ORIGINAL RESEARCH

Analysis on necessity of community health service development based on limits-to-growth archetype
——taking Jiangxi province as an example

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Abstract

Objective: To analyze the necessity of community health service (CHS) development in Jiangxi province based on the current status of healthcare in Jiangxi Province.

Method: The study did a systematic survey on the CHS development among health service organizations in Jiangxi province. The data of the survey were analyzed with system archetype analysis of Peter Senge.

Results: Through system analysis, four limits-to-growth archetypes were built and analyzed. The obstacles restricting the development of healthcare systems were determined, and some effective countermeasures were proposed accordingly.

Conclusion: In order to foster the sustainable development of healthcare in Jiangxi province and alleviate the problem of "difficulty and high cost to access medical services" effectively, the government should place more emphasis on the development of CHS.

Keywords: Limits-to-Growth Archetype, Community health service, Jiangxi province

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Introduction

With the development of economy, the improvement of people's living standards and the increased demands for health service, the healthcare system in China has improved dramatically [1]. However, there are still many problems related to the system to be solved, such as the non-optimal allocation and utilization of health resources in cities, irrational increase of medical expenses, the underdeveloped health service at the grass-roots level, and so on. The health service especially at the grass-roots level still can't follow the steps of urbanization, aging of population, the changes of disease spectrum, the changes of public demands, the new health insurance system for workers, and other considerations.

Though the overall condition of healthcare in China has been at a higher level among developing countries, there is greater disparity in health equity in China compared to other countries [2]. The problem of "difficulty and high cost to access medical services" in China has been a major issue concerning the people's well being, and may affect the stability and sustainable development of the whole society. That the public demands for basic health service could not be satisfied might be due to the shortage of basic health service and the lack of guarantee for the service utilization [3].

Ensuring basic health services to everyone and improving the people's health is important

in raising the people's living standards, and is a key requirement to achieve the "xiao kang" objectives (in which most of China's people would be "moderately well-off") and harmonious society. The well-developed CHS system and optimal allocation of community health resources will ensure that the residents have access to safe, effective and affordable basic medical and health services, ease the supply/demand contradiction, and promote the development of the whole healthcare system and the society.

Definition of limits-to-growth archetype

The method of system dynamics feedback analysis was developed first by Professor Jay W. Forrester in MIT in 1950s [4]. Peter M. Senge applied the method in his book *The fifth discipline: The art & practice of the learning organization*, and developed nine system archetypes: balancing process with delay, limits to growth, shifting the burden, eroding goals, escalation, success to the successful, tragedy of the commons, fixes that fail, and growth and underinvestment [5]. Senge analyzed the development of enterprises in America with these nine archetypes, and figured out the problems and possible solutions by identifying their archetypes and finding the leverages. This way of systemic thinking has influenced enormously the management in America, which makes archetype analysis a highly influential and effective tool in analyzing complex problems.

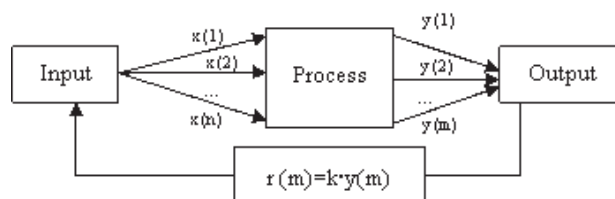System archetypes describe the studied systems with circles of causality including reinforcing feedback, balanc-
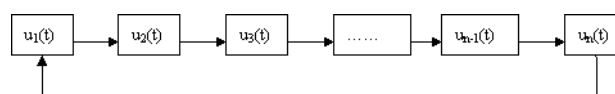

Figure1. Feedback structure

Figure2. Feedback loop

ing feedback, and delays.

Feedback is a process in which the whole or part of the output (y or r [m] =k•y[m]) return to the same system or subsystem as the whole or part of the input (x), Figure 1.

Feedback loop is complete causal path of several variables in the same system, see Figure 2: $u_1(t) \to u_2(t) \to \ldots \to u_{n-1}(t) \to u_n(t) \to u_1(t)$. The polarity of feedback loop is the product of the polarity of each causal path in the loop. If the variable $u_i(t)$ increases during a certain period, $u_i(t)$ can increase (decrease) further after a feedback, which is called positive (negative) feedback loop. When the product of the polarity of each causal path in the loop is positive, the loop is called a positive feedback loop (also called reinforcing feedback loop),

marked as 🐦 or +. In a positive/reinforcing feedback loop, the more the growing action taken, the higher the results level, and yet the result itself produces even more of growing action. So it is a process of self-reinforcing, and is the incitant factor in the whole system. When the product of the polarity of each causal path in the loop is negative, the loop is called a negative feedback loop (also called balancing feedback loop), marked as ⬚ or -. Negative/balancing feedback loop represents the way the system turns back to its original state, which works as a regulator or balancer inside of the system.

Limits-to-growth archetype consists of a reinforcing loop and a balancing loop. The reinforcing loop on the left can accelerate the growth, while the balancing loop on the right can inhibit the development of the system. (See Figure 3)

The structure of causality in reinforcing loop is condition $\overset{+}{\to}$ growing action $\overset{+}{\to}$ condition. While its structure in balancing loop is condition $\overset{+}{\to}$ slowing

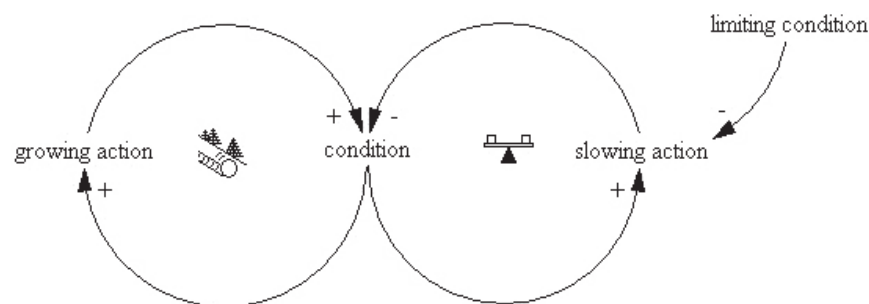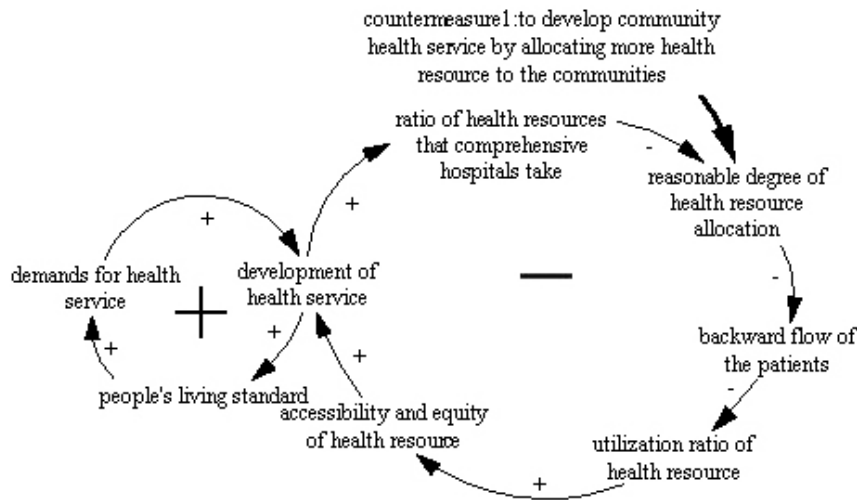

Figure3. Limits-to-growth archetype

Figure4. Limits-to-growth archetype: irrational health resource allocation

action ⇌ condition.

This study is aimed to analyze the development of CHS in Jiangxi Province of China with limits-to-growth archetype analysis based on the detailed data of field survey. The health organizations including comprehensive hospitals and community health centers or stations in Nanchang, Jiujiang, and Ganzhou of Jiangxi Province were selected through random sampling. The information on the development of the health organizations were collected through questionnaires and face-to-face interviews. Then the data was analyzed with limits-to-growth archetype.

The limits-to-growth archetypes of the development of urban CHS in Jiangxi

In this study, the limits-to-growth archetypes also consisted of a reinforcing loop and a balancing loop. The structure of the reinforcing loop was: people's living standard ⇌ demands for health service ⇌ people's living standard. It illustrated that with the improvement of

people's living standard, the demands for health service were also increasing; the increased demands would promote the development of health service, and eventually raise the people's living standard. The promoting process formed a virtuous feedback circle. With archetype analysis, we could analyze the feedback dynamic structures of the variables and the interactions between each other [6], and find the possible solution that could promote the development of the system.

The irrational health resource allocation

Feedback structure

The reinforcing part: people's living standard ⇌ demands for health service ⇌ development of health service ⇌ people's living standard

The balancing part: the development of health service ⇌ ratio of health resources that comprehensive hospitals take ⇌ reasonable degree of health resource allocation ⇌ backward flow of the patients ⇌ utilization ratio of health resources ⇌ accessibility and equity

of health resources ⇌ development of health service (see Figure 4).

Archetype analysis

This archetype reveals that the irrational allocation of health resources inhibits the development of health service. More and more health resources are occupied by comprehensive hospitals. There are many fine resources such as advanced medical facilities and excellent medical talents in comprehensive hospitals, but the health resources in communities are scarce. In Jiangxi Province, community health centers and stations only accounted for 2% of all health organizations, and the hospital beds and medical staff in community health centers and stations only accounted for 5% and 9% of those in hospitals respectively in 2010. It further illustrates that the majority of fine health resources are in hospitals, while the community health centers have fewer medical staff and backward facilities. This might also be the reason that patients prefer getting services from hospitals. In 2010, among all patients in Jiangxi, only 4.6% of patients chose community health organizations, and the patients in community health organizations only accounted for 17% of those in hospitals. The increased proportion of patient visits in comprehensive hospitals caused the waste of health resources both in hospitals and in communities [7].

Solution

The result of archetype analysis suggests that in this archetype the irrational allocation of health resources is a key factor in the development of the whole system. In order to ensure the development of the healthcare system, the inhibiting factor should be eliminated. So the possible

solution is to develop CHS by allocating more health resources to the communities.

CHS could cover the majority of basic health problems. Enhancing the development of CHS could contribute to the reallocation of health resources. More medical facilities and more competent medical workers in communities in the new schema of optimal resource allocation that meets the people's demands could not only increase the utility, accessibility and equity of health resources, but also enhance the sustainable development of healthcare in the province.

The ageing of population
Feedback structure

The reinforcing feedback: people's living standard $\pm$, demands for health service $\pm$, development of health service $\pm$, people's living standard;

The balancing feedback: people's living standard $\pm$, increasing longevity and the ratio of "only child" family $\pm$, ageing of population $\pm$, prevalence of disease $\Rightarrow$ people's living standard;

People's living standard $\Rightarrow$ mortality $\Rightarrow$ ageing of population $\pm$, prevalence of disease $\Rightarrow$ people's living standard (see Figure 5).

Archetype analysis

The ageing of population refers to the dynamic process of a shift in the distribution of a country's population towards older ages usually reflected by a decline in the proportion of the population of young people and a rise in the proportion of the population of the elderly. As a definition in demographic statistics, it emphasizes more the aging of the whole
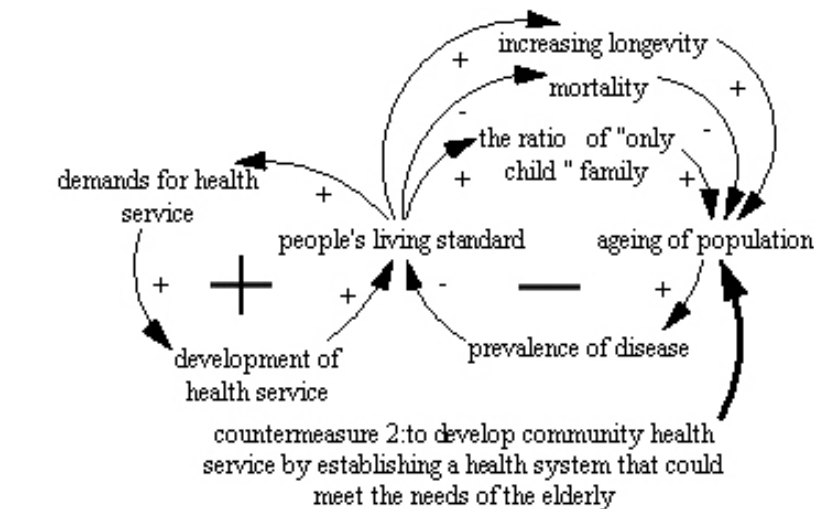

Figure5. limits-to-growth archetype: the aging of population

population instead of an individual. The process of aging of an individual is irreversible, while the process of aging of the whole population could be reversed under certain circumstance [8]. As the people's living standard and the level of health improve, the life expectancy has risen, the mortality has decreased dramatically, and the rate of only child has increased, which accelerate the process of population ageing. (See Table 1). The ageing of population is a sign of social civilization, industrialization and modernization, and also a manifestation of social development, the people's health and living standard, and the development of healthcare [9]. The society should pay much attention on the ageing of population, because without proper policies the population aging may bring many side effects on the development of the economy and the whole society. As the health conditions of the elderly get worse along with the age, the demands for

health service are at a higher level among the elderly. A survey on the 2-week prevalence of the diseases among the elderly showed that the most common diseases among the elderly were chronic diseases, such as circulatory system disease, endocrine disease, nutritional and metabolic disease, immunology disease, musculoskeletal disease, and connective tissue disease [10]. The health condition of the elderly would influence not only an individual's own quality of life, but also the living standard of the whole family and even the society.

Solution

The system analysis shows that ageing of the population is the limiting factor in this archetype. Therefore, the solution is to develop CHS by establishing a health service system that could meet the needs of the elderly.

Table 1. Aging Status of Jiangxi Province from 2005 to 2009

Year	2005	2006	2007	2008	2009
Ratio	7.36%	7.89%	8.35%	8.41%	8.25%

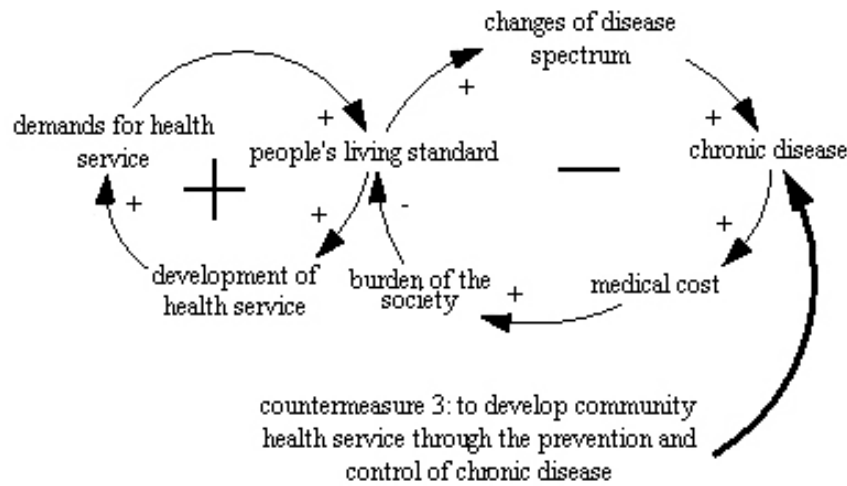Note: Ratio: the proportion of those aged above 65 of all population

Figure 6. limits-to-growth archetype: changes of disease spectrum

The utility of health service in the elderly community was especially low. With the appearance of nuclear families since 2000s, more and more elderly people have to depend on the social welfare and community services. A CHS system that facilitates more accessible, effective, and convenient health services in various forms for the elderly would ensure the development of the economy and lighten the burden of the whole society.

The changes of disease spectrum
Feedback structure
The reinforcing feedback: people's living standard $\pm$ development of health service $\pm$ demands for health service $\pm$ people's living standard.

The balancing feedback: people's living standard $\pm$ changes of disease spectrum $\pm$ chronic disease $\pm$ medical cost $\pm$ burden of the society $\Rightarrow$ people's living standard (see Figure6).

Archetype analysis
The changes of our living condition and high pressure in our life brought by the development of society lead to the changes in the disease spectrum and the medical model. During the evolutionary process of humans, people realized that environmental factors and social factors are very important to our life. As the fundamental elements of our life, they can impact our health and cause diseases [11]. Following the changes of the disease spectrum and medical model, non-communicable diseases and chronic diseases are increasing. The main disease in China has changed from communicable disease to chronic non-communicable disease. The survey in Qingshanhu district in Nanchang city of Jiangxi province suggested that the top ten common chronic diseases were hypertension, diabetes, coronary heart disease, hyperlipemia, chronic obstructive pulmonary disease (COPD), osteoarthrosis, rheumatic/rheumatoid disease, malign tumor, cerebrovascular disease, and tuberculosis. The medical cost on the management of chronic disease is high for the long duration and slow progression of the disease, which is a burden to the individual, the family and the society.

Solution
In this archetype, chronic disease is the key limiting condition. So the solution is to develop CHS through the prevention and control of chronic disease.

Usually chronic disease has a long lasting course and needs to be treated for a very long time. To eliminate these diseases, more effort should be made on its prevention instead of its treatment. To ensure early diagnosis and treatment of chronic disease, it is very important to popularize the knowledge of chronic disease through health education and promotion movements.

Overcrowding in hospitals
Feedback structure
The reinforcing feedback: people's living standard $\pm$ demands for health service $\pm$ development of health service $\pm$ people's living standard.

The balancing feedback: development of health service $\pm$ health resources in hospitals $\pm$ number of patients in hospitals $\pm$ workload of the doctors $\pm$ doctor-patient conflict $\Rightarrow$ patient satisfaction $\pm$ development of health service (see Figure7).

Archetype analysis
The allocation of health resources in China has been uneven for many years as mentioned in the former part. The hospitals possess the majority of health resources and the grass-roots health service organizations stand at the least share of health resources, which is just like an "inverted triangle sign" in contradiction with the health needs of majority featured with regular triangle. These advantages of the hospitals attract many patients
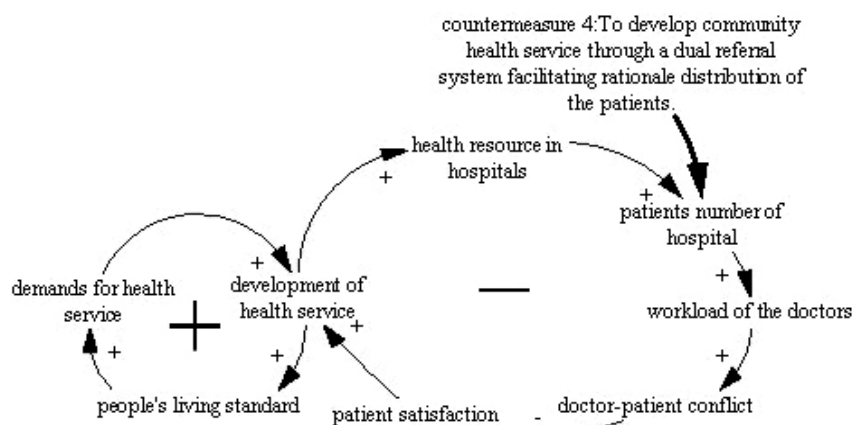
Figure 7. limits-to-growth archetype: patient overcrowding in hospitals

with common disease; the outpatients departments of the hospitals are over-crowded. The doctors in these hospitals have to work overtime to deal with the enormous amount of patients, which may influence the quality of the service. Due to the heavy workload, some of the doctors may treat their patients without patience or with bad attitude, which may make the doctor-patient relationship more tense and lower the level of patient satisfaction. In contrast, the community health organizations have fewer medical staff, backward medical facilities and small coverage of services. People cannot make sure that the quality of the health services provided by them is good enough, so there are very few patients in community health organizations. This pattern is unfavorable to the healthy and sustainable development of health services.

Solution

In this archetype, overcrowding in hospitals is the key limiting condition. Therefore, the solution is to develop CHS through a dual referral system facilitating rational distribution of the patients.

The government should develop relevant policy to encourage conducting the first contact care in community health organizations, and explore the dual referral system between community health organizations and nearby hospitals to realize the model of "minor illness in the community, severe illness in hospital, and recovery back to the community". Rationalizing the distribution of patients and the allocation of health resources could reduce the cost and time in accessing the health services, ease the pressure of hospital, and promote the harmonious development of healthcare system.

Conclusion

With the development of the society, the system of CHS has been developed and perfected. Human practice has showed that CHS can promote people's health both in developed countries and in developing countries. In this paper, four limits-to-growth archetypes of the development of health service in Jiangxi province were built and analyzed, and the possible solutions were proposed. In conclusion, to ensure the sustainable development of healthcare in Jiangxi, the government should place more emphasis on the development of CHS.

Conflict of interest

The authors declare no conflict of interest.

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