

System Dynamics Modeling for Medicine Price Policy in China

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Abstract

There is a strange phenomenon in medicine market in China: abuse of a lot of expensive prescription drugs such as antibiotic, while the low price prescription drugs disappearing in market, and the medicine price is going higher and higher to pay for by patient. This is indeed a disaster in health care system of China. In this paper, we set up a system dynamics model to demonstrate the deep mechanism: this is mainly due to medicine price policy; afterwards, a serials policy is proposed to handle this disaster.

Key words

System Dynamics, Medicine Price, Health Care

Introduction

In China, the most of medicine used by patient is prescription drugs from doctor. There is a strange phenomenon in health care system of china recent years: abuse of a lot of expensive medicine such as antibiotic for patient, the medicine price is go higher and higher; and for same kind of medicine, only higher price one can be distributed to patient, while the lower price but good medicine disappearing in the market. This is indeed the disaster in health care system of China. By abuse the expensive medicine such as antibiotic, which will damage the health of the patient and even health of next generation; with higher price, more patient cannot afford the treatment, which greatly impacts the effectiveness of health care system.

For these phenomenon, Mo Hao analyzed some interest driven behavior of medicine industry in China[1], Lin Zhao and Tong Qiang Fen also analyzed medicine price decision mechanism and its impact in china[2]. All these research is a qualitative analysis. In this paper, we will analysis medicine system structure and the set up a system dynamics model to demonstrate the deep mechanism. In the modeling, I get many helps from the supply and demand model [5].

The Structure of Medicine Market in China

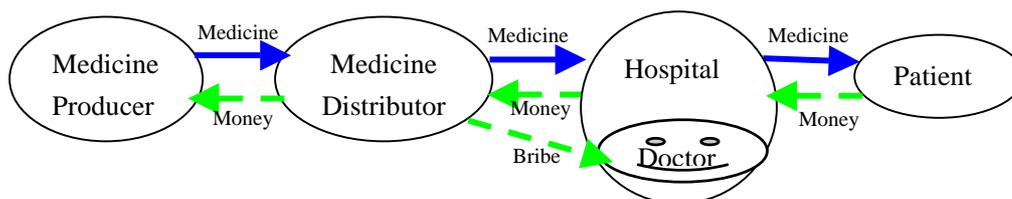


Figure 1. Structure of the medicine market

In china medicine market, there are several key stakeholders: the medicine producer who manufacture the medicine, the medicine distributor who sales medicine to hospital; the hospitals which purchase majority of medicine; the doctors who use medicine to patients; and the medicine consumers or patients who finally pay for medicine. There is also another key stakeholder, the government who has the authority to make medicine policy and decide medicine distribution price.

One key point in this medicine market of China is that hospitals not only supply health service, but also sale prescription drugs to patient via doctors. Normally hospitals will add about 10% to 20% more than medicine distribution price. While, to “sale” more medicine, the medicine distributor will bribe with money about 10% to 20% of medicine distribution price to the doctor. So, as the hospitals, more medicine they “sales” to patient, more money they will earn; while, as a doctor, more medicine he/she prescribes to patient, more money of bribe from distributor he/she will get. In China, normally, the health service price is very low comparing with the medicine price; the salary of doctor is also very low; So, to increase their income, the doctor like to prescribe expensive medicine to patient, the hospitals also like doctors to “sale” more amount and expensive medicines to their “customers”. So for a long time, medicine is the major income for hospital and doctors, though the bribe to doctor is prohibited by government.

Another key point is that, patient as a customer of hospital and doctor has no same information for their disease and also treatment. Indeed, the doctor is the agent of the patient, and patients should accept any treatment and prescription from doctor. Because of losing control for doctors’ behavior, doctors get bribe from medicine distributor.

Normally, government makes decision for medicine distribution price based on cost and market analysis, so in a long time, the distribution price of a medicine is fixed.

Following chart is a feedback loop analysis.

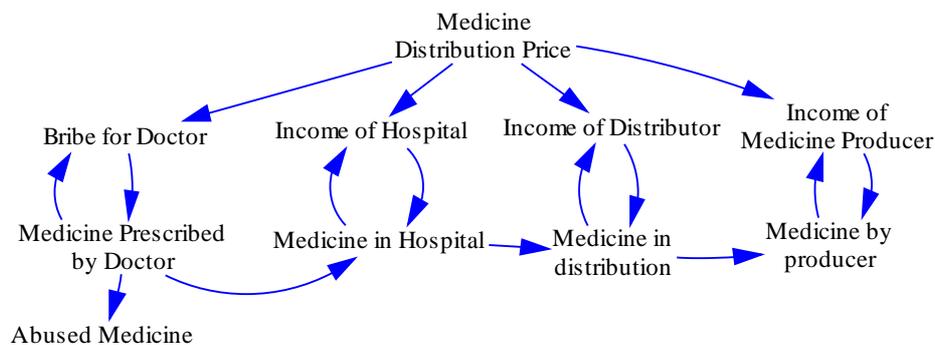


Figure 2. Feedback loop chart of the model

Dynamics Modeling and Base Run

To simulate and research this special medicine market, we set up the following system dynamics model using vensim software. This is a simple model, and we select one kind of medicine for research, and also with assumption that there is an up limit consumption of this medicine.

Suppose the producer, distributor, hospital have their medicine inventory; while there is also total consumption of medicine, total distribution of medicine, total production of medicine, and abused amount of medicine.

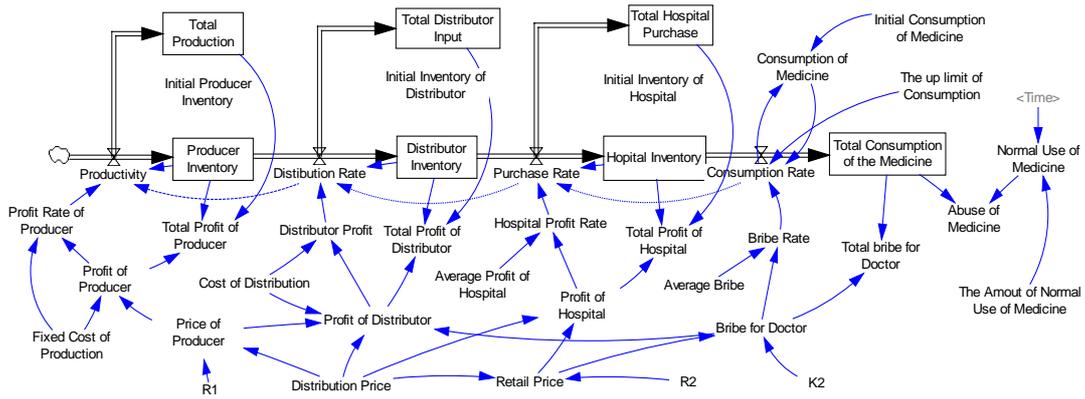


Figure 3: System Dynamics Model for Medicine Market

The price of distribution is given by government, based on this price there are following prices:

- $Price\ of\ Producer = Price\ of\ Distribution * R1$
- $Retail\ Price\ (Hospital\ Price) = Price\ of\ Distribution * (1+R2)$
- $Bribe\ for\ Doctor = Retail\ Price * K2$

There is also a fixed production cost, and cost of distribution. Using following key initial value as input for base run T1:

- $Price\ of\ Distribution = 70$
- $K2 = 0.15$
- $R1 = 0.2$
- $R2 = 0.25$
- $Cost\ of\ Distribution = 10$
- $Fixed\ Cost\ of\ Production = 15$

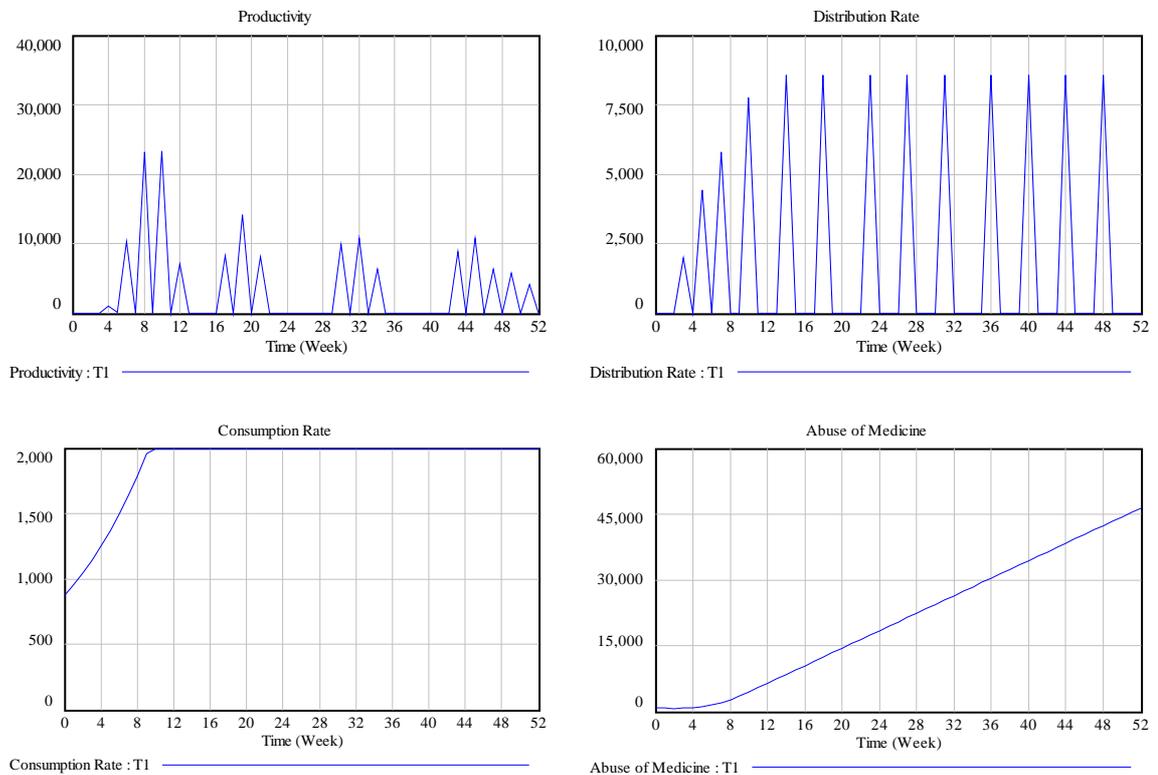
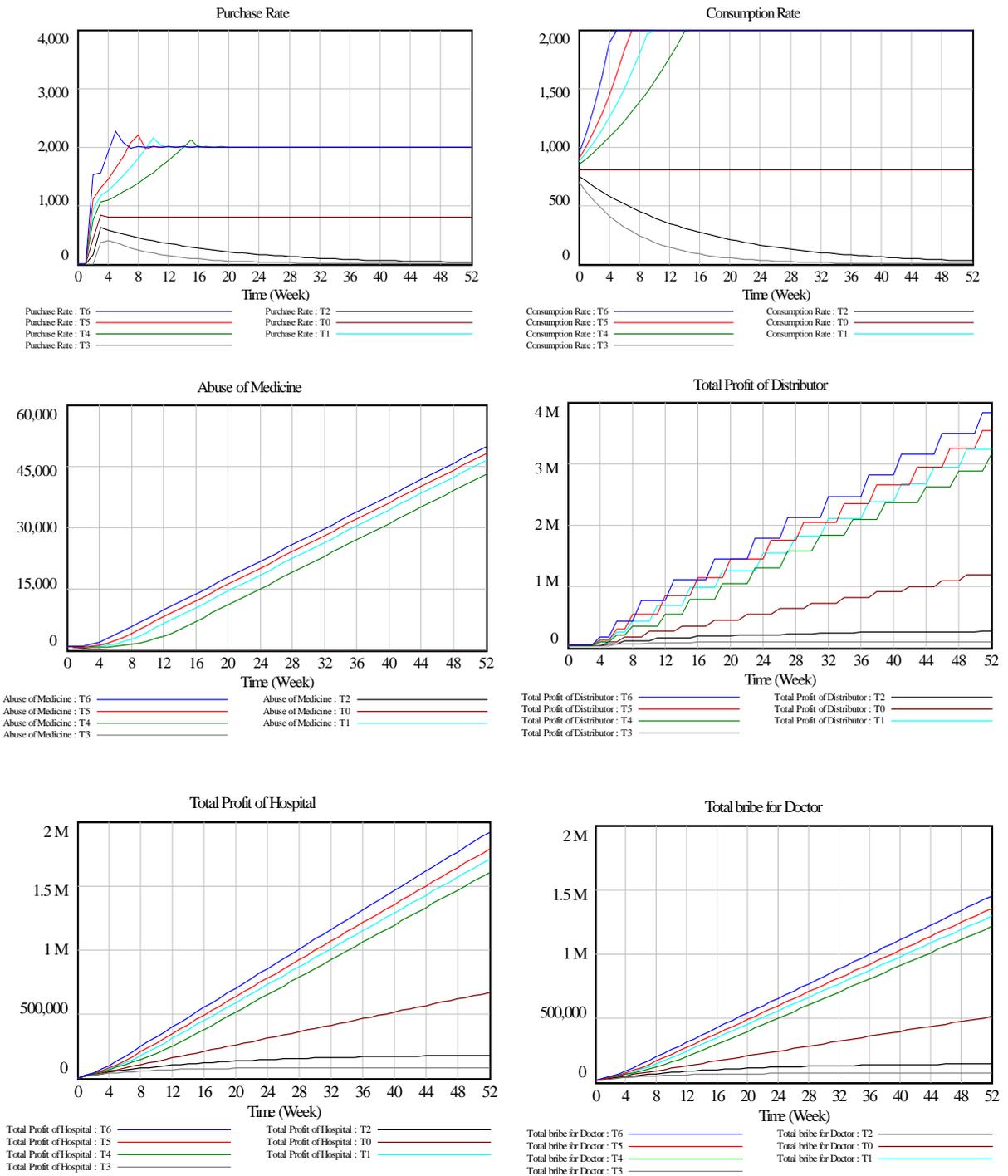


Figure 4. Base Run Results

Base run result is as following chart 4. We can see that the weekly production, distribution and consumption of medicine. Due to the inventory fluctuation, there is a fluctuation of production and distribution, and this is feature of the typical supply demand model. We can also find there is an increasing medicine abuse.

Simulation and Analysis

To have a full understanding, we make following test run with different distribution prices as following: T0: 64, T2: 60, T3:56, T4:68, T5:72, T6:76. By run these tests, we can get following results in figure 5.



From figure5, we can see, at T0 (while the distribution price is 64), the weekly consumption of

medicine, and weekly hospital purchase of medicine is a constant; and also there is no abuse of medicine for patient.

At T1, T4, T5, T6, the consumption of medicine, the hospital purchase and the abuse of medicine increase to maximum limit with the distribution price increasing. While, at T2, T3, all these variables decrease to zero with the distribution price decreasing; indeed, **this means the medicine is disappeared in the market.**

So, the conclusion is clear, **there is a critical distribution price, if we want the medicine can continue distributing in market, the distribution prices of medicine should be more expensive than this critical price.**

We can also see the total profit of distributor, the total bribe for doctor and total hospital income from medicine. At the critical distributor price (T0), the weekly profit of distributor, weekly bribe for doctor, and weekly hospital income from medicine continues because there is the constant amount of medicine still existing in market channel. But while the distributor price is less than distributor price (in case T2, T3), the weekly “profit” of distributor, hospital and doctor will decrease, so finally these stakeholders cannot accept the medicine though patient still may require this medicine.

So, disappear of the cheap and good medicine is due to lose profit for doctor, hospital, distributor and even producer of medicine.

Conclusion and Policy Proposal

By modeling, simulation and analysis, we can get following conclusion:

- The behavior of hospital, doctor and distributor in current medicine market greatly impacts effectiveness of health care system in china. The bribe for doctor, and the hospital income from medicine damages the public health.
- In current medicine system, the same medicine price will go higher and higher, the cheap medicine could not exist in the system; there is also an abuse of medicine tendency because interest pursuit behavior of the distributor, hospital and doctor.
- There is a critical distribution price for every medicine, so for short term policy, we propose government to make price close to the critical price point, by this we can greatly reduce the abuse of medicine, reduce the total cost of society.
- For long term, we should reform current medicine system, remove the medicine purchase and operation function from hospital, set up independent medicine distribution channel; while, government should make policy to increase the income of doctors, and give more investment for hospital and health care system.

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