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Transformation of potential medical demand in China: A system dynamics simulation model

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ABSTRACT

Objectives: The increasing of potential medical demand in China has threatened the health of the population, the medical equity, accessibility to medical services, and has impeded the development of Chinese health delivery system. This study aims to understand the mechanism of the increasing potential medical demand and find some solutions.

Methods: We constructed a system dynamics model to analyze and simulate this problem, to predict the influences of health policies on the actual percentage of patients not seeking medical care (adjusting the quantity structure of hospitals and community health systems (CHSs), adjusting outpatient prices, and adjusting the level of health insurance).

Results: Decreasing the number of hospitals, increasing the number of CHSs, and raising the proportion of health insurance compensation would effectively increase the transformation of potential medical demand. But currently, changes of the outpatient prices didn't play a role in the transformation of potential medical demand.

Conclusions: Combined with validation analysis and model simulation, we suggest some possible solutions. The main factors causing potential medical demand are accessibility to medical services and proportion of health insurance compensation. Thus, adjusting the number of hospitals and CHSs and increasing the proportion of health insurance compensation should decrease the actual percentage of patients not seeking medical care and accelerate the transformation of potential medical demand, which deserved being concerned in policymaking.

1. Introduction

1.1. Problem/significance

Currently, owing to the rapid growth of medical expenses and the unreasonable structure of China's health delivery system, there exists an unusual phenomenon, wherein as the supply of medical services increases, demand shows an unexpected decreasing trend. In fact, this potential medical demand (PMD) exists extensively in China. In this study, PMD is defined as medical need that has not been transformed into actual demand. PMD can be divided into one of two types: one that can be transformed into actual demand, and one that cannot. In China, the amount and structure of the supply and demand of medical services are out of balance, and this greatly influences the equal and effective use of medical services. Therefore, to understand and analyze the PMD problem in China, this study sets forth a system dynamics (SD) simulation model by which to determine the main influencing factors and their mechanisms on PMD transformation; in this way, we can determine the best ways of transforming more PMD by making health policy adjustments.

Survey results vis-à-vis the demand for and use of medical services from 1993 to 2008 in urban and rural China are shown in Table 1; these are taken from *An Analysis Report of National Health Services Survey in China* [11]. As one can see, both of the medical services-use indexes show increasing trends; of these, the two-week medical consultation rate was in decline before 2003, but manifested a significant increase in both urban and rural areas in 2008. The annual rate of hospitalization, meanwhile, persistently increased between 1993 and 2008. These two PMD indexes generally showed an increasing trend, especially since the start of the 21st century, and although a slight declining tendency appeared in 2008, China's PMD continues to be large. The results of our analysis suggest that the growth of medical services supply and the decline in affordable medical demand had led to a low utilization rate, and the increased amount of PMD in China has dramatically

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Table 1
Survey results of demand for and use of medical services from 1993 to 2008 in urban and rural China.

Index	1993		1998		2003		2008	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Two-week medical consultation rate (%)	19.9	16.0	16.2	16.5	11.8	13.9	12.7	15.2
Two-week untreated rate (%)	42.4	33.7	49.9	33.2	57.0	47.8	37.6	37.3
Annual rate of hospitalization (%)	5.0	3.1	4.8	3.1	4.2	3.4	7.1	6.8
Percentage of patients not being hospitalized (%)	26.2	40.6	29.5	35.5	27.8	30.3	26.0	24.7

influenced medical equity there. Therefore, it is necessary to analyze the reasons behind the growth of PMD and to seek reasonable health policies by which PMD can be transformed. At the same time, we need to highlight the factors that influence the two-week medical consultation rate, two-week untreated rate, annual rate of hospitalization, and the percentage of patients not being hospitalized; in urban areas, these are the provision of health insurance, family income [31], quality of care, and accessibility to medical care [72,64]. The factors that influence the four indexes in rural areas are the provision of health insurance [91], family income [98], medical costs, health status, socioeconomic status [60], and race [70]. Ultimately, no significant difference has been found in the demand for and use of medical services, between urban and rural areas.

The literature and survey results in China and elsewhere have explored the factors that influence medical demand, as well as those factors' underlying mechanisms. One of the most important factors refers to the patients themselves. Various studies have focused on the universal factors influencing patients' medical demand, such as health insurance (patients with health insurance were more likely to receive health care when it was needed) [10,52,21,72,48], economic status and monthly salary [30,60,73], health status [30,60,12], demographic factors (including gender, age, race, living settings, education level, and city size) [52,21,72,48,73], and patients' perceptions on medical need and medical use [65], types of health profiles [59], and social relations [81]. Another important influencing factor is the health care providers themselves. The quality of medical services [81], human resource structure, the provision of public and private services, reforms in health department, fee structure of health service system [68], and the degree of supplier-induced demand [84] will have an impact on medical decisions of health care providers.

In addition, more and more studies have focused on medical services demand in developing countries, such as those of the determinants of medical demand [63,1,19,26,79,2], the influencing factors of (and the changes to) medical demand, predictions of medical demand in the future [9,33,40,41,74,75,49], and the potential demand for AIDS vaccines in Thailand [87]. Additionally, some researchers have discussed the elasticity of medical demand in Ghana [50]; the elasticity of medical demand in a certain province of China [53]; the elasticity of medical demand among groups of infants, children, and low-income service recipients [79]; and the elasticity of medical demand among outpatients in China [98].

Additionally, some studies have explored the phenomenon of unmet medical demand. In exploring unmet medical demand and its influencing factors among various social groups, researchers have examined homeless adults [17], young adults [61], the disabled elderly [62], and children [42]. Some other studies explored the reasons behind an increase in unmet medical demand, and its solutions [80]; unmet medical demand regarding different types of disease [82]; and different methods of assessing unmet medical demand and the use of medical services [4].

Moreover, among studies of medical demand, a variety of methods and models have been used in analysis, estimation, and determination. A two-part model and a discrete factor model were used to analyze a dataset that consisted of 6407 urban households in China, and to identify and estimate the determinants of medical demand based on the interaction between growth in medical demand and the shortage of medical care funds [31]. A stochastic dynamic programming model was used to research the influencing factors of medical demand [57]. The Grossman (1972) health capital model in a stochastic environment was used to investigate the effect of long-term care (LTC) insurance on medical care demand, mainly by comparing the influence of means-tested and health-based LTC programs on medical care consumption, decisions, and welfare [5]. A Probit regression model and a zero-truncated negative binomial regression model were used to test the effects of price and income on medical demand in rural China [98]. A Heckman-type model was employed to estimate medical demand and explore the influencing factors of medical demand in African countries [70]. A simplified version of a dynamic Grossman household production model was used to explore the effect of uncertainty of illness on medical demand [69], and Grossman's health production model and national survey data were also used to estimate the effect of digital health information on medical demand [20,38,89]. A generalized version of Grossman's health capital model was considered to examine medical demand, by testing the health capital model; it was also used to identify the key factors of the medical demand equation [45]. Finally, many health economists have developed medical demand models to predict medical demand [15,25,35,36,77,34].

There have also been some studies about medical demand in China. For example, some studies have analyzed medical demand, need, and service use in different regions in China [99,93]; examined a PMD-transformation system by constructing a logical model [54,55]; determined the influencing factors of medical demand by examining both theoretical and empirical elements and using an ordered Probit model [54,55,58,39,56,97]; and looked at the changing tendencies and characteristics of medical demand [92]. All these studies mainly concentrate on theoretical research and description analysis of the previous and current situation; however, they do have some limitations. For example, they cannot predict developing tendencies by simulating a system, and they cannot simulate whether or not a policy will exert a positive role in a health delivery system.

Therefore, to successfully transform PMD into actual demand, and in response to a proposal to bring about equity of medical services, we should make great efforts to identify the reasons behind PMD, recognize the mechanism by which PMD is transformed, pinpoint solutions to the problem of PMD transformation, and then improve the equity of medical services in China.

1.2. Objective

This study aims to determine the influencing factors of PMD and seek out transformation strategies, and thus provide reasonable evidence of scientific health resource allocation, balance the supply and demand of medical services, and ultimately bring about equity of medical services in China.

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