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Analysis on the Causes for Increase/ Decrease in Health Care Expenditures

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Chapter 1

Introduction

1 Introduction

Since the launch of its national health insurance scheme, Korea has embraced 'protection expansion' and 'financial stabilization' as its primary goals and made continuous efforts to create solutions. However, like two sides of a coin, increasing protection and reinforcing financial stability are deemed incompatible and inevitably trigger a vicious cycle: more protection leads to financial troubles and vice versa. For example in 2000, the government's policy to strengthen protection, which had been in place since 1995, brought about the national health insurance system's worst financial crisis, despite the consolidation of the national health service and the separation of prescribing and dispensing drugs. To overcome the crisis, in 2001, the government implemented stringent reform measures, which helped secure financial stability after 2004.

However, amid the accrual of reserve following financial stabilizing efforts started in 2005, combined with growing public opinions for better protection, the government changed its course to increase protection, resulting in fiscal deficits in the national health care scheme in 2006, 2007, 2009 and 2010. Although it turned to surplus in 2011 and 2012, devising new measures for financial stabilization is considered urgent amid

the current financial outlook of potential mid- and long-term financial hardship in the system.

In light of the recent drop in the growth of medical expenses from 2011 to 2013, an in-depth analysis is required to see if such a trend is a temporary phenomenon caused by the economic slump or if it will likely continue going forward. A few hypotheses can be drawn regarding the most recent deceleration in medical costs growth as outlined below:

First, a temporary decline in health care expenditure growth can be detected thanks to the government policies taken. Falling pharmaceutical spending has contributed to lowering medical expenses by 908.6 billion won for six months, between April and September, cutting back the National Health Insurance Corporation (NHIC)'s contribution by 636 billion won. The medical bill for pharmacy was down 2.49% in 2012 on the heels of the falling medicine costs, with the amount of treatment per visit day relating to drug cost decreased by 5.94%. The shrinking pharmaceutical pricing also affected hospitalization by sending the treatment amount per visit day down 1.98%.

Second, the growth of medical costs may slow down due to seasonal factors. For instance, it was observed that the population suffered from yellow dust for a total of 15 days in 2012, which was 10 days less than the preceding year (2011), which had a total of 25 days. The intensity thereof has also weakened,

suggesting lower risk of acute illness including asthma.

Third, proper review is required to check if the impact of rising income on medical expenses continues to increase linearly from the socio-economic perspective. The effect of higher income on medical cost is not boundless but can possibly decline after reaching a certain threshold. As such, it calls for sufficient review.

Fourth, the impact of healthy aging on medical spending should be examined from a demographical standpoint. It is true that the aging population mainly drives a surge in medical cost. However, the latest statistical data released by the NHIC reveals that the increase in medical bills for people in their 50s and 60s is slowing down. We think that this is likely caused by healthy aging trends, which needs to be verified.

Fifth, a study should be conducted on how the rise in health management among people with chronic diseases affects medical spending in terms of disease-causing agents. Although the absolute number of people suffering from chronic illnesses continues to climb, the medical bill per capita has recently shown signs of a modest decline. Specifically, circulatory and endocrine diseases including high blood pressure and diabetes decreased by 3.5% and 10.2%, respectively. Further analysis is required if such trends are likely to be sustained going forward.

Sixth, improving the level of hygiene should also be reviewed in terms of trigger factors. Since the onset of H1N1 flu in 2010,

the importance of hand sanitation has been emphasized, boosting a sense of hygiene and thus reducing the risk of an outbreak or epidemic For instance, highly contagious eye and adnexa disorders declined 3.0% in 2012, 4.6% lower than the average growth of 1.6%. Additionally, higher educational levels have helped boost the awareness for hygiene, pushing the number of diseases easily detectable in the underdeveloped countries down.

Seventh, an analysis should be performed to see if the growing interest in maintaining and investing in good health in terms of health behaviors, which gives rise to elevated health status can possibly reduce the use of medical services.

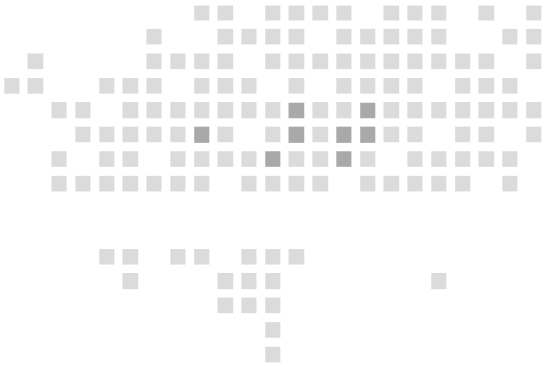
Eighth, advanced health care technologies may cause medical costs to rise. The development of health care can lead to over-diagnosing, likely pushing medical bills upward. A case in point is the soaring number of early diagnoses for thyroid cancer, which showed a tenfold increase over the past 10 years in the number of patients, as well as carcinoma in situ, widely known as 'stage-0 cancer'.

In the past, many studies were carried out to analyze what drives the rise or fall in medical spending. However, a majority of them managed to present only fragmentary outcomes, falling short of providing mid- and long-term solutions. As such, an analysis for the existing cost drivers should be executed with an overall review on the driving forces behind the recent sluggish

growth. Meanwhile, in order to deal with the recurring fiscal crises facing the national health insurance system, it is crucial to find not a temporary fix but a long-term solution for fiscal stabilization of the scheme. To this end, the status of the medical cost structure and the drivers of cost change must be precisely examined before anything else.

In an attempt to ensure fiscal stability in the national health plan, many policies were pursued in the past that put a restraint on medical spendings for a short period of time. Given the recent slow growth in medical expenditure, it is imperative not to take a short-term approach but to seek ways to achieve a win-win outcome that will bring mid- and long-term benefits to suppliers and ensure fiscal stability. Particularly, developing a broad view of medical expenditure management is considered vital to not only making progress in the aspects of supplier, consumer and institution for the short run, but also in setting mid- and long-term goals for fiscal spending.

The study herein conducts 'person panel analysis' and 'aggregate time-series analysis' by utilizing the NHIC data to identify the drivers behind the growth of medical costs and make mid- and long-term health care cost projections, thereby developing a formula to determine target medical cost for the establish ment of a 'Targeted Healthcare Expenditure' framework while setting for the comprehensive solution for medical expenses management.



Chapter 2

Preceding Studies

1. The Causes for Increase/Decrease from the Consumer Perspective
2. The Causes for Increase/Decrease from the Supplier Perspective

2 Preceding Studies

1. The Causes for Increase/Decrease from the Consumer Perspective

1) Aging Population

When considering population aspects, the primary focus is placed on aging rather than the number of subjects. As aging of the population has accelerated in Korea, people who are 65 years old or older accounted for 7.2% of the total population in 2000, marking entry into an aging society. It is predicted that Korea will likely be part of the aged society in 2017 (14.0%) and the super-aged society in 2026 (20.8%).

Hyunchol Shin and Miyoung Choi (2012) conducted an analysis on the degree of contribution of each driver for average annual growth rate of medical cost in the national health insurance system from 2003 to 2009. Despite the failure to reflect the rising demand prompted by price flexibility, they managed to reveal that aging contributes to 13.8% of the medical spending hike. Yet, a detailed analysis is needed as the medical expenses incurred by the elderly, in reality, take up as high as 30.5% of gross medical expenditure.

According to Hyunwoong Shin (2013), although it is true that the aging population drives the increase in medical costs, such a pace has recently slowed down among seniors in their 50s and 60s, indicative of healthy aging trends gaining ground. Yet, the medical cost of those aged 80 or above has continued to soar, serving as one of the key drivers.

As seen above, a different set of criteria should be applied to the elderly. In light of the current varying medical expenditure by age, a detailed analysis into the aging of population is deemed imperative.

Reinhardt U.E. (2003) has rebutted the existing hypothesis that aging boosts the demand for health care service, thus serving as a major contributor to a surge in the entire medical expenses of a country, by tapping into previous studies and data of medical expenditure panel surveys (MEPS). The report has claimed that the following aspects rather than aging itself are considered key drivers behind soaring medical costs: an increase in per capita income, advancing medical technology, rising costs triggered by the shortage of medical staff, asymmetrical distribution of market power from suppliers' standpoint, etc.

Similarly, there exists another survey indicative of no meaningful correlation between aging and medical expense increase. Zweifel P. et al. (2004) argued that there existed no empirical evidence for any meaningful correlation between the surging

medical spending of a nation and the phenomenon of aging, citing the outcome of Getzen's (1992) and Barros' (1998) analyses, in which OECD country-by-country data was utilized. The survey found that age-related variables had a meaningful effect on the health care expenditure of survivors, though the impact of age on the total medical cost appeared substantially smaller after controlling for time of death. The author claimed that the failure of the previous studies to include death-related costs resulted in overstating the aging factor as a determinant of escalating future medical spending.

Such findings, that aging has no significant bearing on medical spending, are also shared by a 2007 report published by the U.S. Congressional Research Service. The study concluded that although it is true that the aging population and high per capita medical cost of the elderly contribute to pushing national medical expenses upward, aging however isn't considered a major determinant. According to the statistics, it is found that health care spending outpaces aging and that not only seniors of 65 years old or older but also all other age brackets show the same pace of growth in medical spending. It went on to say that aging carries less significance in shoring up medical costs than other factors including rising income, advanced medical facility and service, scope of protection, characteristics of health coverage scheme, etc.

Cutler D.M. et al. (1998) discussed that future medical spend-

ing would differ by not simply being driven by aging, but based on the health conditions of the elderly (not visible), advancement of medical science and its potential usage, and the way that the health care service market is organized. In the study, the implications of a change in the health status of seniors for medical costs were examined. Consequently, it was found that the change of health status of people (health promotion) worked to keep future medical spending growth in check. Moreover, the author stressed that there was no meaningful correlation detected between overall medical spending increase and medical costs spent by a particular age group, provided, however, that the sophisticated health service might affect medical expenditure differently according to each age bracket.

2) Healthy Aging

J.O. Martins (2006) offered a framework to make cost projections in areas of health care and long-term care among public health care spending for the period between 2025 and 2050 for OECD countries. In the study, he looked at health care cost drivers from demographic and non-demographic perspectives. To set it apart from existing studies, he incorporated the death-related costs and the health status of population group into demographic factors while having income level, technological trends, and relative pricing included in non-demo-

graphic factors.

For demographic factors in the area of health care, the increasing ratio of senior population would cause medical spending to rise. However, it is predicted that the average amount of medical expenses will decline for each individual within the elderly group with the passage of time. The rationale behind this is as follows: First, 'longevity' represents 'healthy old age'. Second, as major medical spending typically occurs right before death, those leading a healthy elderly life are to be excluded from the target senior population, ultimately sending the average medical cost down.

The percentage of demographic factors in health care expenditure varies from country to country, as Sweden and Korea, after adjusting for 'healthy old life', marked 0% and 1.6%, respectively. In terms of demographic factors under the category of long-term care, the reliance on long-term care would also increase amid the expanding senior population. But, as stated above, the impact will likely be eased, to a certain degree, by the effect of a 'healthy elderly life'. Meanwhile, the study maintains that as far as non-demographic factors in the field of health care are concerned, medical spending generally outstrips income growth because of new medical treatments and the associated costs.

Overall, under a "cost-pressure" scenario, the OECD member countries will likely see their average health care and long-term

care spending almost double from 6.7% in 2005 to 12.8% in 2050; whereas, according to a "cost-containment" scenario, it will hover at 10% in 2050. Meanwhile, it is analyzed that the non-demographic aspects (including the advancement of medical science and the associated costs) of long-term care expenditure constitute a key component, as they have a meaningful effect on the surge in total health care cost.

Additionally, Christine et al. (2013) has also factored in death-related costs and the healthy aging hypothesis to estimate medical expenses. In an effort to add the concept of 'healthy aging' into the analysis, she moved the medical cost curve of survivors (as opposed to non-survivors who are facing imminent death) to the right as life expectancy improves, while gradually delaying the increase in medical spending aligned with age before making any estimation. Specifically, the medical cost projection was made under the assumption that, for example, the current health status of a 70-year-old German equals to that of a 67-year-old man in 2025 and a 64-year-old in 2050.

Sungmi Gang et al. (2009) described that one of the main variables used in relation to medical cost projections was the rising number of an aging population, yet claimed that the surge in aging population didn't necessarily lead to the soaring medical costs. In this study, 'healthy aging' and 'death-related costs' were employed for the estimation of public medical

spending in 2050 with relevant drivers classified into demographic and non-demographic aspects. Upon analysis, it was found that the existing OECD research for public medical cost projection (2006) overestimated Korea's future medical spending, and that all OECD countries would benefit with cost savings amounting to 0.8% of the GDP from healthy aging.

3) Income

The existing studies with regard to income and medical expenses maintain that higher income is bound to elevate the demand for medical services. However, as the growth of income is generally outpaced by the increase of medical spending, many countries have witnessed their portion of medical expenses strengthening against their GDP.

YoungHoh Jung et al. (2000) launched an empirical analysis by utilizing national health care cost estimations and OECD country-specific data in order to define the characteristics of public health care expenditure as well as the causes for rising medical expenses. Their findings are outlined as follows: The nominal health care expenditure elasticity of Korea stands at 1.11 against nominal GDP. Compared to real GDP, the elasticity marked 1.53. In both cases, Korea yielded return values of 1 or above. Besides these, both nominal and real health expenditure elasticity per capita recorded 1.12 and 1.62, re-

spectively, compared to each respective nominal and real GDP per capita, thus supporting the outcomes of the previous studies.

Sangsub Cho and Byungwun Kim (2003) meanwhile conducted an empirical analysis for the elasticity of medical spending in relation to the national income level. The data of 20 OECD countries during the period 1970 to 1997 was utilized. The implementation of a fixed OLS model yielded 1.61 for the impact of national income on medical expenditure. However, employing FM-OLS and DOLS models returned 0.962 and 0.967, respectively, for the elasticity of national income affecting medical spending.

Przywara B. (2010) predicted that the effect of income level on health expenditure would increase by an average of 2.3% against GDP. However, he claims that the advancement of medical science allows the amount of impact to be projected at a 6.3% increment for the same period, indicating that it is three times more powerful than demographic change.

That being said, as both positive and negative correlations involving income elasticity have been observed, not to mention some discrepancies from the preceding studies in terms of the size thereof, it is believed that further analysis is required.

4) Detriments to Health

Lately, medical expenses in national health service are on the rise due to health threats such as smoking, drinking, obesity, etc. France has even gone so far as to charge extra premiums for health detriments, testifying to the growing interest in health risk factors.

Seonmi Lee (2012) conducted a survey targeted at people coming in for regular check-ups between 2001 and 2011. With the introduction of a long-term cohort study encompassing the qualifications of national health insurance, medical usage, and health checkup data, she examined medical spending within the national health plan caused by health risk factors. By category, 1.0512 trillion won in expenses were incurred in 2007 due to smoking, which grew by 48.7% to 1.5633 trillion won in 2011. Drinking accounted for 1.7057 trillion won of health expenditure in 2007 with a whopping 42.68% jump in 2011 to 2.4336 trillion won. The amount of health care costs arising from excessive weight (i.e. overweight, obesity) recorded 1.8971 trillion won in 2007, which then jumped by 41.89% to total 2.6919 trillion won in 2011.

Eunjung Han (2011), meanwhile, reviewed the health trends of Korean people by leveraging 2009 Korea Health Panel (KHP) data. A close analysis revealed that men in their 30s show the highest smoking rate as of 2009, with rates continuing to de-

cline among those aged 50 years old or older. Also, high-risk female drinkers peaked in their 30s before dwindling. Based on health behavior indices relating to smoking and drinking, a low-risk group and a high-risk group were identified. Upon analysis of the subjective health status of each group, quality of life, and nature of medical services used, it was found that the average age of the high-risk group (46.5 years old) was lower than the low-risk group. Also, their average medical fees spent appeared lower than average. Additionally, it was analyzed that the segment of people who 'stopped smoking while staying sober over the past 1 year' exhibited older age, lower annual household income, and higher yearly medical expenses, when compared to both high-risk and low-risk groups. This can be suggestive of the likelihood that the members of such a segment may suffer health problems or illnesses, resulting in high medical spending and a behavioral change by giving up smoking and drinking.

However, the study above contains its own limitations in that conducting a time-series analysis is impossible due to the short history of the health panel survey. Nevertheless, it allows us to recognize the recent trends that the awareness of good health is gaining ground, prompting more investment in that direction. As such, it is essential to take these factors (i.e. behavioral changes as part of health promotion) into consideration when determining variables affecting future medical costs.

5) An Increase in the Number of Eligible People

Now, we would like to look into how the rise in the number of eligible people covered by the national health plan affects health care expenditure. In discussion of the implications of a surge in the number of insured for medical spending, Hyunchol Shin and Miyoung Choi (2012) stated that although it was true that the rising population inevitably led to higher health care costs, it however shouldn't be overlooked that many were pulled out of Medical Aid and placed into the national health insurance scheme in 2008 and 2009.

In 2008, Medical Aid Class 1 diminished by 3.52%, while Medical Aid Class 2 witnessed a drastic fall (21.50%) in 2009. Given that a big drop was observed in Medical Aid Class 2 during 2009, the year characterized by the largest sign-up rate over the past five years, we can safely assume that the transition of Medical Aid beneficiaries to the national health regime has definitely taken its toll.

Meanwhile, Kyungrae Hyun et al. (2012) raised the need for a thorough analysis, citing the steady population growth every year and an average annual growth of below 1%, though it appears that the expansion of recipients is weighing down on health costs. The study concluded that the share of demographic contribution was enlarged by a jump in medical spending for the elderly in the midst of a growing senior population.

Youngseok Shin (1999) defined the number of eligible people as one of the determining factors for the sizing of medical costs, yet more focus was placed on analyzing the age-based distribution of beneficiaries rather than the absolute number of the population. As there is no mechanism available to allow disease-inducing risk factors to be quantified on an individual basis, the study embraced 'age' as an explanatory variable in determining the probability of disease and the size of health expenditure.

According to Przywara B. (2010), the effect of demographic change on medical spending will likely increase within a range of 0.7% and 3.8% (1.9% on average) compared to the GDP in 27 European countries during the period 2007 to 2060, whereas, as for health status, the effect will likely fall within the range of 0.3% (12 EU member states) and 0.8% (15 EU member states) against GDP during the same period.

2. The Causes for Increase/Decrease from the Supplier Perspective

1) Supplier-Induced Demand

The attraction of consumers by health care service providers is considered one of the main drivers that determine the sizing of medical cost. As long as service providers hold a monopo-

listic power, supplier induced demand (SID) is considered inevitable. Health economics has recently provided some ground for SID as it drives health spending. Consequently, it is now being regarded as one of the major issues. The concept of SID originated from Shain and Romer (1959). Specifically, given a strong correlation observed between the number of beds per 1,000 population and length of stay, it appears that doctors are inducing patients' demand for health services.

Based on the definition of Feldstein (2004), SID involves changing the volume of care offered by doctors in favor of the doctor's personal economic gain. Finding empirical evidence for SID is difficult, yet it is necessary in order to develop health care policies. This is attributed to the fact that proper compensation for service providers prevents unnecessary expenses from occurring while simultaneously helping boost the public's health.

Although Christel E. Van Dijk et al. (2012) admitted that it was difficult to obtain solid evidence that the rising medical expenses were spurred by moral hazards and SID, the study, however, did recognize the need for research to come up with health-promoting policies.

Romer's law (1961) stated, "Hospitals, once provided, tend to be used." This suggests that the rising use of medical services amid the expansion of health care supply is directly tied to the surge in health expenditure. The addition of doctors or new

beds and the adoption of new sophisticated technology create demand for health care services, substantially driving up medical costs.

Arrow (1963) discussed that the level of information held by each different actor participating in the health care market tended to vary wildly, with the amount of information available to patients being the most limited.

Richardson (1981), meanwhile, defined SID as "doctors' capacity to move the demand curve of patients toward the right side regardless of whether they like it or not." As the asymmetrical ownership of data empowers doctors to shift demand curve, moving it to the left can also be perceived as SID.

Minkyung Shin (2009) claimed that doctors were at risk of acting as an unreasonable agent by providing biased information to patients since the delivery of service earned them financial gains.

According to Fuch (1978), the rate of admission soars as the number of surgeons increases per eligible patient. Such findings were also supported by Cromwell and Mitchell (1986).

Grytten et al. (1995) and Sorensen and Gytten (1999) suggested that physician density had a negative impact on the number of patients per doctor. Specifically, Grytten et al. (1995) argued that physician density positively affected medical spending per capita in a meaningful way, whereas Sorensen and Gytten (1999) maintained that it had a significant negative

effect on gross medical cost per doctor.

Additionally, Carlsen and Grytten (1998) pointed out that physician density might affect medical cost per doctor and medical cost per eligible patient differently.

Madden et al. (2005) looked into the effect on hospital visit rates after the republic of Ireland introduced a new fee system in 1989. Self-report data was used in this research. It was widely expected that since SID played a vital role prior to the change of fee system, there would be a discrepancy in hospital visit rates between those covered by the national health plan and those privately insured during the year 1987 and for the period 1995 to 2000. However, there was no difference found between the consumption tendencies of public and private policy holders.

Meanwhile, Eunhwan Oh (2000) studied how the national health insurance fee related to SID. In circumstances where the fee is controlled at 6% or below or if the rise in fee continues to decline for three straight years, the volume of service offering is presumed to expand, contributing to raising total medical expenditure by roughly 0.1-0.6%.

Changboh Kim (2002) tried to verify the hypothesis regarding the demand induced by doctors. Subsequently, it found that physician density had a positive and meaningful effect on the number of patients in the case of region-based analysis, while a negative, yet meaningful effect, was detected during the hos-

pital-level analysis.

Sunman Gwon (2006), on the other hand, claimed that the emergence of new and expensive medical equipment, medicines, and medical treatments resulted in not only promoting health and quality of life, but increasing the intensity of treatment, thereby contributing to the surge in health care costs.

As seen above, the rapid spread of medical technology is largely dependent on health care service providers rather than users. Therefore, it is crucial for government policy to focus on price regulation, overhaul of the medical fee payment system, regulation of the introduction of new medical treatments, economic feasibility research, safety controls for medical technology, etc. Furthermore, strategies are required to minimize social costs associated with the opposition of stakeholders regarding the reform of the medical fee payment or the implementation of economic feasibility research.

Munjeong Phil (2011) believed that the number of beds underlying health service supply and the number of doctors representing the induced demand contributed to driving medical expenses. As such, maintaining them at proper size is deemed vital.

As the asymmetry of information between health service providers and consumers has allowed the addition of doctors to give way to increasing medical spending, the government must endeavor to put effective policies in place to eliminate such disparity.

2) A Surge in the Number of Doctors

An analysis was conducted on the relationship between the number of doctors and medical cost (Youngseok Shin, etc. 1999). The outcome showed that the increased number of doctors facilitated market entry, giving rise to the expansion in the supply of health care services.

HakJoo Kim (2005) tried to determine the size of contribution to the increase in total medical cost from the rise in elderly population, number of doctors, and national income. Upon analysis, it was found that more doctors didn't produce a meaningful outcome in most models. This can be explained by the fact that since the number of doctors per capita remains small, neither fiercer competition driven by over-supply nor a big drop in medical demand per doctor was observed.

A sharp rise in the number of doctors is considered impossible due to the high market barrier in the form of a doctor's license. However, with the number of doctors gradually increasing, a thorough analysis is needed to assess its impact on medical expenses.

3) Other Factors

In addition to the analysis of the reasons behind soaring medical fees and recent slowing growth, Seokjun Yun (2013)

conducted a study to estimate the amount of contribution for each factor and make future medical cost projections. He argued that the surge in health expenditure was driven by the rising fee and current fee system (fee-for-service), expansion of benefit coverage and eligibility, changes in medical technology, absence of gatekeepers, low-birth and aging trends, higher income level, etc. Consumer/patient-related factors include, but are not limited to, the preference for tertiary hospitals, abuse or misuse of drugs, social admission[1], moral hazard among Medical Aid beneficiaries, disease classification and health behaviors.

Heeyoung Lee et al. (2010) has tried to seek a solution for financial stabilization by identifying medical fee drivers and thus figuring out which part of fee growth appears unnecessary. As for main content, the preceding studies were outlined and relevant factors were then defined. Also, a microscopic approach was taken to analyze the causes in terms of individual patient and health care facility (i.e. clinic, general hospital) through the utilization of national health insurance billing data. Specifically, it drew a conclusion by carrying out a linear regression analysis in order to determine the relationship between medical cost and its drivers by individual and service provider. Seniors, patients with chronic diseases, the low-in-

1) Social admission: It occurs in a circumstance where the demand of the elderly who wish to join a social welfare facility outweighs the supply of social welfare service. Social admission refers to a patient staying in a regular hospital for a long run for the purpose of health care instead of medical treatment.

come bracket, and the individually-insured were selected for individual specific factors. From a provider standpoint, the following factors were identified: number of patients, number of beds, doctor head count, number of specialized doctors, ratio of patients with liver diseases and cancer patient ratio.

Przywara B. (2010) in a survey defined demographic change, health status, morbidity and mortality rate trends, death-related costs, economic growth, income level, technological advancement, health care resources, etc. as the factors that influence health expenditure. For forecasting, it has come up with a detailed methodology on how factor-specific medical spending will likely vary within European nations during the period between 2007 and 2060.

The OECD (2009) performed an analysis on the change in health care costs among OECD countries from 1995 to 2006 in order to assess potential factors from a demand and supply perspective. Subsequently, it was found that the country-based gap in health expenditure would have relevance to income, demographic structure, and change of disease tendency (e.g. the rate of developing a cancer) for the demand side and medical technology for the supply side. In addition, the increasing number of acute care beds could boost the average length of stay. Also, since the number of doctors and nurses, their respective pay, administrative expenses, and medicine cost immensely vary from country to country, it could potentially drive

medical expenses.

Slower growth in medical spending has been observed not only in Korea but also around the world lately. According to the OECD report, all OECD countries except for Germany have experienced a decline in health expenditure growth in 2010, primarily because cuts in public health budgets, which many countries pushed forth due to the recent economic crisis. The hygienic conditions of patients and the level of livelihood have also played a significant role.

The degree of contribution by factor was measured based on the previous studies. A hike in daily medical fees, indicative of the intensity of treatment, displayed the highest contribution rate, followed by the change in the number of visit days per examinee, fee hike, and demographic structure (aging).

Fabio Pammolli et al. (2012) defined health cost drivers in European countries from 1980 to 2007 as the following five factors: abnormal economic status against GDP (Baumol's model of "unbalanced growth"), aging population, technological advancement, labor participation by women, composition of welfare system, and other public budget variables.

Regression analysis has verified that "Baumol's disease" affects health expenditure. It has also been analyzed that the level of income, labor participation by female workers, advancement of technology, and quality of health care services have implications for medical spending.

Chapter 3

Analysis Method

3 Analysis Method

1. Data Analysis

Our main focus was placed on identifying empirical evidence for the factors impacting medical cost through the utilization of the NHIC data. The period from 2002 to 2010 (9 years in total) was selected for analysis. Through the steps below, we processed individual-annual panel data to finalize analysis data.

First, the detailed medical information on invoicing label was converted to yearly data for each individual. For instance, the total medical fee per visit was compressed to annual gross medical fee specific to each individual. Detailed medical information includes care commencement date, health service provider ID code, inpatient/outpatient code, number of visit days, medical cost billed, medical cost confirmed, medical equipment fee billed and confirmed, etc.

Second, we merged the data regarding eligibility, medical treatment details, and health checkup every year from 2002 to 2010 by using individual serial number to build yearly cross-sectional data. Those without health checkup information were excluded from our final data. For eligibility data, personal demographic information, gender (social variable), date of birth, 16 cities and provinces, health insurance classi-

fication code, disability class, income class (20 levels), etc. were specified. Included in the health checkup data are height, weight, blood pressure, gross cholesterol, past or present history of chronic diseases, smoking status, drinking habit, exercise frequency, etc.

2. Study Variables

1) Dependent Variables

Medical cost, a dependent variable, represents total annual health care expenditure confirmed for each individual (self contribution + contribution paid by the insurer). Yearly total medical spending and gross medical fee by service provider (tertiary/general hospitals, other hospitals, clinics) are incorporated into analysis with total medical cost classified into in-patient and outpatient.

〈Table 1〉 and 〈Table 2〉 below outline the average medical cost and the individual-based average of total medical cost for the year, and it is found that they share similarity with the average medical fee for the entire nation. For example, Korea's gross medical fee in 2004 averaged 316,512 won (=15,204,953,000,000 won/48 million population), displaying a modest difference of 291,421 won in the analysis. Given that there will likely be no big variance in the error of margin for

the confirmed medical cost every year, as our analysis data is consistently handled by the NHIC, it can be said that the panel analysis data built for the study herein is representative of the entire nation.

As you can see from 〈Table 1〉, the panel data reveals that individual average cost during the period 2002 to 2010 stands at 437,992 won. Average annual in-patient fee was 159,192 won, whereas the average outpatient fee was 1.75 times higher at 278,800 won. By service provider, doctor's clinics came in highest with an average medical fee totaling 198,327 won, followed by tertiary hospitals (177,666 won), and other hospitals (53,980 won). Next, we grouped the type of service provider by in-patient and out-patient. We found that the average in-patient fee for each individual was at least 1.35 times higher than the out-patient fee in tertiary/general hospitals and other hospitals, while small clinics saw 88% of total fees coming from outpatient.

〈Table 1〉 Dependent Variables Used in Regression Analysis

(Unit: KRW)

Variable	Definition	Average	Standard Deviation
Total medical fee	Total health care cost confirmed (inpatient + outpatient)	437,992	1,230,722
Gross in-patient expenses	Total cost for in-patients confirmed	159,192	953,517
Gross out-patient expenses	Total cost for out-patients confirmed	278,800	607,912
Total medical fee with tertiary/general hospital	Total medical care cost with tertiary/general hospitals confirmed (inpatient + outpatient)	176,666	1,002,289
Gross in-patient expenses (Tertiary/general hospital)	Total in-patient cost with tertiary/general hospitals confirmed	101,455	821,109
Gross out-patient expenses (Tertiary/general hospital)	Total outpatient cost with tertiary/general hospitals confirmed	75,211	425,550
Total medical fee with other hospitals	Total medical cost with other hospitals confirmed (inpatient + outpatient)	53,980	383,178
Gross in-patient expenses (Other hospitals)	Total in-patient cost with other hospitals confirmed	31,853	342,567
Gross out-patient expenses (Other hospitals)	Total out-patient cost with other hospitals confirmed	22,127	121,029
Total medical fee with clinics	Total medical cost with doctor's clinics confirmed	198,327	436,226
Gross in-patient expenses (clinics)	Total in-patient cost with doctor's clinics confirmed	23,077	178,538
Gross out-patient expenses (clinics)	Total out-patient cost with doctor's clinics confirmed	175,249	380,390

Note: No information is available regarding dental hospitals/clinics, general hospitals/other hospitals/clinics specializing in Chinese medicine.

Meanwhile, 〈Table 2〉 allows us to define the medical cost trends captured in the analysis data from 2002 to 2010. According to the table, all medical expense items have increased steadily. Total medical cost jumped to 597,721 won in 2010 from an average of 229,474 won in 2002, growing 13% every year on average since 2005. The comparison of inpatient and outpatient reveals that during the period between 2005 and 2010, the average annual growth of inpatient cost was 19%,

outpacing 10% of outpatient cost growth. As for the type of medical facility, the medical fee per eligible person increased by 32%, 17%, and 7% on average for tertiary hospitals, general hospitals, and doctor's clinics, respectively.

2) Independent Variables

Independent variables included in the regression analysis model consisted of socio-demographic characteristics of each individual, chronic diseases (Y/N), health behavioral variables, and supplier behavioral variables. Leveraging the variables group, a multivariate regression analysis was first executed. Based on the return values obtained, we then proceeded to build a regression model with the most parsimonious and explanatory variables.

As described in 〈Table 3〉, socio-demographic variables encompassed age, sex, income class, and place of residence. Panel data was composed of about 16% of people aged between 55 years old and below 65 years old, 9% aged between 65 years old and below 75 years old, and finally 2.5% aged 75 years old or older. A group comprising subjects 55 years old and below was assigned as a reference. Women accounted for 55% of the sample. As you can see from average value of income class, the sample included sufficient observations for each of the 20 income levels, with the lowest income bracket defined as a refer-

ence group. For place of residence, Seoul citizens were designated as a reference group with the number of cities and provinces controlled at 15. An average of 7% of the sample suffered or has been suffering from chronic illnesses such as high blood pressure, heart disease, diabetes, or cancer in the past or present, while 11% exhibited high cholesterol levels. Health behavioral variables included smoking (Y/N), smoking duration, high-risk drinking (Y/N), exercise frequency, and body mass index (BMI). On average, 24.5% were classified as current smokers. The duration of smoking, historically or currently, was categorized as 'below 5 years', '5-10 years', '10-20 years', '20-30 years', or '30 years or above', while the control group comprised of non-smokers in the past and present. Of current or past smokers, it was discovered that around 28% had smoked for over 30 years; 10% for 10-19 years, about 6% for 20-29 years, and over 9% for less than 10 years.

Of the sample, about 32% exercised 1 or 2 days per week. Those working out 3 or more days reached roughly 30%. Meanwhile, BMI scores averaged 24.

With regard to the supplier behavioral variable, since medical technology is viewed as a major driving force behind the surging medical bill, we controlled the number of billings for high-priced CT and MRI scans.

〈Table 2〉 Dependent Variables Used in Regression Analysis (2002-2010)

(Unit: KRW)

	2002	2003	2004	2005	2006	2007	2008	2009	2010
Total medical fee	229,474	271,253	291,412	354,404	417,938	466,546	475,074	555,740	597,721
Gross in-patient cost	61,377	81,701	89,392	114,789	149,113	171,219	180,879	216,700	233,086
Gross out-patient cost	168,097	189,551	202,020	239,615	268,825	295,327	294,194	339,040	364,635
Total medical fee with tertiary/general hospitals	74,300	97,864	104,681	133,256	168,677	190,841	196,844	231,953	254,182
Gross in-patient cost (Tertiary/general hospitals)	42,671	56,130	57,954	75,831	98,052	110,772	115,330	133,257	143,993
Gross out-patient cost (Tertiary/general hospitals)	31,629	41,734	46,727	57,426	70,625	80,068	81,514	98,696	110,189
Total medical fee with other hospitals	10,490	20,021	27,143	38,146	47,035	56,337	62,255	79,640	86,902
Gross in-patient cost (Other hospitals)	6,379	11,068	14,578	20,474	26,819	32,769	36,943	48,651	52,867
Gross out-patient cost (Other hospitals)	4,111	8,953	12,565	17,672	20,216	23,568	25,312	30,989	34,035
Total medical fee with clinics	142,239	149,527	155,077	176,756	194,897	209,741	206,283	230,100	242,412
Gross in-patient cost (clinics)	12,316	14,463	16,782	18,278	23,308	25,408	25,425	28,737	29,350
Gross out-patient cost (clinics)	129,923	135,064	138,295	158,478	171,590	184,333	180,858	201,364	213,062

〈Table 3〉 Independent Variables Used in Regression Analysis

Independent Variable	Definition	Average	Standard Deviation
Age (Reference group: less than 55 years old)			
55 ~ 65 years old	1 = Those between 65 years old and below 75 years old; 0 = Others (as of Dec. 31 every year)	0.162	0.369
65 ~ 75 years old	1 = 65 years old ~ below 75 years old; 0 = Others	0.091	0.287
75 years old or older	1 = 75 years old or older; 0 = Others	0.025	0.156
Female	1 = Female; 0 = Male	0.55	0.497
Income class (Reference group: Income class 1 ~ 4)			
Class 5-8	5-8 of 20 income levels	0.16	0.367
Class 9-12	9-12 of 20 income levels	0.2	0.4
Class 13-16	13-16 of 20 income levels	0.237	0.425
Class 17-20	17-20 of 20 income levels	0.262	0.44
Area of residence (Reference group: Seoul)			
Busan	1 = Living in Busan; 0 = Others	0.083	0.276
Daegu	1 = Living in Daegu; 0 = Others	0.053	0.225
Incheon	1 = Living in Incheon; 0 = Others	0.051	0.219
Gwangju	1 = Living in Gwangju; 0 = Others	0.029	0.169
Daejon	1 = Living in Daejon; 0 = Others	0.032	0.175
Ulsan	1 = Living in Ulsan; 0 = Others	0.029	0.167
Kyunggi	1 = Living in Kyunggi Province; 0 = Others	0.193	0.395

Independent Variable	Definition	Average	Standard Deviation
Gangwon	1 = Living in Gangwon Province; 0=Others	0.031	0.174
North Chungcheng	1 = Living in North Chungcheng Province; 0 = Others	0.035	0.184
South Chungcheng	1 = Living in South Chungcheng Province; 0 = Others	0.043	0.203
North Jeolla	1 = Living in North Jeolla Province; 0 = Others	0.042	0.2
South Jeolla	1 = Living in South Jeolla Province; 0 = Others	0.046	0.209
North Kyungbuk	1 = Living in North Kyungbuk Province; 0 = Others	0.065	0.247
South Kyungbuk	1 = Living in South Kyungbuk Province; 0 = Others	0.07	0.255
Jeju Island	1 = Living on Jeju Island; 0 = Others	0.011	0.103
Disability	1 = Disabled; 0 = Not disabled	0.013	0.114
Chronic disease			
Chronic disease	1 = High blood pressure, heart disease, diabetes, or cancer in the past or present; 0 = Others	0.07	0.255
High cholesterol	1 = If total cholesterol is 240mg/dL or above; 0 = Others	0.108	0.311
Health behavior			
Smoking	1 = Currently a smoker; 0 = Currently a non-smoker	0.245	0.43
Duration of less than 5 years	1 = Smoking less than 5 years in the past or present; 0 = Others	0.046	0.21
5-9 years	1 = Smoking 5-9 years in the past or present; 0 = Others	0.048	0.213
10-19 years	1 = Smoking 10-19 years in the past or present; 0 = Others	0.102	0.303
20-29 years	1 = Smoking 20-29 years in the past or present; 0 = Others	0.058	0.234
30 years or more	1 = Smoking 30 years or more in the past or present; 0 = Others	0.283	0.45

Independent Variable	Definition	Average	Standard Deviation
High-risk drinking	1 = Drink an average 7 shots of Soju at a table for men and 5 shots for women, and enjoy drinking at least twice a week; 0 = Others (Defined by the National Nutrition Survey)	0.42	0.494
1~2 days of exercise	1 = Work out 1-2 days a week; 0 = Others	0.32	0.467
3 or more days of exercise	1 = Work out 3 days or more per week; 0 = Others	0.301	0.495
Body mass index	= Weight (kg) ÷ Height (meters2)	24.3	625
Supplier behavior			
CT	Annual number of CT billings by individual	0.019	0.166
MRI	Annual number of MRI billings by individual	0.0011	0.0363
Year (Reference group: 2002)			
2003	Relevant year	0.076	0.264
2004		0.093	0.29
2005		0.091	0.287
2006		0.118	0.323
2007		0.111	0.314
2008		0.134	0.341
2009		0.147	0.354
2010		0.16	0.366

Note: Under the fixed effect model, the time-invariant variables such as female, income class, and area of residence were eliminated along with the fixed effect in the process of within-transformation, thus being excluded from the model.

〈Table 4〉 describes the historical trends of each variable controlled in the model during the period between 2002 and 2010. Like 〈Table 2〉, it measures average growth rate from 2005 to 2010. For starters, the elderly population of the sample showed a steady rise, growing 8.73% every year on average between 2005 and 2010. The number of women slightly declined yearly, with no big variance observed in income class 13 or above. The ratio of handicapped people somewhat fell while people with chronic diseases underwent a sharp increase with an annual average of 28%. The ratio of high cholesterol also edged up. Smokers were on the gradual decline, yet the percentage of those smoking over 30 years recently shot up. The high-risk drinking rate also increased. Meanwhile, people working out once or twice a week increased by about 11%, with those exercising for 3 or more days increasing by as much as 40%. CT and MRI, part of supplier behavioral variables, were steadily gaining ground.

〈Table 4〉 Yearly Trends for Independent Variables (2002-2010)

	2002	2003	2004	2005	2006	2007	2008	2009	2010
55-below 65 years old	0.13	0.15	0.15	0.16	0.15	0.17	0.17	0.17	0.18
65-below 75 years old	0.06	0.08	0.07	0.09	0.09	0.09	0.08	0.11	0.11
75 years old or older	0.01	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03
Female	0.61	0.58	0.58	0.56	0.54	0.55	0.54	0.53	0.53
Income class 5-8	0.15	0.18	0.16	0.17	0.15	0.16	0.16	0.16	0.16
Income class 9-12	0.2	0.2	0.19	0.21	0.2	0.2	0.2	0.21	0.2
Income class 13-16	0.25	0.22	0.24	0.23	0.24	0.23	0.23	0.24	0.24
Income class 17-20	0.28	0.23	0.27	0.25	0.28	0.25	0.27	0.26	0.27
Disability	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Chronic disease	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.11	0.13
High cholesterol	0.11	0.12	0.11	0.1	0.11	0.11	0.1	0.11	0.11
Smoking	0.29	0.28	0.26	0.24	0.22	0.24	0.24	0.24	0.23
Less than 5 years of smoking	0.032	0.031	0.028	0.026	0.022	0.022	0.023	0.010	0.009
5-9 years of smoking	0.072	0.067	0.064	0.059	0.050	0.053	0.054	0.022	0.019
10-19 years of smoking	0.150	0.139	0.136	0.119	0.105	0.112	0.114	0.083	0.078
20-29 years of smoking	0.073	0.069	0.070	0.064	0.062	0.062	0.068	0.065	0.065
30 years or above	0.046	0.054	0.048	0.050	0.047	0.051	0.052	0.041	0.040
High-risk drinking	0.071	0.072	0.072	0.132	0.130	0.129	0.132	0.145	0.145
1-2 days of exercise	0.265	0.258	0.275	0.271	0.272	0.275	0.289	0.321	0.334
3 days or more of exercise	0.160	0.171	0.190	0.190	0.183	0.188	0.196	0.236	0.245
Body mass index (BMI)	24.47	31.95	23.51	23.59	23.6	23.65	23.63	23.81	23.72
CT	0.029	0.039	0.043	0.054	0.042	0.049	0.057	0.066	0.077
MRI	0	0	0	0.005	0.0052	0.0065	0.0082	0.0102	0.0128

Note: For the average no. of CT and MRI billings, there was no relevant information available after 2007. So, we replaced with the average annual growth by service provider type for the period from 2003 to 2011, which was provided by the national health insurance statistics yearbook.

3) Study Model

(1) Individual Panel Analysis

For individual-based panel analysis, the multivariate regression model [1] was employed as shown below:

[1] $e_j = x_j'\beta + \epsilon_j$

In model [1], j refers to individual index while ϵ represents general errors. e is a dependent variable involving medical cost. x concerns a vector value for the independent variables discussed above, whereas β measures the size of impact of each variable in the population studied. Model [1] estimation was made through the utilization of OLS. Because ϵ was in violation of Gaussian's general assumption (i.e. error), cluster-robust standard deviation was calculated at the individual level to verify the statistical effectiveness of β value returned.

Under Model [1], the projected β value potentially contains an error primarily due to endogeneity bias. In principle, endogeneity bias is derived from the effective correlation of ϵ at simultaneous equations. As such, the fixed effect model is considered an effective measuring model that can reduce such bias significantly.

Having said that, we decided to employ individual-based fixed effect model, as shown in Model [2] below, by breaking

composite error (ϵ) down into time-invariant, individual heterogeneity (ρ) and random error (ϵ). (t= year index)

[2] $e_{jt} = x_{jt}'\beta + \rho_j + \epsilon_{jt}$

Fixed effect transformation (within transformation) allowed individual heterogeneity ρ to be removed, thereby minimizing β bias. Also, the statistical effectiveness of the projected β value was verified by having cluster-robust standard deviation estimated at individual level, as seen in Model [1].

At the preliminary stage of analysis, the medical cost e was transformed to log value for modeling. Based on Kennedy re-transformation results, it was found that Model [1] and Model [2] were considerably aligned.

(2) Medical Cost Projection Simulation

The projected β value from the panel model was used to run simulation. Simulation analysis was mainly conducted through the following 3 steps: 1) Create a scenario for future environment changes. 2) Estimate future values for the determinants of medical cost before building simulation data. 3) Apply the returned β value into simulation data to make future cost projections.

Chapter 4

Analysis Outcome

4 Analysis Outcome

1. Individual-based Panel Analysis

Although the outcome of multiple regression analysis in 〈Table 5〉 presumes to exhibit a somewhat lower level of accuracy for the projected β value, it is, overall, consistent with our expectations.

A significant correlation was observed between aging and surging medical spending. Compared to the age group of below 55 years old, those aged between 55 and 64 years old spent 160,862 won more annually for total medical fees on average. The amount of difference swelled to as high as an average of 339,897 won for the elderly age group (65-74 years old), with the oldest age group (75 years old or older) amounting to 426,339 won.

Gender-based comparison suggested that women's total medical fee was lower than that of men by an annual average of 33,449 won. Similar to the outcome of age-focused analysis, higher income level would increase total medical cost, as well. It was analyzed that the highest income brackets (income level 17-20) spent 26,306 won more than the lowest income earners every year on average.

Regional discrepancy is also statistically effective with a considerable deviation. Compared to Seoul residents, there was no significant gap detected with those living in Daegu; however, the total medical fee was found higher in South Jeolla province by as much as an average of 45,392 won annually.

Those who are handicapped, meanwhile, spent 173,984 won more for total medical fee annually than people without disability. Similarly, chronic diseases also elevated average total medical cost by 301,985 won every year. High cholesterol holds significant relevance, too, as it contributed to boosting yearly total medical fee by as much as 32,040 won.

The outcome of health behavioral variables was generally consistent with our expectations. However, currently the total medical fee spent by smokers is found to be 36,233 won less than that of non-smokers, which is contradictory to the conventional findings characterized by smokers' relatively higher medical cost. This may reflect the lack of interest in health by smokers. Meanwhile, the duration of smoking clearly demonstrates a meaningful correlation between longer smoking period and total medical cost growth. It was analyzed that long-term smoking of 30 or more incurred a total of 15,798 won of medical expenses on average each year as compared to the non-smokers group (reference group). Similarly, total medical fee and outpatient cost for high-risk drinkers recorded an annual average of 18,033 won and 16,606 won, respectively,

exhibiting low relevance.

Regular exercise every week was found to have significant relevance to the declining health care cost. Also, the frequent use of expensive CT and MRI maintains high correlation with the surge in medical spending. For example, a yearly increment of one MRI billing would raise total medical cost by approximately 1.7 million won.

In terms of year variable, a steady rise was seen in average annual gross medical cost and gross outpatient fee during the period from 2002 to 2010. The in-patient cost, on the other hand, fell in 2007 before moving upward later on.

〈Table 5〉 Determining Factors for Total Medical Cost: Multivariate Regression Model

	Total Medical Cost	Total In-patient Cost	Total Out-patient Cost
55 - below 65 years old	160816.2***	133846.9***	111900.9***
	(39.50)	(16.89)	(48.36)
65 - below 75 years old	339897.1***	312976.7***	207872.0***
	(48.79)	(20.24)	(67.99)
75 years old or older	426299.2***	326172.4***	242253.8***
	(28.76)	(11.41)	(36.41)
Female	-33448.9***	-3555	-28580.5***
	(-11.88)	(-0.66)	(-16.93)
Income class 5-8	9896.1**	7992.1	4118.3*
	(2.71)	(1.05)	(2.31)
Income class 9-12	15109.5***	557.6	9686.3***
	(4.32)	(0.08)	(5.42)
Income class 13-16	28093.1***	10990.3	20310.4***
	(7.46)	(1.47)	(9.67)
Income class 17-20	26305.5***	-534.3	27894.6***
	(7.46)	(-0.08)	(14.87)
Busan	22736.3***	24347.9**	11708.5***
	(4.98)	(2.83)	(4.70)

	Total Medical Cost	Total In-patient Cost	Total Out-patient Cost
Daegu	5410.2	2013.7	7703.7**
	(1.15)	(0.22)	(3.01)
Incheon	9103.7	8688.7	3100.3
	(1.74)	(0.98)	(0.92)
Gwangju	27586.8***	30729.1*	7184.7
	(3.61)	(2.49)	(1.31)
Daejon	24847.4*	3051.9	24807.1**
	(2.42)	(0.27)	(2.71)
Ulsan	25495.9***	33631.4**	8615.1**
	(4.58)	(2.92)	(3.28)
Kyunggi	3685.2	1194.9	2712.6
	(1.13)	(0.19)	(1.50)
Gangwon	28511.3***	30666.8*	4412.7
	(3.99)	(2.47)	(1.15)
North Chungcheng	24382.2***	14690.7	19625.8***
	(3.64)	(1.14)	(4.88)
South Chungcheng	37114.3***	34139.3**	21831.3***
	(6.34)	(2.74)	(6.98)
North Jeolla	45392.3***	39689.2**	18478.7***
	(7.11)	(2.97)	(5.36)
South Jeolla	40502.1***	47967.9***	14582.2***
	(7.04)	(4.11)	(5.00)
North Kyungbuk	17906.1***	14926.7	9615.5**
	(3.48)	(1.62)	(3.04)
South Kyungnam	23382.6***	35146.0***	8292.2**
	(5.08)	(4.23)	(3.06)
Jeju Island	40379.0***	1011.2	35709.3***
	(4.45)	(0.06)	(7.04)
Disability	173983.9***	97346.8***	120748.5***
Chronic disease	301984.6***	242350.1***	172638.7***
	(27.45)	(14.78)	(23.94)
High cholesterol	32040.1***	8307.4	24714.2***
	(9.37)	(1.16)	(14.21)
Body mass index (BMI)	-0.277**	1424.1	-0.217**
	(-2.96)	(1.78)	(-2.66)
Smoking	-36233.0***	-13150.9	-29730.5***
	(-9.76)	(-1.72)	(-16.45)
Less than 5 years in smoking duration	-7808.4	-11670	-7380.9**
	(-1.54)	(-1.08)	(-2.97)
5-9 years	-17122.8***	-7670.9	-14139.4***
	(-4.32)	(-0.95)	(-7.30)

	Total Medical Cost	Total In-patient Cost	Total Out-patient Cost
10-19 years	-840.5	1908.1	284
	(-0.20)	(0.23)	(0.13)
20-29 years	30200.9***	32618.4**	18386.2***
	(5.78)	(3.21)	(6.83)
30 or more years	57073.2***	72695.2***	15797.8***
	(7.64)	(4.93)	(4.90)
High-risk drinking	-18033.3***	-13846.7*	-16605.6***
	(-5.30)	(-2.32)	(-10.71)
1-2 days of exercise	-13802.0***	-17941.8***	-3216.1*
	(-5.86)	(-4.09)	(-2.40)
3 or more days of exercise	-4227.7	-27134.0***	8904.2***
	(-1.52)	(-5.04)	(6.08)
CT	1145842.1***	1599444.4***	416875.3***
	(52.82)	(26.09)	(51.17)
MRI	1704024.2***	1511804.5***	802486.1***
	(11.74)	(5.47)	(9.60)
2003	12205.4***	-1643.9	8152.0***
	(4.62)	(-0.06)	(5.79)
2004	34131.1***	30123.9	21530.2***
	(14.15)	(1.11)	(17.90)
2005	40714.5***	27622.6	26582.8***
	(13.75)	(0.87)	(18.33)
2006	91726.6***	293093.5***	49475.0***
	(27.56)	(9.18)	(26.96)
2007	98032.6***	-855139.0***	51008.9***
	(25.33)	(-39.16)	(29.85)
2008	101077.9***	-856020.1***	48081.7***
2009	155775.6***	-853090.5***	81708.6***
	-16.17	(-36.91)	-17.33
2010	146863.4***	-877719.2***	84830.2***
	-15.37	(-38.01)	-16.77
Constant	131130.5***	803655.8***	120349.2***
	-33.10	-28.86	-57.32
Observations	662051	237262	661688

Note: Parenthesis represents t values. (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$)

As seen in 〈Table 6〉 below, fixed effect modeling was performed to minimize endogeneity bias. The outcome of analysis was, overall, similar to that of the multivariate regression

model. The main difference was that there was no correlation found between the variables of smoking duration (20-29 years and 30 or more years) and medical fee.

〈Table 6〉 Determining Factors for Total Medical Cost: Fixed Effect Model

	Total Medical Cost	Total In-patient Cost	Total Out-patient Cost
55 - below 65 years old	84320.6***	-81340	49222.2***
	(5.58)	(-1.04)	(6.76)
65 - below 75 years old	314676.9***	-23180.6	160611.3***
	(8.94)	(-0.13)	(13.97)
75 years or older	605357.1***	-410585.5	310023.5***
Body mass index (BMI)	0.157	407.5	0.0658
	(1.31)	(0.10)	(0.69)
High cholesterol	5108.4	5521.9	2567.6
	(0.63)	(0.18)	(0.74)
Chronic disease	153672.5***	8416	78107.5***
	(6.52)	(0.11)	(6.13)
Smoking	-29561.7**	2879	-16599.9***
	(-3.26)	(0.08)	(-5.34)
Less than 5 years in smoking duration	22882.2*	15778.5	11207.6**
	(2.22)	(0.36)	(2.76)
5-9 years	26425.9***	7788	11941.3***
	(3.55)	(0.25)	(4.26)
10-19 years	3117.2	-8943.4	4931.6
	(0.39)	(-0.30)	(1.40)
20-29 years	-10343.3	-17238.8	-1823.5
	(-0.97)	(-0.42)	(-0.45)
30 or more years	4964.5	22778	-45.21
	(0.29)	(0.32)	(-0.01)
High-risk drinking	-49137.9***	-42645.6	-21211.4***
	(-6.68)	(-1.60)	(-9.37)
1-2 days of exercise	-12328.8**	-16163	-2342.9
	(-2.82)	(-0.95)	(-1.13)
3 or more days of exercise	-17877.8**	-33010.2	-1939.5
	(-3.17)	(-1.48)	(-0.67)
CT	915493.5***	1262658.0***	316303.8***
	(25.84)	(6.79)	(28.28)
MRI	1289082.5***	922856.6	599713.9***

	Total Medical Cost	Total In-patient Cost	Total Out-patient Cost
	(6.15)	(1.12)	(7.32)
2003	23652.4***	46246.2	12657.0***
	(5.37)	(0.49)	(6.46)
2004	51121.7***	41073.3	32635.0***
	(12.73)	(0.46)	(17.85)
2005	80335.6***	85969.1	55590.7***
	(16.33)	(0.94)	(25.71)
2006	131154.1***	246872.0**	80546.0***
	(25.37)	(2.73)	(34.64)
2007	153892.6***	-667038.2***	91670.2***
	(24.10)	(-9.38)	(32.97)
2008	167259.6***	-659439.4***	96594.8***
	(24.57)	(-9.26)	(28.81)
2009	230086.1***	-639956.7***	135073.4***
	(17.08)	(-8.68)	(20.93)
2010	232730.0***	-643425.5***	146022.2***
	(16.27)	(-8.55)	(22.75)
Constant	146104.2***	776326.5***	120122.0***
	(24.51)	(6.31)	(44.47)
Observations	664571	238933	664207

Note: Parenthesis represents t values. (* p < 0.05, ** p < 0.01, *** p < 0.001)

2. Simulation

Based on the results of fixed effect model analysis for total medical cost as shown in <Table 6> and the projected β value of independent variables that are determinants of medical fee, we ran a simulation to forecast gross medical expenditure.

To assess the adequacy of the fixed effect model as a prediction model, we undertook the following steps: (1) On the back of 2002-2010 data, in-sample prediction was conducted to estimate the margin of error between actual and projected

total medical cost. (2) The average total medical spending per capita reported by the 2011 yearbook on national health insurance statistics was compared against the corresponding projected value generated through simulation to verify the difference between actual and projected cost.

First, as mentioned in formula [3] below, the in-sample prediction involves making projections for medical cost by using the projected value ($\hat{\beta}$) of independent variables (x) and the actual value of effective determinants.

[3] $\widehat{e_{jt}} = x_{jt}'\hat{\beta}$

Then, the average actual medical fee ($\bar{e}$) captured from the sample is compared against the corresponding projected value ($\bar{\hat{e}}$) to determine their difference ($\bar{e} - \bar{\hat{e}}$) and error rate ($\frac{\bar{e}}{\bar{\hat{e}}}$).

As discussed below, for future cost projections, our plan was to introduce one-step-ahead and multiple-step-ahead forecasting by using 2010 data only. As such, we conducted a comparison between actual and projected medical cost.

As seen in 〈Table 7〉 below, the 2010 sample analysis reveals that actual medical cost per eligible person is 597,721 won. Given that the projected cost arrived at through fixed effect modeling stands at 603,754, it can be said that in-sample prediction boasts high accuracy with an error rate of 1%.

〈Table 7〉 In-Sample Forecasting on Total Medical Cost Based on 2010 Data

(Unit: KRW)

(1) Average total medical cost according to the yearbook	597,721
(2) Total medical cost projected by the fixed effect model	603,754
(3) Difference=(1)-(2)	6,033
(4) Error rate	1.11%)

Second, the health care cost for 2011 was projected through running the simulation as follows:

The information provided by the National Statistics Office (NSO) and the NHIC and the sample data of the study herein were used to estimate the growth of key cost drivers among independent variables during the period from 2010 to 2011.

To identify the change in aging composition for the period between 2010 and 2011, the NSO data was utilized. According to the data, people falling within the range of 55 years old and 64 years old rose by 5.2% during the relevant period; furthermore, a 2.1% increment was observed for the age group 65-74 years old, while the age group 75 years old or older jumped by 6.1%.

For variables such as chronic diseases, smoking, smoking duration of 5-9 years and 10-19 years, high-risk drinking, 1-2 days exercise a week, and 3 or more days of exercise a week, the historical 3-year moving average data (MA(3)) was used. For the period between 2010 and 2011, they grew by 28.05%, -0.85%, 4.75%, 7.84%, 18.95%, 10.8%, and 37.9%, respectively.

Recently, increments of 8.68% and 21.1% were witnessed with

CT and MRI, respectively. By leveraging these increments specified above, we made a projection for 2011 by variable while excluding 2002-2009 data from the simulation sample.

The 2010 actual observations for cost driver variables were aligned with the probability distribution for 2011 through variable-specific random sampling. In other words, we replaced the 2010 actual observations by 2011 projections obtained through the 2nd step calculation above.

Applying $\hat{\beta}$ of formula [3] into 2011 virtual data enabled total medical fee per eligible person for 2011 to be projected. For instance, if individual equals to "1" and the expected value of the 2011 vector x is vector c, the correct calculation will be as follows: $\hat{\theta}_{1,2011} = c'_{1,2011}\hat{\beta}$

As seen in 〈Table 8〉, the total medical fee projected for 2011 is pretty close to the actual cost with an error of 1%.

Based on the findings of 〈Table 9〉, it is expected that future gross medical cost can be projected within a small margin of error with the adoption of a fixed effect model.

〈Table 8〉 2011 Actual vs Projected Total Medical Cost Comparison

(Unit: KRW)

(1) Average total medical cost according to the yearbook	643,364
(2) Average total medical cost projected through fixed effect modeling by using 2010 sample only	639,671
(3) Difference = (1)-(2)	3,693
(4) Error rate	1.1.6%)

Finally, we came up with a total medical cost projection for 2020 by embracing the method that predicted the average annual total medical expenditure for 2011 and implementing multiple-step-ahead forecasting.

As when we made cost projections for 2011 earlier, our assumption was that the annual cost driver trends would likely continue until 2020.

〈Table 9〉 below illustrates future cost projections acquired by applying simple moving averages of the previous medical fees and conducting simulation. We have them categorized by total medical cost and service provider type.

Under Model 1, the moving averages of the past four years were used for forecasting. As a result, 2012 yielded a projected medical cost of 694,994 won per eligible person, 4.7% higher than the actual cost of 663,480 won. The outcome is consistent with what actually happened when we overestimated medical cost by 4.8% in 2012.

If the same method is applied for future medical cost estimation, a medical expense of 1,203,847 won per eligible person is predicted for 2020.

Meanwhile, Model 2 allows simulation to be performed based on the results of the fixed effect model that measured the impact of each individual's socio-demographic features, chronic disease, health behavior, and supplier behavior. The basic assumption here is that medical cost determinants should main-

tain the current growth rate.

Consequently, total medical fee for 2011 was projected at 639,671 won, merely 0.62% less than the actual cost of 643,364 won.

For 2012, 675,585 won was projected, which is approximately 1.8% higher than the actual 663,480 won.

We think that such forecast error can be attributed to temporary factors such as the drop in acute sickness cases amid the weakening of yellow dust in 2012. Unfortunately, given the insufficient volume of data and other limitations, it is challenging for the NHIC to compile personal panel data on either a monthly or seasonal basis, making the control of seasonal factors out of the question.

Nevertheless, if seasonal factors including yellow dust are limited to a particular year, such temporary elements may negatively affect future medical cost projections.

That being said, a thorough review is required as to whether incorporating seasonal factors or macroscopic aspects such as institutional or social environment change into the model can contribute to improving forecasting.

Running a simulation with the pre-defined determinants has resulted in predicting the total medical cost per eligible person for 2020 at 1,009,955 won, which is 193,892 won smaller than the value projected by Model 1 using simple moving averages.

By service provider type, it is estimated that 429,485 won,

146,836 won, and 409,598 won of medical expenses will accrue per eligible person with tertiary/general hospitals, other regular hospitals, and doctor's clinics, respectively, in 2020.

〈Table 9〉 Total Medical Cost Projections until 2020

(Unit: KRW)

Year	Model 1				Model 2			
	Projected medical cost per eligible person based on the historical 4-year moving averages				Projected medical cost per eligible person backed by the fixed effect model and simulation			
	Total fee	Tertiary/ general	Other hospitals	Doctor's clinics	Total fee	Tertiary/ general	Other hospitals	Doctor's clinics
2010	597,721	254,182	86,902	242,412	597,721	254,182	86,902	242,412
2011	653,667	277,973	95,036	265,102	639,671	272,021	93,001	259,425
2012	694,994	300,281	102,663	286,376	675,585	287,294	98,223	273,991
2013	725,450	328,327	112,251	313,124	712,705	303,079	103,619	289,045
2014	785,590	355,545	121,557	339,082	755,178	321,141	109,794	306,270
2015	850,715	385,020	131,634	367,192	797,648	339,201	115,969	323,494
2016	908,744	411,283	140,613	392,238	840,111	357,259	122,143	340,716
2017	971,863	439,850	150,380	419,482	882,575	375,317	128,317	357,938
2018	1,045,596	473,220	161,789	451,307	925,038	393,374	134,490	375,159
2019	1,123,085	508,290	173,779	484,753	967,497	411,430	140,663	392,379
2020	1,203,847	544,842	186,275	519,613	1,009,955	429,485	146,836	409,598

Note: For 2010, actual total medical cost released by the NHIC was used.

Chapter 5

Methodology for Comprehensive Medical Expense Management

5 Methodology for Comprehensive Medical Expense Management

1. The Need for Targeted Healthcare Expenditure

Korea has embraced a fee-for-service platform centering around a resource-based relative value scale (RBRVS) and conversion factor (CF). Various issues have arisen with the fee-for-service system such as the oversupply of health care service, supplier induced demand, excessive care for medical treatments of high relative value, etc. The RBRVS has simply played a role as a coordinator to handle disparities between service items, whereas medical fee is actually determined by conversion factor. However, Korea's current fee system is dominated by price negotiation, failing to, in reality, control price and volume at the same time.

The current CF assessment process also contains some limitations. At time of signing the CF contract, both insurers and suppliers do calculation on their own while providing data that only works in their favor. As a result, fee raise hovers around 2% every year. Although the conversion factor survey is being outsourced by the NHIC each year, the results are only used to determine the priority of rate hikes based on type, and are not reflected in the decision about the absolute size of conversion factor contracted.

The NHIC requires both index and SGR models to incorporate the price and volume of historical health spending when calculating CF. However, in reality, fee pricing is rather done through negotiation with medical service providers. Finally, 1-3% of hike is agreed, which then would lead to a 10% increase in health care cost across the board. The next year, a new logic emerges to justify another fee raise. This is just how it is structured currently.

Adding the increasing volume outright to the payables to service providers, as we do currently, is tantamount to tearing down the foundation of the principle of fixed total or financial neutrality. If the principle fails to be upheld in the relative value scales (RVS), corrective actions need to be taken even with CF.

Against this backdrop, it is critical to have the CF contract made in a way to not just handle a raise in conversion factor, but also manage both price and volume amid the rising RBRVS and increasing volume of care. Also, the development of the institution that allows effective and binding fiscal management is crucial. In other words, it is vital to go beyond simply calculating CF with no real binding effect to move toward establishing a system that enables effective and binding fiscal management.

To this end, setting target medical cost should be ensured with the price and volume of health care service taken into consideration. Also, a change should be made to allow the difference between targeted and actual health care cost to de-

termine conversion factor. This is termed as “Targeted Healthcare Expenditure”, and relevant solutions are proposed in the following sections.

2. Solutions for the Introduction of Targeted Healthcare Expenditure

Targeted healthcare expenditure can be summarized as integrating the price and volume of care to define conversion factor in a comprehensive manner. At the time of negotiation over fee contract, insurers and suppliers will sit together and agree on the target medical spending for the next year with the price and volume of care taken into account. Based on the agreed target budget, the conversion factor for the following year will be determined.

It is structured in such a way as to allow the medical fee to be lowered if the actual cost for the next year is found higher than the targeted one and vice versa.

Now, let's look into how it can be executed. The current platform of fee contract employed by the national health plan has its limitations since the pricing is made only for the next year, thus failing to reflect the volume of care. Our suggestion allows target medical cost for the next year to be agreed, at the time of the CF contract, by supplier type, based on which pricing for the year followed will be determined. In other words,

during annual negotiation for CF contract, we would not only make a contract for the conversion factor of the next year, but also agree on the target health care cost thereof and the resultant CF calculation for the year ensued.

At first, our approach should obtain consensus on the way targeted healthcare expenditure is calculated. If we wish to have it taking hold for the long run, we should configure it in a way as to enable fee pricing to be automatically done every year through a long-standing formula. After all, this will be a fee structure that allows targeted health expenditure to be sustainably maintained through total sum management.

It involves assigning a certain level of growth to the previous year's medical cost in order to produce a targeted medical fee, based on which the fee for the following year will be decided. Here, what is considered most critical is how to calculate targeted healthcare expenditure.

The example for target medical cost calculation is stated as follows:

Targeted healthcare expenditure = Medical expenses of prior year × Proper growth rate (Increase in eligible population × Medical fee hike × Inflation growth × Increasing suppliers × α × β)

Targeted medical cost should be determined after factoring in the characteristics of each different type of health service provider. To this end, sufficient research and review is deemed necessary between insurers and suppliers. Also, continuous dialogue and joint study are desired as it calls for mutual trust between the two parties.

It would be ideal if this new system can be applied to all types of providers at once. However, if that is deemed difficult, we can review an option to have it rolled out with a few selected types of service providers such as dental clinics, Chinese medicine clinics, and pharmacies in which target expenditure can be rather easily calculated. Moreover, if the introduction of this new platform into the departments of medicine appears daunting, conducting a pilot test can be also considered in which the conversion factor of Medical Aid is separated from the national health insurance plan.

One of the expected effects includes the enhanced predictability of medical expenses, since the sizing of medical cost payable can be done beforehand, thus enabling effective health cost management at a national level.

Given the fact that the price regulation, traditionally used to curb costs in the medical area, only managed to control the price of health care service while failing to keep the volume in check, it is analyzed that the targeted healthcare expenditure will allow 'price' and 'volume' to be managed simultaneously,

thus being perceived more effective in controlling the pace of medical cost growth.

A detailed plan on how to utilize this new platform for actual CF contract will be discussed separately in Section 2.

3. Considerations During Targeted Healthcare Expenditure Calculation

The key to the success of this regime is to develop a formula that enables target medical cost to be set at the most reasonable and realistic level possible. It refers to the target value, which generally allows the medical spending of the next year to be set at the appropriate level. Ultimately, instrumental to the targeted healthcare expenditure is how cost drivers are properly added to the prior medical expenses.

As for the considerations to be reflected in the calculation of targeted medical cost, we can review some practices implemented in foreign countries for reference. The detailed information is provided in 〈Table 10〉 below.

〈Table 10〉 Cost Drivers Used for Fee Pricing in Foreign Countries

	Medical Cost Aspect	Expenditure Aspect
U.S. (SGR)	○ A surge in eligible population ○ Rising income ○ Change in laws and regulations ○ Fee hike	○ Labor cost growth ○ Administration cost growth ○ Material cost growth
Taiwan	○ Natural growth rate ○ Increasing population ○ Age-based composition	○ Wage index is adopted for labor cost ○ Wholesale price index is

	Medical Cost Aspect	Expenditure Aspect
	○ Change in gender composition reflected ○ Change in medical service expenditure index	adopted for drugs and materials cost ○ Retail price index is adopted for others
Canada	○ Reasons for structured frequency increase - A rise in eligible population - Increasing number of doctors - Policy intervention - New technology ○ Acceptable supplier/user factors - Increase in service providers (doctors) - Growing user needs	○ Reasons for structured price surge - Consumer price index (CPI) - Medical economic index (MEI)
Korea's index model	○ Actual year-on-year medical cost growth	○ Higher labor cost ○ Increasing manpower per provider ○ Rising number of service providers ○ Rising administration cost (consumer price index) ○ Rising material cost

Source: Gihong Jeon (2012), "Automatic Stabilizer for the National Health Service Finance"; re-compiled materials discussed in the seminar hosted by the Korea Society of Health Policy and Administration.

Overall, both healthcare cost drivers and expenditure drivers should be taken into account to determine the total medical fee.

The sustainable growth rate (SGR) model adopted by the U.S. considers medical cost drivers such as the rise in eligible population, soaring income, change in laws and institutions, and medical fee hike to estimate targeted healthcare expenditure. For the calculation of conversion factor, the U.S. has recognized not only target expenditure but also the medical eco-

nomic index (MEI) to assign a relevant index for labor cost, administration cost, and material cost, respectively.

Taiwan determines global budget based on medical cost driver-related considerations such as natural growth rate, rising population, age and gender composition, change in medical service expenditure index, etc. In terms of expenditure, it bears resemblance to the U.S. as it utilizes each respective index to reflect labor cost, medicine cost, material cost, and administration cost. In particular, Taiwan has mandated medical cost and expenditure drivers as non-negotiable, triggering it to be automatically calculated through the pre-agreed formula with suppliers.

In the province of Alberta in Canada, the frequency of service is categorized by the reasons for structured frequency increase and the allowable supplier/user factors in order to determine the highest and lowest ceilings for growth. For the former, the increasing eligible population, rising number of doctors, government intervention, and new technology are included. The latter concerns the surge in health care service providers or doctors as well as the growing consumer demand. From an expenditure standpoint, the structured price increase is represented by CPI or MEI as in the case of the U.S. SGR model.

Finally, we would like to elaborate on Korea's index model. In terms of medical cost drivers, the current year's actual

growth in medical cost is reflected to determine conversion factor. As far as expenditure drivers are concerned, diverse factors including labor cost, manpower expansion, increasing number of providers, administration cost, and material cost are taken into consideration.

After considering various cost drivers discussed in foreign practices or preceding studies, it is recommended that the following variables be taken into account for the calculation of targeted healthcare expenditure:

- ○ Demographic characteristics: Growing population, change in sex and age composition, etc.
- ○ Health insurance-related institutions: Changes driven by laws and regulations, conversion factor increment, relative value scales (RVS) adjusted, development of new medical treatments, etc.
- ○ Suppliers: Rising number of doctors and facilities, increasing number of beds, etc.
- ○ Users: Change in health status, change in health behaviors, impact of health promotion and investment
- ○ Others: Economic conditions (i.e. income), change in external environment (i.e. climate), and change in the type of diseases

Upon reviewing these determining factors of targeted expenditure, a formula that can be accepted by both suppliers and the NHIC should be developed before gaining consensus. Finding common ground with suppliers will likely be challenging, but it is essential to establish solutions deemed most reasonable by both academic and practical perspectives, while striving to narrow the gap between suppliers and the NHIC.

Particularly given the latest development that the medical cost that used to surge 10% has entered stabilization, showing a sign of stable growth at a certain level, developing a reasonable solution for the estimation of target medical cost doesn't appear daunting after all. Once a consensus is reached for the solution, it can be defined as a 'non-negotiable' component to ensure sustainable usage.

Finally, before adding new variables performing additional analysis, as mentioned earlier, should also be considered to figure out, in addition to the existing cost drivers, what has caused medical spending growth to slow down recently.