Decision Support

Choosing among hospitals in the subsidized health insurance system of China: A sequential game approach

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ABSTRACT

Using tax revenues to subsidize health insurance and to achieve safe and effective health services has become an important means of health care reform for governments. However, how to select designated hospitals or specific medical facilities that allow as many patients as possible to afford medicine and treatment is a difficult problem that the governments of some countries must face. In this paper, we try to address the problem by constructing a sequential game model and presenting an application under China's new cooperative medical scheme (NCMS). We consider a market with two different hospital quality levels and give the optimal decision of the government. Our results show the following: (1) more NCMS-designated hospitals approved by the government may not guarantee that more patients obtain medical services, which depends on the financial budget and the medical service levels. When the budget is large enough, subsidizing both levels of hospitals is optimal. Otherwise, the government should approve only one level. (2) A larger difference between the medical service levels of different hospitals leads to a smaller number of patients who can obtain medical services. In other words, a large service level difference between hospitals harms the goal of the government. (3) The number of hospital patients increases as the medical budget increases.

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1. Introduction

The goal to provide affordable and equitable basic health care for people, especially for informal-sector workers and their families, is shared by numerous nations, particularly low- and middle-income countries (WHO, 2000). To this end, some countries have initiated health care system reforms to achieve universal access to safe and effective health services. Social health insurance systems, including private and public health insurance, have been implemented by both developed and developing countries. In developed countries, such as the United States, 70% of the population accepts health insurance from private or insurance agents, and the poorest 10 of the population is afforded medical services by national health care. In England, Sweden, and Denmark, almost everyone has access to free health insurance. In contrast to high-income countries, low- and middle-income counties have to confront insufficient budgets and large populations. Several counties have recently used tax revenues to subsidize health insurance for informal-sector (usually rural) workers and their families, e.g., Colombia, the Philippines, Vietnam, and China

(Wagstaff, Lindelow, Gao, Xu, & Qian, 2009). In China, a basic social medical insurance system, which includes the new cooperative medical scheme (NCMS), has been developed and is expanding rapidly (Li, Yu, Butler, Yiengprugsawan, & Yu, 2011). NCMS is guided, organized, and conducted by the government and financed in part through flat-rate household contributions and in part through government subsidies (You & Kobayashi, 2009). In contrast, in Colombia, the Philippines, and Vietnam, the poor are enrolled in the national social health insurance scheme based on the taxpayer's expense, and the household enrolls at its own expense; however, the contribution paid by non-poor voluntary enrollees is sometimes subsidized (Wagstaff et al., 2009). In the Philippines and China, it is optional for informal-sector workers to enroll in the national social health insurance, but in some countries, such as Colombia, it is compulsory for citizens to enroll.

In the subsidized social health insurance system of most developing countries, the patients can obtain reimbursement when they receive medical services in any public hospital. However, this is not the case for China. In China, patients can obtain reimbursement only when they receive medical service from NCMS-designated hospitals that are approved by the Chinese government. Based on the report of the National Health and Family Planning Commission of PRC (NHFPC, 2014), at the end of May 2015, there were approximately 26,000 hospitals across the country. However, there

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were only 13,326 NCMS-designated hospitals. In other words, only 51.3% of the hospitals are approved to be NCMS-designated hospitals. This paper considers what is unique about the Chinese situation and why the Chinese government does not allow all of the hospitals to join NCMS.

In China, the rural Chinese widely perceive that hospitals at higher administrative levels offer higher quality services (Eggleston, Shen, Lau, Schmid, & Chan, 2008b). As a result, the high level hospitals almost dominate the market with larger market shares and higher prices, which cause tension of medical resources. However, the empirical evidence shows that individuals may prioritize price over quality in choosing facilities (Hotchkiss, 1998). Therefore, selecting designated hospitals may be a tool for the government to affect health care market competition. In the practice of China, local governments usually prefer to choose hospitals with large scale and high service quality as NCMS-designated hospitals. For example, the criteria for choosing NCMS-designated hospitals, which is issued by the Bureau of Human Resources and Social Security of Shenzhen City, includes hospital space, the numbers of doctors and nurses, medical facilities, etc. (SC, 2014). The criteria means high cost and high quality, in other words, Shenzhen government prefer to choosing high level hospitals to be NCMS-designated. Subsequently, this raises more questions: Do the criteria in Shenzhen City benefit social welfare? What type of hospitals should the Chinese government choose as designated hospitals? To answer these questions, we consider a medical market that comprises two hospitals with different service levels and develop a three-stage sequential game model involving three players: the government, the hospitals, and the patients. We solve the game model and obtain the optimal strategy for the government. Our results show the following: (1) approving more NCMS-designated hospitals may not ensure that more patients be able to afford medical services; (2) if the difference in medial service levels between different hospitals is larger, then the number of patients who can afford medical services will be smaller; and (3) the number of hospital patients increases as the medical budget increases, but the marginal benefit of financial support decreases regardless of how the government designates hospitals for NCMS.

The remainder of this paper is organized as follows: Section 2 gives a literature review for surveying topics related to our research. Section 3 presents the main assumptions and notations. In Section 4, we derive the numbers of patients who select NCMS and non-NCMS hospitals. From the perspective of the government, whose goal is to enable as many patients as possible to afford medical treatment, we formulate a decision model that maximizes the total number of patients who can obtain medical treatment. Then, the optimal government policy for approving NCMS-designated hospitals is obtained. Section 5 gives the case of a monopoly market. Section 6 conducts numerical studies to evaluate the performance of different government decisions, and Section 7 draws conclusions.

2. Literature review

This work is related to several research streams, including NCMS, game models for health insurance, health finance, and patients' valuation of hospital service. We briefly review each research stream in the subsequent sections.

Over the past decade, numerous studies on NCMS have been published since the implementation of the NCMS program in 2003. Researchers mainly focus on two aspects of the program, i.e., present achievements and implementation problems. You and Kobayashi (2009) demonstrated that the program has substantially improved health care access and utilization among its participants. NCMS has also made important advances in achieving equal access to medical services and insurance coverage in China

(Meng et al., 2012). Although some literature (see Lei & Lin, 2009; Liu, Gao, & Rizzo, 2011; Wagstaff et al., 2009; Wang, Gu, & Dupre, 2008) showed that the NCMS in China has achieved outstanding performance, they also highlighted that the government's regulatory audits need to be further strengthened, for example, through the approval of designated hospitals and reimbursement policies. You and Kobayashi (2009) also indicated that NCMS appeared to have no statistically significant effect on the average household out-of-pocket health spending and catastrophic expenditure risk. All of these studies were mostly empirical and focused on the existing problems or the effects of the NCMS program. To our best knowledge, our paper is the first work that addresses the selection of designated hospitals in NCMS using a three-stage sequential game model.

NCMS is essentially a type of public health insurance that is composed of service providers (hospitals) and patients. Understanding the strategic interdependencies among the insurance, providers, and patients is critical to optimizing patients' health outcomes (Roehrig & Rousseau, 2011). Game theory provides a framework to understanding these interdependencies and can shed light on how improvements to the joint health care system may be accomplished by altering the "autonomous behaviors" of individual parties (Thomas, 2003). Research applying game theory to the analysis of health care markets was performed by Chiu (1997). The study shows that the introduction of conventional insurance policies increases the equilibrium price of health care and that if the supply of health care is sufficiently price-inelastic, the increase in price always leads to a reduction in consumer welfare. Vaithianathan (2002) demonstrated that in a competitive equilibrium of the insurance market, some consumers are self-insured, so an insufficiently large premium subsidy will not reduce demand for public care. Vaithianathan (2006) assumed that health care providers have market power and engage in Cournot competition. The author concluded that government intervention plays a beneficial role, in either the insurance or the health care market. Wigger and Anlauf (2002) discussed the normative properties of the individuals' choice of insurance against the risk of drug expenses in the presence of a monopolistic drug industry using a game method. Wright (2006) showed that when doctors and hospitals make pricing decisions autonomously in the manner of Nash equilibrium, that is, neither party takes into account the effect their pricing decisions have on the cost or profits of the other party, then providers will collectively drive up health care prices and simultaneously reduce their individual profits. Most of these studies focus on the profit (welfare) of individuals or providers. In this paper, we emphasize maximizing the number of patients who can afford medical treatment at hospitals.

The NCMS program is subsidized by the government, and the hospital management decisions are highly dependent on the reimbursement system of the country. Due to limited budgets, many countries changed problematic public inpatient reimbursement systems that encouraged hospitals to extend the stay length of patients or to increase medical services for patients to maximize their income from reimbursement systems (Leidl, 1998). The budget of a hospital depends on both the reimbursement system and the number, type, and average length of stays of the patients treated. The higher the budget is, the more resources a hospital can afford (Rauner, Kraus, & Schwarz, 2008). Gruber, Hendren, and Townsend (2012) investigated the impacts of both extending insurance coverage to the previously uninsured and increasing the reimbursement for the publicly insured poor in Thailand. Field (2011) described how the government created the private health care sector, how the government continues to sustain it, and how the Patient Protection and Affordable Care Act (PPCA) fits into the historical pattern. Straube (2013) described the current efforts of the government to improve quality and value in the health care