

Impact of the zero markup drug policy on hospitalization expenditure in western rural China: an interrupted time series analysis

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Abstract

Objectives: To assess the long-term effects of the introduction of China's zero markup drug policy on hospitalization expenditure and hospitalization expenditures after reimbursement.

Methods: An interrupted time series was used to evaluate the impact of the zero markup drug policy on hospitalization expenditure and hospitalization expenditure after reimbursement at primary health institutions in Fufeng County of Shaanxi Province, western China. Two regression models were developed. Monthly average hospitalization expenditure and monthly average hospitalization expenditure after reimbursement in primary health institutions were analyzed covering the period 2009 through to 2013.

Results: For the monthly average hospitalization expenditure, the increasing trend was slowed down after the introduction of the zero markup drug policy (coefficient=-16.49, $P=0.009$). For the monthly average hospitalization expenditure after reimbursement, the increasing trend was slowed down after the introduction of the zero markup drug policy (coefficient=-10.84, $P=0.064$), and a significant decrease in the intercept was noted after the second intervention of changes in reimbursement schemes of the new rural cooperative medical insurance (coefficient=-220.64, $P<0.001$).

Conclusions: A statistically significant absolute decrease in the level or trend of monthly average hospitalization expenditure and monthly average hospitalization expenditure after reimbursement was detected after the introduction of the zero markup drug policy in western China. However, hos-

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pitalization expenditure and hospitalization expenditure after reimbursement were still increasing. More effective policies are needed to prevent these costs from continuing to rise.

Keywords: National Essential Medicines Policy, zero markup drug policy, hospitalization expenditure, interrupted time series analysis, China

Introduction

In the last three decades, the Chinese health care system had undergone tremendous changes. The government largely reduced its funding for public hospitals and encouraged them to achieve profits. One financial report of medical institutions showed that government funding constituted about 60% percent of hospital revenues in the 1980s, but by 2009 it had fallen to 11% [1]. To support this transformation, hospitals were allowed to earn a 15% markup on the sale of pharmaceutical products. Consequently, hospitals had financial incentives to prescribe expensive drugs or over-prescribe drugs to patients, and drug sales became an important source of hospital revenues. In 2009, drug sales accounted for 42% of the total income for public hospitals on average, and this proportion was even larger for primary health institutions [2]. The chasing benefit behavior of the health provider caused high health expenditure and led to serious burdens for patients, especially for rural inpatients. One hospitalization can cost as much as 6.7 times the annual income of a low-income person in rural areas of China [3]. Between 2000 and 2012, drug expenditure grew at an average annual rate of 14% [4], and the financial burden grew rapidly with the increased expenditure.

In order to effectively address these problems, the Chinese government launched a new round of health system reforms in August 2009. One of the central components of this reform was the National Essential Medicines Policy (NEMP), which aimed to increase the availability of cost-effective medicines. As a key part of the NEMP, the zero markup drug policy (ZMDP) was introduced to decouple hospital compensations from prescribing essential medicines and finally reduce the financial burden to the public. To guarantee the successful implementation of ZMDP, the government increased subsidies to hospitals to compensate for their income loss. Since the early of 2010, the ZMDP was implemented in primary health institutions. At the end of 2011 all primary health institutions were covered by ZMDP. To deepen the health system reform, implementing ZMDP in secondary hospitals was proposed. By the end of 2015, the ZMDP had been extended to all the county hospitals in China.

To further support the NEMP and provide financial protection for patients, the health insurance system gave priority to essential medicines. All essential medicines were included in the list of the health insurance reimbursement directory, and the reimbursement ratios of essential medicines were higher than those of nonessential medicines. However, as rural health facilities relied so heavily on drug revenue before the implementation of ZMDP [5], providers sought to make up for lost drug revenue by other methods, such as increasing diagnostic fees, care fees, surgery fees and treatment fees [6]. Consequently, the financial burden for the public may still be severe.

The effect of ZMDP in primary health institutions on health expense has been the subject of much research. For example, Wang et al. [7] investigated 60 primary health institutions in Shandong, Hubei and Sichuan Provinces and found that the average medical expense per outpatient and per inpatient decreased by 25.93% and 25.22%, respectively after the implementation of ZMDP. And studies conducted by Sun et al. [8], Yang et al. [9], Song et al. [10], Shi et al. [11] got similar results in Anhui, Hubei, Shandong and Beijing respectively. Zhang et al. [2] proved that ZMDP played a positive role in containing the rapid increase in pharmaceutical and health expenditure without altering the delivery of health care by conducting a pre-post treatment-control study in Chongqing, Henan and Jiangsu provinces. Except for focusing on primary health institutions, recently, Zhou et al. [12] found that ZMDP reduced the medical expense for patients at secondary health institutions in Shaanxi Province. As the researches above showed, the ZMDP had positive results and can reduce the total health expense (inpatients and outpatients) significantly, especially in rural areas. However, most research on the effects of ZMDP used pre-post and short-term data, and usually analyzed prescriptions in certain hospitals. More studies to detect the long-term effects of ZMDP are needed. No studies seem to have discussed whether the ZMDP benefits the patients by incorporating health insurance data.

Therefore, in this paper, we had two objectives: (1) to assess the long-term effect of ZMDP on hospitalization expenditure; (2) to assess the long-term effect of ZMDP on hospitalization expenditure after reimbursement. As ZMDP was mainly implemented in primary health institutions, rural residents who enrolled in New Rural Cooperative Medical System (NRCMS) and sought health service in primary health institutions were the target population.

Methods

Study design

We conducted the study in Shaanxi Province, which was ranked 14th for GDP per capita from a sample of 31 provinces in 2012 [13]. With a population of 37.93 million and 11 areas in its jurisdiction, Shaanxi Province was broadly representative of the typical health and health system status of the 12 western provinces of China. As such, in 2012, the Ministry of Health of China and WHO selected Shaanxi Province as one of three pilot regions for the Western Area Health Initiative, which was implemented from 2012 to 2015 to explore key health issues in western China [14].

In response to the National Essential Medicine Policy, the ZMDP in Shaanxi Province was implemented in stages [15]. From February 1st of 2010, all the public-owned primary hospitals in five cities (Yulin, Baoji, Xianyang, Shangluo, and Tongchuan) had to purchase and use essential medicines, and all the essential medicines had to be sold with zero make-up. For those non-essential medicines in stock, they also had to be sold out with zero markup before May 1st. After the success in the first five cities, primary hospitals in the remaining cities implemented this policy since November, 2010.

Fufeng County in Baoji city was selected to be our specific study area, for two reasons: According to the per capita net income of rural residents, all the 91 counties which were covered by NRCMS in Shaanxi Province can be classified into three income strata (high, middle and low), Fufeng was in the middle income strata and can represent the average economic level of rural residents of Shaanxi. The information system of NRCMS in Fufeng County was established two years before the implementation of ZMDP, and there were sufficient data kept in this system to support our analysis.

Outcome measures and intervention

We conducted an interrupted time series study and two indicators were analyzed: First, the monthly average hospitalization expenditure (AHE) in primary health institutions. For this indicator, the related intervention was the implementation of ZMDP which tried to reduce the drug expenditure and total health expenditure. And the intervention in Fufeng County started from February 1st, 2010. Second, the monthly average hospitalization expenditure after reimbursement (AHER) in primary health institutions. For this indicator, there were two related interventions. From the start of ZMDP, the NRCMS included all the essential medicines in the reimbursement directory and provided high reimbursement proportion for these medicines. Therefore the implementation of ZMDP can be regarded as the first intervention. In April 2011, the NRCMS in Fufeng County released a new standard for inpatient reimbursement to further reduce the actual health expenditure (the health expenditure

after reimbursement) for patients: in the public owned primary health institutions, the deductible was 28.1845\$ (1\$=6.3865RMB), and the reimbursement proportion was 85%. This new standard was implemented from May 1st 2011. Before that, the deductible in primary health institutions was 28.1845\$ (1\$=6.3865RMB) and the reimbursement proportion was only 75%. So the changes in reimbursement schemes of NRCMS can be recognized as the second intervention, and the intervention was implemented in May 2011. The AHE and AHER from 2009 to 2013 were used for analysis.

Data sources

We obtained the data of total hospitalization expenditure, total hospitalization subsidies and total number of hospitalizations for each month in primary health institutions (including all the town hospitals and community health service centers) from the department of the new rural medical scheme in Fufeng County. Based on the data, the AHE and AHER were calculated (Table 1).

Sample size and data analysis

Interrupted time series are regarded as the strongest, quasi-experimental design to evaluate longitudinal effects of time-delimited interventions [16-17]. Segmented regression analysis of interrupted time series data can assess, in statistical terms, how much an intervention changed an outcome of interest, transiently or long-term [18]. Usually, the regression model with two interventions can be formulated as following:

$$Y_t = b_0 + b_1T_t + b_2P_{1t} + b_3D_{1t} + b_4P_{2t} + b_5D_{2t} + e_t$$

Where Y_t is the outcome measure in time t ; T_t is a continuous variable counting the number of periods at time t from the start of the observation period, usually it equals to t ; P_{1t} is an indicator for time t occurring before ($P_{1t}=0$) or after ($P_{1t}=1$) the first intervention; D_{1t} is a continuous variable counting the number of periods after the first intervention at time t , for the time before the first intervention $D_{1t}=0$; P_{2t} is an indicator for time t occurring before ($P_{2t}=0$) or after ($P_{2t}=1$) the second intervention; D_{2t} is a continuous variable counting the number of periods after the second intervention at time t , for the time before the second intervention $D_{2t}=0$. Parameter b_0 estimates the baseline level of the outcome at time zero; b_1 estimates the change in the outcome that occurs with each period before the first intervention (i.e. the baseline trend); b_2 (b_4) estimates the level change in the outcome after the first (second) intervention, compared with the level at the end of the preceding segment; and b_3 (b_5) estimates the change in the trend in the outcome after the first (second) intervention, compared with the trend before the first (second) intervention; e_t estimates the random variability not explained by the model at time t .

Here, we modeled the data using interrupted time series analysis to assess causal links between

the interventions and the outcomes of interest. For segmented regression analysis, it required at least 24 observations to be able to assess seasonality in the data [19]. A long time series with 60 observations (i.e. one per month) in our sample increased the confidence, reduced standard errors, increased power, reduced the possibility of type I error, and improved detection of autocorrelation or secular trends [18,20].

For the AHE, two segments with one interruption point were constructed. The interruption points were marked as February 2010 to December 2013, as these represented the time points at which the ZMDP were implemented. For the AHER, three segments with two interruption points were constructed. The first interruption occurred in February 2010 (as the same as AHE), and the interruption points were marked as February 2010 to April 2011. The second interruption points were marked as May 2011 to December 2013, as these represented the time points at which the changes in reimbursement schemes of NRCMS occurred. We looked for abrupt drops or increases in the two indicators (AHE and AHER) and for gradual changes in trends at the interruption times.

We conducted several diagnostic assessments for the two models (one for AHE and the other for AHER). The Durbin-Watson test indicated the existence of autocorrelations. Therefore the Cochrane-Orcutt auto regression procedure was used to correct for first order serially correlated errors [21]. Besides, the Kolmogorov-Smirnov statistic was used for testing the normality of the residuals for two models. The time series data can often exhibit seasonal fluctuations [22]. If seasonal fluctuations existed, then these need be controlled in the analysis to avoid spurious associations. Here the Dicky-Fuller statistic was estimated and the result showed that the series were stationary and lack of seasonality [23]. We also estimated the Breusch-Pagan statistic to check for heteroscedasticity in the residuals and the results suggested that heteroscedasticity only existed for AHE [21]. Then robust regression in the Stata was used to correct the heteroscedasticity for AHE.

Results

In Fufeng County, from 2009 to 2013 the annual rural residents joined in NRCMS increased from 358513 to 380735. And the corresponding rates in the rural residents covered by NRCMS were 96% in 2009 and 98.8% in 2013 (Table 1).

Monthly average hospitalization expenditure (AHE)

Figure 1 showed the time series of AHE from 2009 to 2013. Before the introduction of ZMDP, there was an increasing trend in the AHE. After the intervention, no abrupt level change was noted but

changes can be observed in the trend. A regression model was developed for AHE:

$$Y = 676.09 + 21.12 \times T - 40.26 \times P_1 - 16.49 \times D_1$$

Where Y was the AHE after correcting for autocorrelation ($Y_t - \rho Y_{t-1}$), ρ was the autocorrelation parameter and equaled 0.2746982.

As Table 2 shows, a significant rise was found in the AHE from month to month before the intervention. After the intervention started, a significant decrease (-16.49) in the regression slop ($P < 0.001$) was noted. The intercept also showed a decrease (-40.26) but not statistically significant ($P = 0.366$). According to this model, the increase trend of AHE was slowed down after the intervention, but no changes to the level of AHE.

Monthly average hospitalization expenditure after reimbursement (AHER)

In the time series of AHER from 2009 to 2013, we observed two statistically significant “interruption” points (Figure 2). Before the introduction of ZMDP, there was an increase trend in the AHER. After this intervention, no abrupt level change was noted but changes in the trend can be observed. Since May 2011, after the changes of reimbursement rules in NRCMS, a significant change in the level of AHER was noted.

Regression model was developed for AHER:

$$Y^{\wedge} = 253.13 + 16.88 \times T - 71.31 \times P_1 - 10.84 \times D_1 - 220.64 \times P_2 - 2.53 \times D_2$$

Where Y^{\wedge} was the AHE after correcting for autocorrelation ($Y_t^{\wedge} - \rho Y_{t-1}^{\wedge}$), ρ was the autocorrelation parameter and equaled 0.2962412.

As Table 3 displayed, a significant rise was found in the AHER from month to month before the interventions. After the first intervention started, a significant decrease (-10.84) in the regression slop ($P = 0.064$) was noted. The intercept also showed a decrease (-71.31) but not statistically significant ($P = 0.102$). After the second intervention, the regression slop decreased greatly (-220.64) and significantly ($P = 0.000$) was noted. The intercept also showed a little decrease (-2.53) but not statistically significant ($P = 0.474$). According to this model, the increase trend of AHER was slowed down after the first intervention and the level of AHER had a decrease after the second intervention.

Discussion

To the best of our knowledge, this was the first quantitative study to investigate the long-term effects of ZMDP on hospitalization expenditure and hospitalization expenditure after reimbursement in China. An interrupted time series analysis showed The ZMDP in China resulted in a deceleration of the growth of AHE and AHER; and that the changes in reimbursement schemes of the NRCMS further

decreased the AHER.

Before the introduction of ZMDP, both AHE and AHER revealed a trend of fast increase. The intervention slowed down the growth rates of the two indicators significantly. The relative decrease rate of AHE (16.49/21.12) was bigger than that of AHER (10.84/16.88). This suggested that the impact of ZMDP on AHE was greater than that on AHER. We noted two possible explanations for this result. One was that the reimbursement proportion for essential medicines was not high enough. The other reason was that the hospitals increased other fees, which had lower reimbursement proportion or even cannot be reimbursed in the NRCMS. A deep reason may be that the government subsidies were not enough and physicians over-provided medical services or products for patients to get more payment [6], especially in primary health institutions [5].

The changes in reimbursement schemes of NRCMS further decreased the AHER. This suggested that increasing the reimbursement ratio was an effective approach to reduce financial burden for patients in a short-term. However, the intervention of NRCMS didn't slow down the increasing trend significantly ($P=0.474$). The possible explanation was that the total hospitalization expenditure was increasing greatly as a result of hospitals seeking to make up for lost drug revenue.

Our results about ZMDP were different from those of previous studies [2, 7-12] that claimed that the ZMDP can reduce the hospitalization expense significantly. As Table 2 shows, after the introduction of ZMDP the hospitalization expense decreased a little but not significantly ($P=0.366$). From Figure 1, we can find that after a little drop the hospitalization expense quickly reached and exceeded the level before the intervention. Different results may due to different approaches. Previous studies [2, 7-12] only compared the hospitalization expenses in two years (one before and one after the intervention) and in this study we analyzed a long-term period of data. The other reason may be that previous studies were conducted in health institutions and included all kinds of patients who may be enrolled in NRCMS, or beneficiaries of other health insurance schemes (such as medical insurance for urban workers, medical insurance for urban residents et al.), or even patients without any insurance. While in this study only patients enrolled in NRCMS were considered.

Our study had important methodological strengths. As the strongest, quasi-experimental design [16-17], interrupted time series was used in our study and long-term effects can be evaluated. We also included a relatively large number of observations (i.e. one per month) that resulted in enough power to obtain significant results at the desired confidence level.

Limitations of this study included lack of a control group. Although an interrupted time series study did not require a control group to establish a causal link between an intervention and an outcome [18], a control group may be helpful in better understanding of the effects of the interventions. We only conducted the study in one county, whereas ideally it should have been conducted in a provincially or nationally representative sample. However, as the NRCMS operated at the county level, focusing on a single county provided high quality data by monitoring contextual factors that may influence our interests.

Conclusion

Using interrupted time series analysis, we estimated a statistically significant absolute decrease in the level or trend of AHE and AHER following the introduction of ZMDP and changes in the reimbursement scheme of NRCMS in Fufeng County of Shaanxi Province, western China. This indicates that these policies have partly achieved their goals of controlling or reducing the hospitalization expense and the financial burden to the rural public. However, the hospitalization expenditure and hospitalization expenditure after reimbursement were still increasing. Therefore more effective policies were needed to prevent these costs from continuing to rise. Further research is needed to conduct a more natural experiment by including a control group and evaluate the long-term effects of these policies in a wider scope.

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Table 1. Hospitalizations in the primary health institutions during the study period in Fufeng County, Shaanxi Province, 2009 to 2013

Parameters	2009	2010	2011	2012	2013
Population covered by NRCMS	358513	355393	379455	378155	380735
The proportion covered by NRCMS (%)	96	94	98	98.6	98.8
Number of hospitalizations, monthly average	15345	12658	16408	22626	18442
AHE (RMB)	1079.93	1289.04	1327.10	1404.00	1485.30
AHER (RMB)	481.69	605.78	509.99	397.95	496.54

All the expenditure data was adjusted according to the Consumer Price Index (CPI) in 2013.

NRCMS: New Rural Cooperative Medical System

AHE: the monthly average hospitalization expenditure

AHER: the monthly average hospitalization expenditure after reimbursement

Table 2. Estimated coefficients of segmented regression model for the AHE in primary health institutions in Fufeng County before and after the intervention, Shaanxi Province, January 2009 to December 2013

Parameter	Value (RSE)	<i>t</i>	<i>P</i>
Intercept	676.09(45.39)	14.89	<0.001***
Pre-intervention slope	21.12(6.01)	3.51	0.001***
Change in intercept	-40.26(44.20)	-0.91	0.366
Change in slope	-16.49(6.09)	-2.71	0.009***

RSE, robust standard error.

Two-tail *P* value: **P*<0.10, ***P*<0.05, ****P*<0.01

Table 3. Estimated coefficients of segmented regression model for the AHER in the primary health institutions in Fufeng County before and after two interventions, Shaanxi Province, January 2009 to December 2013

Parameter	Value (SE)	<i>t</i>	<i>p</i>
Intercept	253.13(34.33)	7.37	<0.001***
Pre-intervention slope	16.88(4.66)	3.62	0.001***
First Change in intercept	-71.31(42.85)	-1.66	0.102
First Change in slope	-10.84(5.73)	-1.89	0.064*
Second Change in intercept	-220.64(34.05)	-6.48	<0.001***
Second Change in slope	-2.53(3.50)	-0.72	0.474

SE, standard error.

Two-tail *P* value: **P*<0.10, ***P*<0.05, ****P*<0.01

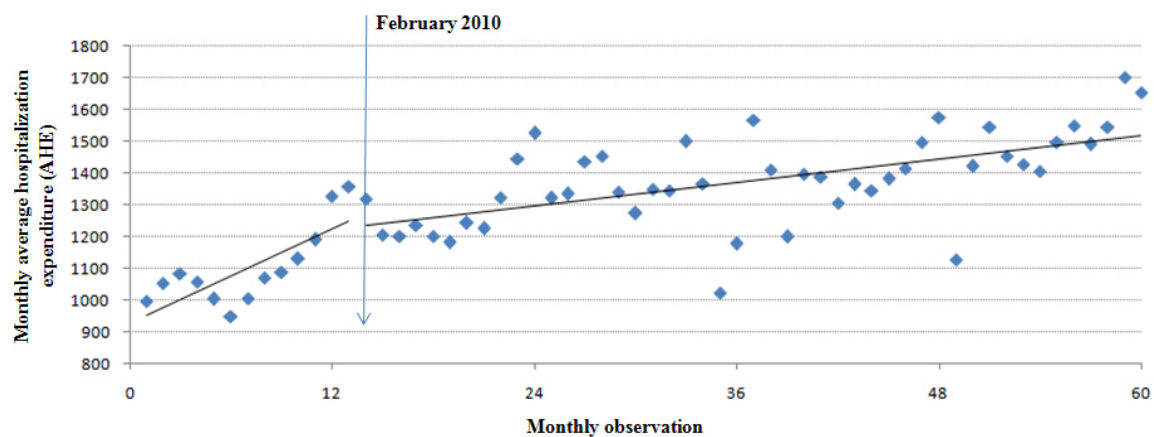


Figure 1. Trend in the AHE in the primary health institutions in Fufeng County

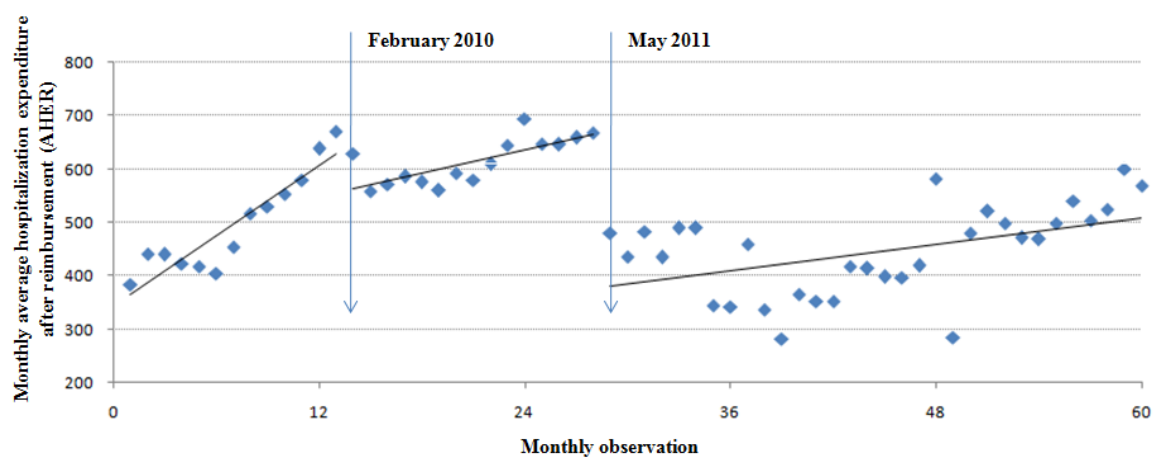


Figure 2. Trend in the AHER in the primary health institutions in Fufeng County