Short-term differences in drug prices after implementation of the national essential medicines system: A case study in rural Jiangxi Province, China

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ABSTRACT

Objectives: China’s 2009 national essential medicine system (NEMS) was designed to reduce prices through a zero-markup policy and a centralized bidding system. To analyze NEMS’s short-term impact on drug prices, we estimated the retail and wholesale prices before and after the reform at health institutions in rural Jiangxi Province.

Materials and Methods: We undertook two cross-sectional surveys of prices of 39 medicines in November 2008 and May 2010, calculated inflation adjusted prices, and used the Wilcoxon signed-rank and rank-sum tests to examine price changes at different health institutions.

Results: Retail prices at pilot (P < 0.01) and nonpilot (P < 0.01) township health centers decreased significantly, whereas the declines at retail pharmacies (P = 0.57) and village clinics (P = 0.29) were insignificant. The decline at pilot township health centers was the largest, compared with other kinds of health institutions (P < 0.01). Retail prices of essential and non-essential medicines declined significantly at pilot facilities (P < 0.05); price drops for non-essential medicines occurred only at pilot facilities (P < 0.05). No significant decline of wholesale prices were found at pilot (P = 0.86) and nonpilot units (P = 0.18), retail pharmacies (P = 0.18), and village clinics (P = 0.20). The wholesale prices changes at pilot units before and after the reform were higher than at nonpilot public units (P < 0.05), retail pharmacies (P < 0.05), and village clinics (P < 0.05).

Conclusion: While the NEMS zero-markup policy significantly reduced retail prices at pilot health institutions, the centralized bidding system was insufficient to lower wholesale prices. A drug price management system should be constructed to control medicine prices and a long-term price information system is needed to monitor price changes.

KEY WORDS: China, drug prices, healthcare reform, national essential medicine system, rural healthcare

Introduction

The poor accessibility of medicines in Chinese rural areas is mainly due to high prices engendered by the drug addiction policy. The 2009 national essential medicine system (NEMS) pilot program in Jiangxi Province used a zero-markup policy and centralized bidding system as the key pillars of its strategy for reducing the medicine prices.
Previous studies [1,3,12‑20] have not compared between pilot and nonpilot NEMS units or between essential and non-essential medicines. In this paper, we thus aim to determine whether the zero-markup policy reduced retail prices and whether the centralized bidding system reduced wholesale prices.

We hypothesized that the retail and wholesale prices would decrease more at pilot township health centers than at other institutions and that retail and wholesale prices would decrease more for essential medicines than for nonessential medicines. To investigate this, we undertook two cross-sectional surveys, using non-essential medicines and nonpilot units of NEMS as reference categories.

**Materials and Methods**

**Sampling**

Three types of grassroots healthcare institutions [township health centers (pilot units), township health centers that don’t participate in the NEMS reform), retail pharmacies, and village clinics] were identified as the sample units for this study’s survey, although the NEMS targeted government-sponsored township health centers in its first implementation. There were two main reasons: Firstly, we intended to compare the price changes between pilot and nonpilot NEMS units (including the nonpilot township health centers, retail pharmacies, and village clinics) to establish whether the price drop was attributable to the reform. Secondly, these institutions are the main sources from which rural residents obtain drugs.

Due to the strong support from Jiangxi’s Department of Food and Drug Supervision and Administration, all 91 counties with independent pharmaceutical supervision and administration departments were selected as areas for survey data collection.

We used a multistage sampling method. First, two townships were randomly sampled in every county. Second, one village was randomly sampled in every township. Third, one public township health center and one private retail pharmacy were randomly sampled in every township. Four, one private village clinic was randomly sampled in every village. In total, 182 public township health centers, 182 private retail pharmacies, and 182 private village clinics were chosen for data collection. Of the public township health centers, 85 (approximately 46.79%) were chosen as NEMS pilot units in 2009.

**Medicines Surveyed**

The initial implementation of NEMS focused on generic drugs. The 39 lowest-priced generic medicines were chosen based on several sources of information: Pharmaceutical sales information, local disease prevalence, and special Chinese considerations. Of these 39 medicines, 21 (53.85%) belong to the 2009 national essential medicines list, and 21 are traditional Chinese medicines (Table 1).

**Data Collection**

The cross-sectional survey was conducted at two points of time: November 2008, to estimate the prices before the NEMS reform, and May 2010, to estimate prices after the reform. The lowest wholesale and retail prices of the 39 medicines were collected for all types of health institutions.

For comparison purposes, prices of 2010 were adjusted for inflation using the consumer price index, taking 2008 as the base year.

A trained survey team was divided into several groups, each consisting of two drug supervisors and managers, one teacher, and one student majoring in health management. All survey personnel received training on standard survey methodologies and data collection/entry procedures prior to the survey. The resulting data were entered into a pre-designed database by two people using a double-entry technique.

**Statistical Analysis**

Medicine prices were expressed in median unit prices (MUPs), referring to the price per individual tablet, capsule, milliliter, gram, or dose. For the purpose of price comparison, two indicators were defined based on the MUPs. The median price/guide price ratio (MGR), an expression of medicine prices, was equal to the ratio of the median medicine price (wholesale or retail) to the guide price established by national development and reform commission. The change in MGR (MGRC) measures the change in MGR after the reform and is equal to the ratio of the 2010 MGR to the 2008 MGR.

First, we compared the MGRs for retail prices (wholesale price) before and after the zero-markup policy at each type of health institution and that between pilot institutions and other types of institutions, respectively, in 2008 and 2010. Then we compared the MGRCs between pilot township health centers and other kinds of health institutions. Given the non-normality of the data (as tested via the Kolmogorov–Smirnov test), we used the Wilcoxon signed-rank test to identify whether the differences were significant ($P < 0.05$ as the significance level). Finally, we compared the MGR and MGRC for essential and non-essential medicines across every type of institution, using a normality approximation (as per the following formula) of the Wilcoxon rank-sum test to identify the significance. All analyzes were completed using SPSS 16.0. (manufactured by SPSS China, with copyright acquired by Fudan University).

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Z = \frac{\left(\frac{\sum_{i=1}^{n} x_i}{n} - \mu \right)}{\sigma/\sqrt{n}}
\]

**Results**

For retail prices, 33 of the 39 medicines at pilot township health centers (84.62%), 28 at nonpilot township health centers (71.79%), 23 at retail pharmacies (58.97%), and 24 at village clinics (61.54%) saw price decreases. In addition, the MGRC of these four types of health units was respectively equal to 0.85, 0.95, 1.00, and 0.99. From 2008 to 2010, the significant price drops could be seen in essential and non-essential medicines at all types of institutions, while neither MGR changes of non-essential medicines at nonpilot health centers, retail pharmacies, and village clinics, nor that of all medicines at private sector were statistically significant [Table 2].

Before the reform, the mean MGR at public pilot sector was higher than at private retail pharmacies ($P < 0.01$) and rural clinics ($P < 0.01$), but no significant differences were found after the reform (retail pharmacies, $P = 0.58$; village clinics, $P = 0.26$). The MGR at the pilot unit was significantly lower than at nonpilot public unit ($P < 0.05$) after the reform, with the opposite before the reform ($P = 0.26$).
The mean MGRC at pilot township health centers was significantly lower than at nonpilot township health centers ($P < 0.01$), retail pharmacies ($P < 0.01$), and village clinics ($P < 0.01$), while the mean MGRC at nonpilot township health centers was insignificantly different from that at retail pharmacies ($P = 0.33$) or village clinics ($P = 0.20$).

For wholesale prices, there were five results consistent with the retail prices. Firstly, the mean MGR in the public sector in 2008 was significantly higher than in private sector ($P < 0.01$), but prices between pilot and nonpilot public sector were of insignificant difference. Secondly, in 2010, the MGR at nonpilot township health centers was higher than at retail pharmacies ($P < 0.01$) or village clinics ($P < 0.01$). Thirdly, the MGR changes before and after the reform at both retail pharmacies ($P = 0.18$) and village clinics ($P = 0.21$) were not statistically significant. Fourthly, no significant differences in the MGR between nonpilot township health centers and retail pharmacies ($P = 0.33$), or village clinics ($P = 0.20$) were acquired. Fifthly, the MGR of essential medicines was of significance in retail pharmacies and that of non‑essential medicines was of no significance in nonpilot health centers and private sector [Table 3].

Table 1: Surveyed medicines and their indicative prices

| Medicine                        | Dosage form          | Strength       | TCM | NEML 2009 |
|---------------------------------|----------------------|----------------|-----|-----------|
| Compound Danshen               | Tablet               | -              | Yes | Yes       |
| Buzhong yiqi pill               | Concentrated pill    | 3g/8 pill      | Yes | Yes       |
| Liwei Dihuang pill             | Concentrated pill    | 3g/8 pill      | Yes | Yes       |
| Amoxicillin                    | Capsule              | 250 mg         | No  | Yes       |
| Cefradine                      | Capsule              | 250 mg         | No  | No        |
| Cefalexins                     | Capsule              | 125 mg         | No  | Yes       |
| Ceftriaxone sodium             | Powder-injection     | 500 mg         | No  | Yes       |
| Metronidazole                  | Tablet               | 200 mg         | No  | Yes       |
| Banlangen granule              | Granule              | 10 g           | Yes | Yes       |
| Ranitidine hydrochloride       | Capsule              | 150 mg         | No  | Yes       |
| Levofloxacin hydrochloride     | Injection            | 200 mg         | No  | Yes       |
| Shuanghuanglian injection      | Injection            | 20 mL          | Yes | No        |
| Aspirin                        | Tablet               | 25 mg          | No  | Yes       |
| Yangxue danggui syrup          | Syrup                | 200 mL         | Yes | No        |
| Ceftaxime sodium               | Powder-injection     | 1 g            | No  | No        |
| Pediatric paracetamol, artificial cow-bezoar, and chlorphenamine maleate granules | Granules | 6 g | No | No |
| Qingkailing granules           | Granules             | 3 g            | Yes | Yes       |
| Qiangli Pipa distillate        | Syrup                | 120 mL         | Yes | No        |
| Paracetamol, caffeine, artificial cow-bezoar, and chlorphenamine maleate | Capsule | - | No | No |
| Compound Ejiao mixture         | Mixture              | 20 mL          | Yes | No        |
| Diao Xinxuekang                | Capsule              | 350 mg         | Yes | Yes       |
| Dexamethasone acetate ointment | Ointment             | 20 g           | No  | No        |
| Roxithromycin                  | Capsule              | 75 mg          | No  | No        |
| Jian weixiao shi tablet        | Tablet               | 800 mg         | Yes | No        |
| Shexiang zhuanggu plaster      | Plaster              | -              | Yes | No        |
| Miconazole                     | Ointment             | 20 g           | No  | No        |
| Ofloxacin eye drops            | Drops                | 15 mg          | No  | Yes       |
| Kang Gong Yan tablets          | Tablet               | 0.25 g         | Yes | No        |
| Huo xiang Zhen gai bolus       | Honey bolus          | 3 g            | Yes | No        |
| Jie Er Yin Xi Ye               | Lotion               | 350 mL         | Yes | No        |
| Compound Caoshanhu tablets     | Tablet               | 1 g            | Yes | No        |
| Red flower oil                 | Salve                | 20 mL          | Yes | No        |

*Each tablet contains 125 mg of 4-acetamidophenol, 5 mg of artificial bezoar, and 0.5 mg of chlorphenamine maleate. NEML=National essential medicine list, TCM=Traditional Chinese medicine.
Table 2: Retail prices changes at four types of health institutions

| Health institution type | Essential medicine or not | 2008    | 2010    | P       |
|-------------------------|---------------------------|---------|---------|---------|
| Township health centers (pilot) | Essential medicine | 0.67    | 0.49    | 0.000   |
|                          | Nonessential medicine    | 0.67    | 0.57    | 0.0260  |
|                          | All                       | 0.67    | 0.50    | 0.0000  |
| Township health centers (nonpilot) | Essential medicine | 0.69    | 0.60    | 0.000   |
|                          | Non-essential medicine    | 0.70    | 0.69    | 0.766   |
|                          | All                       | 0.69    | 0.62    | 0.003   |
| Retail pharmacies       | Essential medicine        | 0.59    | 0.52    | 0.000   |
|                          | Non-essential medicine    | 0.63    | 0.62    | 0.806   |
|                          | All                       | 0.61    | 0.55    | 0.567   |
| Village clinics         | Essential medicine        | 0.54    | 0.48    | 0.000   |
|                          | Non-essential medicine    | 0.60    | 0.56    | 0.472   |
|                          | All                       | 0.56    | 0.50    | 0.290   |

Table 3: Wholesale prices and price changes at four types of health institutions

| Health institution type | Essential medicine or not | 2008    | 2010    | P       |
|-------------------------|---------------------------|---------|---------|---------|
| Township health centers (pilot) | Essential medicine | 0.49    | 0.48    | 0.614   |
|                          | Nonessential medicine    | 0.50    | 0.51    | 0.528   |
|                          | All                       | 0.49    | 0.49    | 0.856   |
| Township health centers (nonpilot) | Essential medicine | 0.50    | 0.49    | 0.181   |
|                          | Non-essential medicine    | 0.53    | 0.50    | 0.396   |
|                          | All                       | 0.52    | 0.50    | 0.180   |
| Retail pharmacies       | Essential medicine        | 0.45    | 0.41    | 0.027   |
|                          | Non-essential medicine    | 0.53    | 0.49    | 0.372   |
|                          | All                       | 0.49    | 0.45    | 0.180   |
| Village clinics         | Essential medicine        | 0.45    | 0.42    | 0.543   |
|                          | Non-essential medicine    | 0.52    | 0.49    | 0.647   |
|                          | All                       | 0.48    | 0.45    | 0.204   |

While there were four results different from retail prices. Firstly, the mean MGR at pilot-township health centers in 2010 was higher than at retail pharmacies (P < 0.01) and village clinics (P < 0.01), but not higher than at nonpilot township health centers (P = 0.33). Second, neither the MGR changes at pilot-township health centers nor those at nonpilot township health centers were statistically significant [Table 3]. Third, the mean MGRC at pilot-township health centers was not significantly different from that at nonpilot township health centers (P < 0.05), retail pharmacies (P < 0.05), or village clinics (P < 0.05). Fourth, for both essential and non-essential medicines, the MGR changes at the pilot unit were of no statistical significance [Table 3].

Discussion

As hypothesized, retail prices at pilot health institutions decreased significantly after the NEMS reform. Furthermore, the price drop was larger than at any type of nonpilot health institution, including nonpilot township health centers, retail pharmacies, and village clinics. In other words, medicine prices in pilot government-sponsored institutions were no longer higher than those in the private sector. This suggests that the zero-markup policy did have the desired effect of reducing drug prices, because it removed the additional price markups. Thus, it appears that the NEMS zero-markup policy had a significant impact on retail medicine prices.

The fall in retail prices in the nonpilot public sector after the reform can be explained by a few factors. First, because of high medicine prices and their impact on patients’ medicine purchasing behavior, these facilities had incentives to decrease their retail prices for medicines to attract more patients for medicine purchasing and gain advantages in competition with pilot unit. Second, larger fiscal subsidies for health institutions reduced their motivation to obtain additional income through drug markups. Third, mandatory price-lowering policies (implemented more than 20 times) had positive effects. A significant decline in the prices of nonessential medicines at pilot institutions can be considered effects of the zero-markup policy and increased fiscal subsidies. They may also be linked to limited economic benefits, given the low use of non-essential medicines. The significant contrast between the price decline for essential medicines and the lack of decline for non-essential medicines at nonpilot health institutions could be interpreted as competition with pilot institutions. Because the pilot institutions were limited in their sales of non-essential medicines, nonpilot institutions may gain competitive advantages and greater profits by selling nonessential medicines, even at higher prices.

Several possible reasons explain the lack of a difference in retail price declines between essential and non-essential medicines. First, unclear policy on non-essential medicines led institutions to sell non-essential medicines at high prereform prices. This may have held down average retail prices of non-essential medicines. Second, gaining income from medicine markups, combined with a lack of effective supervision may have led doctors to prescribe medicines at higher prices. Third, insufficient government subsidies without timely regulatory treatment made it difficult for pilot institutions to survive financially, providing an incentive to prescribe the medicines at high prices.

However, in contrast to other studies and our hypothesis, there were no significant decrease in wholesale prices at any level of health institution, and the price changes at pilot health institutions were no more than at other institutions. Therefore, we found no evidence of decreases in wholesale prices, suggesting that the current centralized bidding system is insufficient.

The high wholesale prices in the public sector, when compared to the private sector in both 2008 and 2010, might be because the centralized pharmaceutical bidding and distribution system did not improve procurement efficiency as expected. One important reason might be like medicines, only one supplier was found; this may have led to monopoly pricing. Additionally, the pilot institutions had limited incentives to lower their purchase prices to gain higher profits because of the zero-markup policy; in the private sector, the incentive was just the opposite. Finally, prices for some medicines were already too low to reduce it further.

Through our analysis of retail and wholesale prices at nonpilot health institutions, huge markups (average profits of more than 20%) were found. This raises a new question: If the zero-markup policy is expanded in scope, will the local
government be able to afford the large revenue losses resulting from terminating drug price markups? Considering this and aiming to safeguard the sustainability of NEMS, greater efforts should be made to clarify the health service and drug pricing mechanisms as well as the compensation mechanisms such as charging pharmaceutical service fees.

This study has several important limitations. First, the medicines surveyed were limited and might not represent the entire market, considering the diverse dosage forms and strengths of many medicines. Second, we collected data at only two points of time at short intervals before and after the reform; these might not reflect the long-term effects of the reform or might even distort the actual effect of the zero-markup policy on retail prices. Third, our study only focused on medicine prices and did not consider sales amounts. As such, it does not fully reflect the burden of drug expenses. Further, the study focused on the lowest-priced generic equivalent drugs without including any originator brands. Widening the focus might result in different price changes because of the high prices of originator brands, as shown in past studies. [3,11,13‑20,22]

Based on our findings, further research should be undertaken in order to reduce the prices and ensure the sustainability of the NEMS reforms in grassroots healthcare institutions in rural areas. Such studies might examine the long-term impact of NEMS on drug prices, improving the efficiency of the centralized pharmaceutical bidding and distribution system to reduce the wholesale prices, and the rationality of fiscal subsidies and pharmaceutical service fees to relieve the financial pressures and ensure the continued operation of healthcare institutions.

In summary, the early stages of implementing NEMS in Jiangxi Province saw a relatively sharp decline in retail drug prices in pilot public sector institutions but no obvious changes in wholesale prices. Future policies should target the sustainability of NEMS, and more data should be collected to monitor its implementation.

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Conflicts of Interest

There are no conflicts of interest.

References

1. Tang R, Zhao G. Study on the accessibility of essential medicines in rural areas against the background of new medical accessibility reforms. Expanding Horiz 2010;1:18-20.
2. Song Y, Bian Y. An empirical analysis of the influence of the essential medicines system on accessibility in rural areas. Chin J Health Policy 2012;5:16-20.
3. Sun Q, Santoro MA, Meng Q, Liu C, Eggleston K. Pharmaceutical policy in China. Health Aff (Millwood) 2008;27:1042-50.
4. United Nations Millennium Development Goal (MDG) Gap Task Force 8. Delivering on the Global Partnership for Achieving the MDGs, Report; 2008. Available from: http://www.un.org/esa/policy/mdggap. [Last cited on 2009 Jul 28].
5. Hogerzeil HV. Essential medicines and human rights: What can they learn from each other? Bull World Health Organ 2006;84:371-5.
6. World Health Organization. WHO Medicines Strategy: Countries at the Core 2004-2007. Geneva: World Health Organization; 2008.
7. Department for International Development. Increasing Access to Essential Medicines in the Developing World: UK Government Policy and Plans. Available from: http://www.dfid.gov.uk/Pubs/files/accessmedicines.pdf. [Last cited on 2007 Nov 25].
8. Yip W, Eggleston K. Addressing government and market failures with payment incentives: Hospital reimbursement reform in Hainan, China. Soc Sci Med 2004;58:267-77.
9. Eggleston K, Ling L, Qingyue M, Lindelow M, Wagstaff A. Health service delivery in China: A literature review. Health Econ 2008;17:149-65.
10. National Development and Reform Commission. Opinions on further rectifying the medical and drug markets. Beijing: National Development and Reform Commission; 2006.
11. Guan X, Liang H, Xue Y, Shi L. An analysis of China’s national essential medicines policy. J Public Health Policy 2011;32:305-19.
12. Wang S, Chen H, Zhou W, Zhu Y, Yuan H, Wang L, et al. Measures and advices for sale prices of essential drugs primary medical institutions in Jiangxi’s. Chin Health Econ 2013;32:76-8.
13. Fang Y, Wagner AK, Yang S, Jiang M, Zhang F, Ross-Degnan D. Access to affordable medicines after health reform: Evidence from two cross-sectional surveys in Shaanxi Province, western China. Lancet Glob Health 2013;1:e227-7.
14. Chen L, Zhang M, Xu X. Guo L. A comparative analysis of drug prices and sales volume before and after implementation of the National Essential Medicines system in Fujian Province. Chin J Health Policy 2011;4:7-12.
15. He P, Liu B, Sun Q, Zuo G. Comparative analysis of drug prices in township health centers before and after the essential medicines system reform: Based on a survey in three counties of Anhui Province. Chin J Health Policy 2011;4:11-6.
16. Li X, Zhang Y, Liang H, Wu S. Empirical analysis of drug prices under the National Essential Medicine System. Chin Health Serv Manage 2012;12:906-8.
17. Jiang MH, Wang L, Wang W, Wang X, Fang Y, Yang S, et al. Comparative study on the price and availability of essential drugs in public hospital and retail pharmacy of Shaanxi Province. China Pharm 2013;24:308-13.
18. Wang S, Liu Y, Guan X. Empirical study of essential drug prices in parts of China. Chinese Health Serv Manage 2011;28:266-7, 309.
19. Guo R, Di L, Yang L, Zhao F, Tian L, Yang L. Comparative analysis of the price of essential medicines based on a survey of primary health care institutions and pharmacies in 18 provinces. Chin J Health Policy 2012;5:22-6.
20. Guan X, Li H, Liu Y, Shi L, Guo R. Empirical study of essential medicine prices in China. China Pharm 2013;24:2224-8.
21. Yang L, Li L, Huang Y, Hu M, Li Y, Xu T. Analysis of drug price bidding and sale-permission under centralized bidding on essential medicines in Sichuan Province in 2011. China Pharm 2012;23:1464-6.
22. Senaratna SM, Manampullanma U, Fernandopulle BM. Medicine prices, availability and affordability in Sri Lanka. Indian J Pharmacol 2011;43:60-3.