between 1997 and 2003. At present, copayments are uniformly 30% in all patients, excluding the elderly and children.

The Japanese government has established detailed official fees for individual medical services. However, little information on the fees for medical services has been made available to the public. In general, in a free market, the prices of goods and services are known to consumers. Consumers compare quality with price and decide on the purchase of goods and services. However, the medical service market is not consistent with the principles of a free market economy. The onset of a disorder or disease is unpredictable in most cases, and the need to seek medical service occurs unexpectedly. The contents of medical services are often determined by physicians as service providers, and not by patients as consumers. It is difficult for patients to correctly evaluate the quality of a medical service before its execution, and it is also almost impossible for them to collect information on the price of a medical service before purchase.

Can consumers estimate the monetary value of a medical service? A possible applicable measure is the measurement of willingness to pay (WTP) for medical services. In recent years there has been rapid growth in the number of studies on WTP measurement for specific medical services.4-6) WTP is used as benefit in cost-benefit analysis (CBA), and its advantages and problems have been clarified.7-9) Furthermore, WTP is necessary to estimate demand for medical care in
The contingent valuation method (CVM) was developed as a method of measuring WTP. CVM was originally a method of measuring the benefits of pure public goods and services without markets, such as environmental goods. However, CVM is also applicable to quasi-public goods and services, such as medical services that are not supplied by a market mechanism based on free economics. CVM is consistent with the theoretical foundation of welfare economics. Furthermore, CVM can quantify not only health benefit, but also nonhealth benefit that consumers derive from health care programmes such as ‘reassurance value’ or ‘process utility’. WTP is used as benefit in CBA, which has a broader scope than cost effectiveness analysis (CEA). While CEA mainly addresses questions of productive efficiency with only health outcomes, CBA can address questions of allocative efficiency.

The aims of the present study were to 1) measure WTP for cardiovascular disease treatments by CVM in Japan's health care system, 2) analyze various factors affecting WTP, and 3) discuss the health policy implications of the results. We measured WTP for the outpatient treatment of hypertension, which is the most prevalent disease in Japanese people. In addition, WTP for the inpatient treatment of myocardial infarction (MI) was also measured, for which hypertension is a major risk factor. While there have been several previous reports concerning WTP for the treatment of cardiovascular diseases in Sweden and the United States, this study is the first of its kind in Japan. We regard this study as being a pilot study of WTP measurement for our future studies of cost-benefit analysis in Japan's healthcare system.

METHODS

Subjects: Males and females aged 40-49 years who live in Japan were considered to be a population for sampling. A questionnaire survey was conducted using the Internet. Cooperation was obtained from a private Internet survey company in which about 195,000 Internet users are registered. On February 22, 2005, an e-mail requesting cooperation in the questionnaire was simultaneously sent to about 1,800 males and females who had been randomly selected from the 40,000 registered users aged 40-49 years. The e-mail recipients accessed the web site for the questionnaire by themselves and directly filled in the questionnaire on the web. Over a period of 2 days, we collected 547 replies. The web page was immediately closed, and the survey was completed. The response rate was 30.4%; 547/1,800. The questionnaire was so designed so that the person could not proceed to the next question until each question was answered. Therefore, there were no samples containing missing values.


Sample characteristics: The sample characteristics included sex, marital status (married/single), household annual income, hospitalization history, enrollment in a private medical insurance program, the presence or absence of symptoms during the previous 3-month period, and visits to medical institutions when symptoms were present.

Information on medical institutions: The subjects selected information they wanted on medical institutions among the following 6 items (Multiple choices were permitted.)

- Item (1); Presence or absence of emergency/holiday medical practice
- Item (2); Fields each physician specializes in or is strong in
- Item (3); Extent of advanced medical apparatus/equipment
- Item (4); Results of treatment according to disorders
- Item (5); Rating of medical institutions by independent third parties
- Item (6); Information on the prices of medical services

Hypothetical scenarios for asking WTP: Hypertension and MI were selected as representative cardiovascular diseases. Hypothetical scenarios mentioning contraction of each disease and a description of medical service for it were presented to the subjects, and WTP for each medical service was determined from an ex post consumer based perspective. The payment vehicle was out-of-pocket copayment under public medical insurance. The subjects selected one of 7 prices using the ‘payment cards’ method. The exchange rate was set at 105 Japanese yen per US dollar.

1. Hypertension. Question: “Assume the following hypothetical situation. You had been told by a physician for the past several years that you have hypertension. You have tried to restrict your salt intake and perform mild exercise. However, since the hypertension did not improve, you visited the outpatient clinic of a hospital. As a result of further examination, the physician prescribed an antihypertensive drug and recommended continuous administration of this drug and treatment on an outpatient basis once monthly. You have no symptoms. The physician explained to you that hypertension increases the risks of ischemic heart disease and cerebrovascular disease and requires semipermanent treatment. What is the maximum are you willing to pay per month for treatment in the future?

Payment card (in US$): 40, 80, 120, 160, 200, 400, and 600

2. Myocardial infarction. Question: “Assume the following hypothetical situation. You suddenly develop severe chest pain. You were brought to a hospital by ambulance, diagnosed as having had an acute myocardial infarction, and immediately underwent life-saving treatment and emergency cardiac catheter intervention. As a result, you survived and recovered after treatment on an inpatient basis for 2 months. What is the maximum are you willing to pay for the pro-
provided medical service?

Payment card (in US dollars):
3,000, 6,000, 9,000, 15,000, 30,000, 60,000, and 90,000

Analytic methods: SPSS version 13.0 (SPSS Ltd., Chicago, US) was used for all statistical analyses. A \( P \) value < 0.05 was considered to be statistically significant.

(1) Principle component analysis of “information on medical institutions”. We totaled the number of subjects who selected each item of “information on medical institutions”. Significant components were extracted from the 6 items by principle component analysis.

(2) Comparison of the mean WTP. WTP distribution and the mean value were obtained for hypertension and MI. Next, to evaluate the possible association between WTP and “sex and marital status”, the mean WTP value was compared among 4 groups (“single males”, “married males”, “single females”, and “married females”). In addition, to evaluate the possible association between WTP and “symptoms and coping methods”, the mean WTP was compared among 3 groups (“absence of symptoms”, “presence of symptoms and visits to medical institutions”, “presence of symptoms without visits to medical institutions”). The mean WTP was also compared between the 2 groups with and without hospitalization history and between the 2 groups with and without enrollment in a private medical insurance program. Since the normality and homogeneity of the variance of WTP distribution were in doubt, the mean value was compared by the nonparametric test (the Mann-Whitney test for comparison between 2 groups and the Kruskal-Wallis test for comparison among 3 or more groups).

(3) Factors affecting WTP. Categorical regression analysis was performed using WTP as a dependent variable. Independent variables were as follows: household annual income, sex and marital status, symptoms and coping methods, hospitalization history, enrollment in a private medical insurance program, and each component obtained by principle component analysis of “information on medical institutions”. Categorical regression is useful when analyzing data containing nominal, ordinal, and interval-level independent variables. In categorical regression analysis with SPSS, the optimal scaling method is adopted, which quantifies categorical variables and then treats them as numerical variables, applying nonlinear transformations to find the best-fitting model. For nominal variables, the order of the categories is not retained but values maximizing goodness of fit are created for each category. For ordinal variables, order is retained and values maximizing goodness of fit are created. For interval variables, order is retained, as are equal distances between values.
RESULTS

Descriptive statistics: The descriptive statistics are shown in Table I. There were 301 males and 246 females. The mean annual income (± SD) was $73,309 ± 30,410. Symptoms were observed during the previous 3-month period in 464 subjects (84.8%), 186 of whom visited a medical institution. A past history of hospitalization was present in 255 subjects (46.6%) and 397 (72.6%) subjects were enrolled in private medical insurance.

Principle component analysis of “information on medical institutions”: The subjects most frequently requested information on “fields physicians specialize in and are strong in” among the 6 items (337 subjects, 61.6%) (Table II-1). Principle component analysis of the 6 items showed 3 principle components. The factor loadings of the 3 principle components are shown in Table II-2. As the first principle component (eigenvalue, 1.426), the factor loading was 0.655 for “rating of medical institutions by independent third parties” and 0.404 for “results of treatment according to disorders”. Thus, the first principle component was defined as “objective evaluation” of medical institutions based on opinions and data. As the second principle component (eigenvalue, 1.185), the factor loading was 0.817 for “fields physicians specialize in and are strong in” and 0.221 for “results of treat-

Table I. Descriptive Statistics (n = 547)

<table>
<thead>
<tr>
<th>Sex and marital status</th>
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<tbody>
<tr>
<td>Single males</td>
<td>55</td>
</tr>
<tr>
<td>Married males</td>
<td>246</td>
</tr>
<tr>
<td>Single females</td>
<td>46</td>
</tr>
<tr>
<td>Married females</td>
<td>200</td>
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<tr>
<td>Household annual income (US dollars)</td>
<td></td>
</tr>
<tr>
<td>0-10000</td>
<td>10</td>
</tr>
<tr>
<td>10,000-20,000</td>
<td>6</td>
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<tr>
<td>20,000-30,000</td>
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<tr>
<td>60,000-80,000</td>
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<td>80,000-100,000</td>
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<td>100,000-150,000</td>
<td>72</td>
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<tr>
<td>150,000+</td>
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<tr>
<td>Enrollment in private medical insurance</td>
<td></td>
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<tr>
<td>Not enrolled</td>
<td>150</td>
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<tr>
<td>Enrolled</td>
<td>397</td>
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<tr>
<td>History of hospitalization</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>292</td>
</tr>
<tr>
<td>Yes</td>
<td>255</td>
</tr>
<tr>
<td>Symptoms and coping methods</td>
<td></td>
</tr>
<tr>
<td>Absence of symptoms</td>
<td>83</td>
</tr>
<tr>
<td>Presence of symptoms and visits to medical institutions</td>
<td>186</td>
</tr>
<tr>
<td>Presence of symptoms without visits to medical institutions</td>
<td>278</td>
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</table>
ment according to disorders”. Thus, the second principle component represented “specialty” such as physicians’ treatment techniques. As the third principle component (eigenvalue, 1.099), the factor loading was 0.838 for “information on medical prices”. Thus, the third principle component was defined as “economical rationality”.

WTP statistics and analysis:

(I) Statistics according to WTP categories and comparison of the mean value. The mean WTP (± SD) for medical services for hypertension was $75.03 ± 50.88. The WTP distribution is shown in Figure 1-1. The WTP was $40 in 245 subjects (44.8%) and $80 in 199 (36.4%). The mean WTP (± SD) for medical services for MI was $8,928.70 ± $8,185.38. WTP distribution is shown in Figure 1-2.

Table III presents statistics according to the WTP categories and results of the nonparametric test. The mean WTP for hypertension was relatively high in the married males ($84.1); the Kruskal-Wallis test for comparison of the mean value among the 4 groups showed a significant difference ($P < 0.01). Concerning symptoms and coping methods, the WTP for hypertension was slightly higher for “absence of symptoms” ($P = 0.053), and that for MI was slightly lower for

<table>
<thead>
<tr>
<th>Table II. Information on Medical Institutions</th>
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<tbody>
<tr>
<td>1. Number of Subjects Who Selected Each Item</td>
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<tr>
<td>Item (1); Presence or absence of emergency/holiday medical practice</td>
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<td>Item (2); Field each physician specializes in or is strong in</td>
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<td>Item (3); Extent of advanced medical apparatuses/equipment</td>
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<td>Item (4); Results of treatment according to disorders</td>
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<td>Item (5); Rating of medical institutions by third parties</td>
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<td>Item (6); Information on prices of medical services</td>
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2. Results of Principle Component Analysis

<table>
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<tr>
<th>Factor loadings</th>
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<tr>
<td>Item (1)</td>
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<td>Item (2)</td>
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<td>Item (3)</td>
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<td>Item (4)</td>
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<td>Item (5)</td>
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<td>Item (6)</td>
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“absence of symptoms” ($P = 0.077$), however, the differences were not statistically significant.

(2) Factors affecting WTP. Categorical regression analysis was performed using WTP as a dependent variable and each basic attribute and 3 comprehensive characteristics of “information on medical institutions” (“objective evaluation”, “specialty”, and “economic rationality”) obtained by principle component analysis as independent variables.

Table IV-1 shows the result of analysis for hypertension. “Sex and marital status” and “symptoms and coping methods” were significant variables affecting WTP for hypertension ($P < 0.01$). “Married males” showed a significantly higher WTP than the other groups. The group “with symptoms” showed a significantly lower WTP than the group “without symptoms”. However, three components of “information on medical institutions” were not significant.

It is noteworthy that “household annual income” was not a significant factor
affecting WTP for hypertension ($P = 0.2243$). For further analysis, we tested the correlations between “household annual income” and 7 other independent vari-
ables. Only “enrollment in private medical insurance” had a low positive correlation with “household annual income” (Spearman’s rho = 0.137, P = 0.001). Therefore, we performed another categorical regression analysis excluding “enrollment in private medical insurance” from the independent variables. The results also revealed that “household annual income” did not affect WTP for hypertension (P = 0.2237).

Table IV-2 show variables affecting WTP for MI. “Household annual income” was a significant factor (P < 0.01), ie, WTP is, ceteris paribus, higher with higher income. “Sex and marital status” and “symptoms and coping methods” were also significant (P < 0.05). The group “with symptoms” showed a higher WTP than the group “without symptoms”, which was a result reverse to that for hypertension. Among the 3 principle components of “information on medical institutions”, “objective evaluation” was a significant factor (P < 0.01).

DISCUSSION

Advantages and disadvantages of a questionnaire survey using the Internet: As a method for conducting questionnaire surveys, the Internet survey has increasingly been used in recent years, mainly by profit-making enterprises for marketing research, and its application to scientific research has also been increasing.22) The disadvantages of an Internet survey are the uneven age distribution of Internet users, which shows a predominance of relatively young people, and the possible development of sampling errors because respondents are limited to active Internet users. In this study, to avoid an uneven age distribution of the sample population, the age of the subjects was limited to 40-49 years.

In addition, bias problems observed in other general questionnaire methods can also occur in an Internet survey. In this study, the percentage of subjects with symptoms was high (84.8%). It is conceivable that persons with symptoms were more interested in this questionnaire than those without symptoms, resulting in a high rate for the presence of symptoms. This is a self-selection bias and can also occur in questionnaires using the conventional mailing method.

The advantages of Internet questionnaire surveys are a complete data set without missing values, rapid collection of massive amounts of data, marked labor-saving with respect to data processing, and relatively low costs.

WTP for medical services: Two previous studies evaluated the WTP for antihypertensive therapy. In 1993, Johannesson and Johansson reported that the mean WTP for antihypertensive therapy was $130 (800 Swedish Kroners) per month in Sweden.16) Ramsey, et al conducted a similar survey at a staff-model health maintenance organization (HMO) in the United States, and reported a mean WTP of $93/month in 1997.18) Our study shows the relatively low WTP measurement of
$75.03/month in Japan, which was equivalent to only about 1.2% of the mean monthly income of the subjects ($6,109).

In the case in which death was avoided by emergency treatment and/or cardiac catheter intervention for MI, the mean WTP was $8,928.70. However, this WTP cannot be considered to represent the value of life. This amount represented about 12% of the mean annual income of the subjects ($73,309). Moreover, there are some problems that should be evaluated, concerning the validity and reliability of WTP measurement. First, it is possible that the WTP value seen in a hypothetical situation is lower than the payment in a real situation. Therefore, general criticisms of CVM include that WTP differs from the actual payment, and WTP is not a monetary value but only satisfaction (so-called warm glow) with the behavior of paying.

In this study, since the payment cards method was used for WTP measurement, there was also a risk of so-called range bias. In other words, it is possible that the range of choices limited replies for WTP. To avoid this problem, evaluation by other methods such as the dichotomous choice method is also necessary. The advantage of the payment cards method is its consistency with “shopping around” purchase behavior, which is visiting some shops that sell the same goods or service at different prices.

In WTP measurement, attention should be paid to strategic bias. Respondents tend to avoid replies adverse to their own benefit. In Japan, the universal health insurance system is in place and citizens strongly believe that the public sector should pay for medical services and therefore are psychologically resistant to expensive medical copayment. This may have reduced the WTP. In the hypothetical scenario of hypertension treatment presented, the expression concerning the prognosis of hypertension might have been a little ambiguous. Therefore, the occurrence of scenario misspecification bias could not be denied. To avoid this problem, further information about the rates of incidence of severe diseases and their mortality rates should be included in future studies.

Factors affecting WTP: Subjects who attach more importance to “objective evaluation” of medical institutions showed higher WTP for medical services for MI. Patients with serious diseases such as MI tend to select medical institutions that are objectively regarded as having high quality. However, such a tendency was not observed for medical services for hypertension.

There is one simple proposition (‘construct’) from economic theory: most goods have a positive income elasticity, meaning, ceteris paribus, higher income is associated with higher WTP. Construct validity should be tested in WTP studies. The logic of construct validation is to determine whether the empirical data are consistent with the theoretical construct. Two studies measured WTP for the treatment of ischemic heart disease, showing relatively low WTP in patients with
low income.\textsuperscript{17,19} The results of the present study were consistent with both the theoretical construct and the results of the previous studies. However, in this study, WTP for hypertension treatment was not significantly affected by income. This may be because the values of WTP themselves indicated by the subjects were relatively low.

These results may have the following medical policy implications. First, the presence of income-associated differences in WTP suggests the necessity for reinforcement of the safety net for the low-income group. For serious diseases such as MI, the burden of the low-income group should be further reduced. In Japan, when copayment for inpatient medical services for 1 month exceeds a certain level, the exceeded portion is paid back to the patient. The limit of the copayment for 1 month differs according to income. In patients aged < 70 years, the limit is generally $689 (72,300 Japanese yen) or more, but $1,331 (139,800 yen) or more in those with a high income and $337 (35,400 yen) or more in those with a low income (exchange rate: 1 US$ = 105 Japanese yen). Such a policy is consistent with the policy implications obtained in this study.

In the treatment of MI, there are no alternative services, and people can readily understand that irreversible sequelae or death may occur unless they receive medical attention. Even if the price of a medical service increases, exceeding WTP, demand may not necessarily decrease. In other words, the price of the medical service for MI is thought to be inelastic. In this study, mean WTP for MI with 2 months hospitalization was about $8,929, which is much higher than the actual amount of copayment ($674, $1,378, or $2,662). However, it is not appropriate to conclude that the actual amount of copayment should be increased based only on these results. Public prices for health services should be determined by taking into consideration various attributes, such as the accounted costs of health services, income level of the nation, financial status of the government, and so forth.

There are also few alternative services for the treatment of hypertension. However, hypertension is mostly asymptomatic, and a patient's awareness of the disease tends to decrease. Therefore, patients themselves may infrequently seek medical care, and even if they seek medical care, continuation of treatment may be relatively difficult. If the price of a medical service exceeds WTP, demand may decrease. In other words, the price of medical service for hypertension is thought to be relatively elastic. It is possible that the feeling of burden associated with copayment may reduce the care-seeking rate. This might increase the potential prevalence of hypertension, resulting in an increase in the incidence of ischemic heart disease and cerebrovascular disease in the future. For diseases such as hypertension that are asymptomatic but are risk factors for serious diseases and require continuous treatment, it is appropriate to establish a uniformly low price
for the medical service irrespective of income.

REFERENCES


