

Analyze the Outpatient Cost Structure Change after the Comprehensive Reform of Public Hospitals by the Least Squares Trend Seasonal Multiplication Model

Wang Meiqin¹, Wu Qingbin^{1,*}, Meng Yu^{2,*}

¹ The First Affiliated Hospital of Jinan University, Information Dept, Guangzhou, China

² The First Affiliated Hospital of Jinan University, Nephrology Dept, Guangzhou, China

* Corresponding author E-mail: spgoal@163.com

* Corresponding author E-mail: elajob@126.com

Keywords: outpatient, expenditure structure, comprehensive reform, least squares trend seasonal multiplication model

Abstract: Background: To find out the seasonal variation rule of outpatient expenditure structure from 2013 to 2016, and predict the outpatient cost structure change in 2017 by the least squares trend seasonal multiplication model, and analyze the effect after the comprehensive reform of public hospitals. **Methods:** Collect the outpatient cost data from 2013 to 2016. The least squares method was applied to calculate the monthly seasonal ratio, and to fit the linear trend equation. Then the trend was rejected, checking and the final trend prediction was carried out, and the interval prediction was carried out with a confidence level of 95%. **Results:** The actual average medicine cost of outpatient in 2017 began to lower than left interval value of the forecast range from July. Inspection fees and test fees also tend to within the scope of the predicted values. However, the diagnosis and examination fees, operation fees, bed fees, Chinese herbal medicine fee is higher than the right interval value of the predicted values. **Conclusion:** By comparing the predicted values of 2017 outpatient cost structure and the actual production, we found that in accordance with the comprehensive reform of public hospitals structural price adjustment, the cost of medicine, inspection fees and inspection fees were reduced, the costs of diagnosis, surgery, nursing, traditional Chinese medical that can reflect personnel technical services value have increased. The comprehensive reform of public hospitals has significant effect.

As a result of the drug addiction policy, the problem of "relying on drugs to support doctors" is becoming more and more serious. The hospitals and doctors can get the benefit by prescribing the prescription, giving the patients a lot of drugs, and letting the patients use expensive medicine. This practice not only aggravates the economic burden for patients, but also brings hidden trouble to the public health, resulting in the problems of drug safety^[1]. Comments on the deepening of the reform of the medical and health system by the Central Committee of the Communist Party of China (2009) (No.6) (hereinafter referred to as "the new medical reform opinion"), the recent key implementation scheme of the medical and health system reform (2009-2011) (No.12) (hereinafter referred to as the "implementation scheme"). They are all aimed at changing the problems of "relying on drugs to support doctors". The new medical reform opinion and implementation scheme will be the key^[2] for deepening the reform of the medical and health system, including basic medical security, basic drug system implementation, basic medical and health system construction, public health equalization and public hospital reform. Among them, the reform of public hospitals is the difficulty of new health care reform, and the focus of public hospital reform is^[3], a chronic disease of "relying on drugs to support doctors".

1. Introduction

According to the decision of the Party Central Committee, the State Council and the provincial

Party committee, Guangdong will completely abolish the drug addition of public hospitals in July 2017 and launched a comprehensive reform of public hospitals in an all-round way. The provincial government agreed that the city of Guangzhou promoted the comprehensive reform of public hospitals in Guangzhou and abolished the drug addition of public hospitals and the implementation of the new medical service price policy in July 15th. In order to test the effect of the comprehensive reform of public hospitals, the least square trend season multiplication model is used to predict the outpatient cost structure in 2017 and compare with the actual cost.

2. Analyze outpatient cost structure

2.1 Data

In this paper, the data on outpatient cost and the visits data of a public hospital from 2013 to 2016 were collected, and the per capita total cost, the cost of Western medicine, the inspection fee, the laboratory fee, the examination fee, the operation fee, the bed fee and the cost of Chinese herbal medicine were calculated for each month to make preparation for predicting the per capita total cost, the cost of Western medicine, the inspection fee, the laboratory fee, the examination fee, the operation fee, the bed fee and the cost of Chinese herbal medicine for each month of 2017.

Here, we take the Western medicine fee as an example, the analysis is carried out.

2.2 Calculate the seasonal ratio

First, we select the data of Western medicine fees per month from 2013 to 2016, and calculate the seasonal ratio[4] according to the formula (1), Table 1 shows the Western medicine fees per month from 2013 to 2016 and the seasonal ratio of Western medicine.

$$\text{Seasonal ratio} = \frac{\text{the average of the same season}}{\text{the total average}} * 100\% \quad (1)$$

Table 1 the Western medicine fees per month from 2013 to 2016 and the seasonal ratio of Western medicine.

Month	2013	2014	2015	2016	Total	Average of Month	Seasonal ratio %
1	137.58	139.92	142.98	158.19	578.67	144.67	105.79
2	134.32	138.09	149.92	152.25	574.58	143.64	105.04
3	123.76	127.15	139.08	141.18	531.17	132.79	97.11
4	124.71	129.33	132.58	140.05	526.67	131.67	96.29
5	123.34	127.19	132.36	139.67	522.57	130.64	95.53
6	122.87	128.52	132.25	148.15	531.8	132.95	97.22
7	122.19	130.61	132.24	148.03	533.07	133.27	97.45
8	117.09	132.36	135.37	151.08	535.9	133.97	97.97
9	125.9	136.13	141.38	156.2	559.61	139.9	102.31
10	124.29	131.72	138.9	151.52	546.43	136.61	99.9
11	127.37	136.04	135.9	153.34	552.65	138.16	101.03
12	130.36	142	142.91	155.52	570.79	142.7	104.35
Total	1513.8	1599.1	1655.9	1795.2	6563.9	1640.98	
Average of year	126.15	133.26	137.99	149.6	546.99	136.75	

2.3 Fitting the straight line tendency equation

A scatter plot is drawn based on the average annual outpatient western medicine fee for 2013-2016 years, as shown in Figure 1. We find that the trend of per capita western medicine fee is increasing year by year.

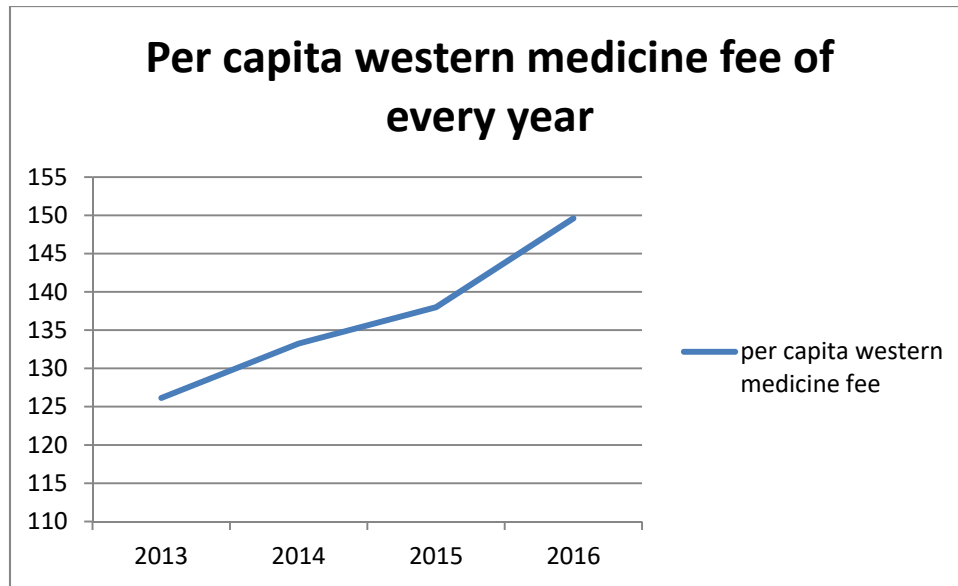


Figure 1 Scatter plot of Year - per capita western medicine fee

According to the statistical time series of the number by period of growth is roughly the same, the principle of the linear equation can be fitted. We set the annual number as the independent variable by using x, set the outpatient annual per capita western medicine fee as the dependent variable by using y. According to the least square method to obtain the linear regression equation, a = 7.508, b = -14988.079, linear regression formula is: $y = -14988.079 + 7.508x$.

Table 2 The least squares method results of Year-per capita western medicine fee using SPSS

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	-14988.079	1946.956		-7.698	.016
Year	7.508	.966	.984	7.768	.016

2.4 Checkout the straight line tendency equation

The theoretical values obtained after the establishment of the above linear trend equation are not consistent with the actual observation values in most cases, and there are some deviations between them. S (y) is used as an estimate standard error and is used to illustrate the representative size of the linear regression equation. If the value of S (y) is smaller, the smaller the error between the theoretical value and the actual observation value, the better the representation of the linear equation, and conversely, the worse the representation of the linear equation is.

It can be seen from table 2 that S (y) = 0.966 has a good representativeness of the straight line equation.

2.5 Tendency prediction

According to the linear trend equation, the theoretical value of Western medicine per capita in 2017 is predicted. For $x = 2017$, $y_{2017} = -14988.079 + 7.508 * 2017 = 155.72$, the monthly mean of outpatient visits in 2017 was 155.72. Based on the monthly seasonal ratio, the estimated values for each month can be obtained. However, the point estimate is only the average level of the forecast value. In order to make the prediction value more scientific, interval prediction is needed. We determine the confidence level $1 - \alpha = 0.95$, look up $t_{\alpha/2,4} = t_{(0.05/2,4)} = 3.50$, and calculate the limit error = $t_{\alpha/2,4} * S(y) = 3.50 * 0.966 = 3.38$ (person time), so as to predict the per capita western medicine fee prediction interval of each month in 2017 with a confidence level of 95%.

Table 3 Predicted interval values of monthly per capita Western medicine fee of 2017

Month	Seasonal ratio %	Predicted value	Lower limit	Upper limit
1	105.79	164.52	161.15	167.9
2	105.04	163.36	159.98	166.74
3	97.11	151.02	147.64	154.4
4	96.29	149.74	146.36	153.12
5	95.53	148.57	145.2	151.95
6	97.22	151.2	147.82	154.58
7	97.45	151.56	148.18	154.94
8	97.97	152.36	148.99	155.74
9	102.31	159.11	155.73	162.48
10	99.9	155.36	151.98	158.74
11	101.03	157.13	153.75	160.5
12	104.35	162.28	158.91	165.66

2.6 Analyze the results

According to the actual monthly per capita Western medicine fee of 2017, we compare with the predicted interval values and specify that if the actual cost is smaller than the left interval value, it is recorded as -1. If the actual cost is within the range, it is recorded as 0. If the actual cost is larger than the right interval value, it is recorded as 1. The results are as follows:

Table 4 the comparison results between the actual per capita monthly cost of Western medicine and the predicted value in 2017

Month	Predicted value	Lower limit	Upper limit	Actual fees	Comparison result
1	164.52	161.15	167.9	175.26	1
2	163.36	159.98	166.74	155.55	-1
3	151.02	147.64	154.4	152.8	0
4	149.74	146.36	153.12	156.16	1
5	148.57	145.2	151.95	154.71	1
6	151.2	147.82	154.58	152.06	0
7	151.56	148.18	154.94	143.33	-1
8	152.36	148.99	155.74	144.55	-1
9	159.11	155.73	162.48	148.78	-1
10	155.36	151.98	158.74	145.77	-1
11	157.13	153.75	160.5	148.6	-1
12	162.28	158.91	165.66	139.53	-1

From the comparison results in Table 4, we can see that from the beginning of the comprehensive reform of public hospitals in July 2017, the per capita monthly cost of Western medicine is lower than the left interval of the predicted value, and the effect of the reform is remarkable.

2.7 Analyze the other cost structure

The same analysis method was used to analyze the cost structure change of inspection fee, laboratory fee, examination fee, operation fee, bed fee and Chinese herbal medicine fee. The results are as follows:

Table 5 Expenditure structure analyze in 2017

Month	Down-regulated result			Up-regulated result			
	Western medicine fee	Inspection fee	Laboratory fee	Examination fee	Operation fee	Bed fee	Chinese herbal medicine fee
1	1	-1	-1	0	-1	0	1
2	-1	1	1	0	1	-1	0
3	0	0	-1	-1	1	0	1
4	1	0	0	0	0	0	1
5	1	0	0	0	0	0	1
6	0	0	0	1	1	-1	1
7	-1	-1	-1	1	0	1	0
8	-1	0	-1	1	1	1	1
9	-1	0	-1	1	1	1	1
10	-1	0	0	1	1	1	1
11	-1	0	0	1	1	1	1
12	-1	0	0	1	1	1	-1

3. Analyze the results

From the 2017 cost structure analysis table of table 5, it can be found that from July, the abolition of drug addition makes the per capita cost of Western medicine lower than the left interval value of the predicted value, and the down-regulation for the price of the inspect projects and inspection items are checked to make the actual per capita inspection fee and testing cost within the range of the predicted value. We can see the effect of the reduction as the number of visits continues to rise. However, the up-regulation for the cost of diagnosis and treatment, operation fee and Chinese herbal medicine, which embody the value of the medical staff, which makes the actual per capita cost of diagnosis and treatment, the cost of operation and Chinese herbal medicine higher than the right range of the predicted value, and the result is remarkable.

4. Conclusion

According to the guiding opinions of the central and provincial government on the comprehensive reform of urban public hospitals, we should adhere to the fairness and benefit of the masses, implement the responsibility of the government for medical treatment, construct the modern hospital management system, and break the profit mechanism of public hospitals in accordance with the steps of "tending space, adjusting the structure and ensuring the connection", and give full play to the public welfare of the public hospitals. Quality and main body function, optimize the distribution of medical and health resources, improve the system of grading diagnosis and treatment, constantly improve the level of medical and health services, and ensure the achievements of the reform to benefit the of the masses^[5].

This reform is not only conducive to the control of medical expenses, but also to alleviate the "expensive" problem of the common people. It also helps to standardize the behavior of doctors and promote the correct attitude of medical treatment. It is of great significance to establish the concept of medical technology service and guide the transformation of "relying on drugs to support doctors" to "relying on technology to support doctors".

Acknowledgement

This work is supported by Guang Dong Province Scientific Research Projects: 2016A040403054, 2016B010108008, 2015B010106008, 2013B090400004 and Guangzhou science and technology

plan: 201604020175.

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