HealthAffairs

At the Intersection of Health, Health Care and Policy

Cite this article as:
Winnie Yip, Timothy Powell-Jackson, Wen Chen, Min Hu, Eduardo Fe, Mu Hu, Weiyan Jian, Ming Lu, Wei Han and William C. Hsiao
Capitation Combined With Pay-For-Performance Improves Antibiotic Prescribing Practices In Rural China
Health Affairs, 33, no.3 (2014):502-510
(published online February 26, 2014; 10.1377/hlthaff.2013.0702)

The online version of this article, along with updated information and services, is available at:
http://content.healthaffairs.org/content/33/3/502.full.html

For Reprints, Links & Permissions:
http://healthaffairs.org/1340_reprints.php

E-mail Alerts : http://content.healthaffairs.org/subscriptions/etoc.dtl

To Subscribe: http://content.healthaffairs.org/subscriptions/online.shtml

Health Affairs is published monthly by Project HOPE at 7500 Old Georgetown Road, Suite 600, Bethesda, MD 20814-6133. Copyright © 2014 by Project HOPE - The People-to-People Health Foundation. As provided by United States copyright law (Title 17, U.S. Code), no part of *Health Affairs* may be reproduced, displayed, or transmitted in any form or by any means, electronic or mechanical, including photocopying or by information storage or retrieval systems, without prior written permission from the Publisher. All rights reserved.

Not for commercial use or unauthorized distribution

Downloaded from content.healthaffairs.org by *Health Affairs* on February 10, 2015
at WORLD BANK

DOI: 10.1377/hlthaff.2013.0702
HEALTH AFFAIRS 33,
NO. 3 (2014): 502–510
©2014 Project HOPE—
The People-to-People Health
Foundation, Inc.

By Winnie Yip, Timothy Powell-Jackson, Wen Chen, Min Hu, Eduardo Fe, Mu Hu, Weiyan Jian, Ming Lu, Wei Han, and William C. Hsiao

Capitation Combined With Pay-For-Performance Improves Antibiotic Prescribing Practices In Rural China

Winnie Yip (winnie.yip@bsg.ox.ac.uk) is a professor of health policy and economics at the Blavatnik School of Government, University of Oxford, in the United Kingdom.

Timothy Powell-Jackson is a lecturer in the Department of Global Health and Development, London School of Hygiene and Tropical Medicine, in the United Kingdom.

Wen Chen is a professor in the School of Public Health, Fudan University, in Shanghai, China.

Min Hu is a lecturer in the School of Public Health, Fudan University.

Eduardo Fe is a senior researcher at the Blavatnik School of Government, University of Oxford.

Mu Hu is a professor of medicine at Peking University Third Hospital, in Beijing, China.

Weiyan Jian is an associate professor in the School of Public Health, Peking University Health Science Centre, in Beijing.

Ming Lu is a lecturer in the Department of Biomedical Informatics, Peking University Health Science Centre.

Wei Han is a researcher at the Blavatnik School of Government, University of Oxford.

ABSTRACT **Pay-for-performance in health care holds promise as a policy lever to improve the quality and efficiency of care. Although the approach has become increasingly popular in developing countries in recent years, most policy designs do not permit the rigorous evaluation of its impact. Thus, evidence of its effect is limited. In collaboration with the government of Ningxia Province, a predominantly rural area in northwest China, we conducted a matched-pair cluster-randomized experiment between 2009 and 2012 to evaluate the effects of capitation with pay-for-performance on primary care providers' antibiotic prescribing practices, health spending, outpatient visit volume, and patient satisfaction. We found that the intervention led to a reduction of approximately 15 percent in antibiotic prescriptions and a small reduction in total spending per visit to village posts—essentially, community health clinics. We found no effect on other outcomes. Our results suggest that capitation with pay-for-performance can improve drug prescribing practices by reducing overprescribing and inappropriate prescribing. Our study also shows that rigorous evaluations of health system interventions are feasible when conducted in close collaboration with the government.**

There have been substantial increases in health spending worldwide in recent decades. Yet it is not clear how much the quality of care and health outcomes have improved as a result. Many health systems could make much better use of their resources than they do now: The World Health Organization estimates that waste through inefficiency accounts for 20–40 percent of spending on health care.[1] A key challenge attracting significant policy attention is how to align providers' incentives with societal goals of improving quality and efficiency.

Paying providers based on their performance as a way to improve quality and efficiency has become a major part of reforms in the United States and United Kingdom,[2–4] as well as in many other advanced economies. More recently, pay-for-performance has also been introduced in various forms in developing countries, often directed at maternal and child health care and specific public health interventions.[5]

Evidence on the effectiveness of pay-for-performance is very limited because many studies do not have a design that permits the rigorous evaluation of causal impacts. A 2012 Cochrane review on pay-for-performance in low- and middle-income countries found that the evidence base was too weak to draw general conclusions: The vast majority of studies were identified as having a high risk of bias.[6]

Downloaded from content.healthaffairs.org by *Health Affairs* on February 10, 2015
at WORLD BANK

Only two studies—one in the Philippines[7] and the other in Rwanda[8]—have used rigorous designs, and their results were mixed. The researchers in the Philippines reported improvements in quality of care, measured through clinical vignettes. Unpublished data also showed improvements in some health outcomes (wasting due to undernutrition and self-reported health status) but not in others (levels of C-reactive protein—a marker for inflammation in the body—and hemoglobin).[6] The intervention in the Rwanda study improved the quality of antenatal care and increased the number of child preventive care visits and facility-based deliveries, but it had no impact on antenatal care visits or immunization rates.[8]

This article contributes to the literature on payment reform by evaluating a pay-for-performance program through a social experiment in rural China. We examined the effect on prescribing practices, spending on care, outpatient visit volume, and patient satisfaction of changing the payment method for primary health care providers from traditional fee-for-service to capitation with pay-for-performance. In collaboration with the local government, we designed the policy evaluation as a matched-pair randomized control study in which the focus was on primary health care providers, since they are a pillar of China's health reform plan that was announced in 2009.[9]

Approval for the study was obtained from the University of Oxford's Ethical Review Committee and Ningxia Medical University's Ethical Review Board.

The Policy Context In China

In April 2009 the Chinese government launched a national program of health care reform. The government doubled its health spending, with the goal of providing affordable, equitable, and effective health care for everyone by 2020.[9] By 2012, as a result of substantial government subsidies, 95 percent of the country's population had health insurance.[10,11]

However, costs have escalated.[10,11] As a result, the expansion of coverage and corresponding increases in reimbursement rates have not resulted in reductions in users' out-of-pocket spending.[10,11] At the same time, there has been no evidence of improvement in the quality of the care provided.[10–12]

Key concerns in China are the overprescribing of antibiotics—they are prescribed far in excess of levels recommended by the World Health Organization[13,14]—and antibiotics' use for inappropriate purposes, such as to treat the common cold.[12,15] Although the government has issued numerous guidelines on the appropriate use of antibiotics, the guidelines' effect has been limited.[16]

Not only is overprescription costly and inefficient, but it also has long-term negative health effects because it produces drug resistance.[17] There are multiple causes of antibiotic overprescription. However, perverse financial incentives faced by health care providers are a major culprit.[18]

Since the 1980s China's health care providers have been paid by fee-for-service. They are also reimbursed according to a distorted government-set fee schedule that includes a profit margin for diagnostic tests and examinations. Finally, government policy allows providers to charge a 15 percent markup on drugs that they prescribe and dispense to patients. These factors have led to the excessive prescription of drugs and the ordering of diagnostic tests that are not clinically necessary.[18]

Primary health care providers have limited training in performing diagnostic tests and examinations, and also limited capacity to perform tests and exams. Thus, their treatment behavior has been shaped by the desire to maximize revenue from selling drugs.[18]

China has recently announced various reforms that are designed to increase providers' incentives to reduce unnecessary care and deliver high-quality services. In its latest Five-Year Plan (covering the period 2012–16), the Chinese government made provider payment reform a top priority as a way to achieve its goal of affordable, equitable, and effective health care for everyone. Notably, the central government has urged local governments to pilot provider payment methods other than fee-for-service, especially innovative methods aimed at both improving quality and controlling spending growth.[19,20]

There have been a limited number of studies on payment reform in China. Although the results of these studies are encouraging, they may be affected by selection bias.[21,22]

Study Data And Methods

SETTING Ningxia Province is in the northwest of China. The province has a population of 6.3 million, and its per capita income is third from the lowest in the country.[23] The most prevalent infectious diseases in Ningxia are viral hepatitis, tuberculosis, syphilis, dysentery, and scarlet fever.[24] As is the case in other parts of China, circulatory system diseases and cancer are the leading causes of death.[25]

In China the central government sets broad policy directions and leaves decisions about policy details to local governments. In the case of the

William C. Hsiao is the K.T. Li Professor of Economics in the Harvard School of Public Health, in Boston, Massachusetts.

Downloaded from content.healthaffairs.org by *Health Affairs* on February 10, 2015
at WORLD BANK

New Cooperative Medical Scheme (NCMS), the national public health insurance program for rural areas, local governments have the authority to determine the design of the benefit package and how providers are paid. With the goal of improving the quality and efficiency of health care in Ningxia, the leaders of the province's government invited us to help design alternative NCMS policy options and conduct evaluations of the options before possibly scaling them up for use in the whole province.

Ningxia has twenty-two counties, about half of which are mountainous and half of which are in the plains. We selected for our study two mountainous counties in which there had been no recent pilot projects of health reforms. In 2009, when we began our study, there were 28 towns, 266 villages, and about 600,000 people in the two counties combined. Our study population consisted of all NCMS enrollees in the counties. The NCMS enrollment rate in the counties was more than 97 percent in 2009.

In Ningxia and the rest of China, the NCMS paid primary health care providers—either township health centers or village posts, the equivalent of community health clinics—on a fee-for-service basis. In 2006 Ningxia's government introduced a policy of no drug profits for the township health centers and village posts under the centers' supervision (the policy was implemented nationwide in the period 2009–11).

This meant that providers could no longer earn money by selling drugs, although they could still charge separate fees for specific services such as injections. Despite the policy change, at the baseline of our study antibiotics were still prescribed frequently—in 49 percent of the visits to township health centers and 38 percent of the visits to village posts.

POLICY INTERVENTION This study's policy intervention changed NCMS payments to township health centers and village posts from fee-for-service to a capitated budget with pay-for-performance. The capitation rate was estimated to cover the cost of outpatient services per NCMS enrollee at each township health center and all the village posts under its supervision. The capitated budget for each center was based on the number of NCMS enrollees in the relevant town and the villages whose posts the center supervised.

At the beginning of every year, the NCMS disbursed 70 percent of the budget to the township health centers, withholding the balance until after performance assessments of both the centers and the village posts at the middle and end of the year (each center in turn disbursed a share of the 70 percent to the village posts under its supervision). Performance assessments of township health centers were conducted by a committee whose members represented the provincial and county departments of health and the county NCMS office. Assessments of village posts were performed by representatives of the supervising township health center, the county department of health, and the county NCMS office.

After each assessment, the county NCMS office compared the performance score for each township health center to the average score in the county. Each center that scored above the average received more than the 30 percent of the budget that had been withheld, in proportion to how much above the county average its score was. Each center that scored below the average received less than the 30 percent, in proportion to how much lower than average its score was.

Performance scores of the village posts formed part of the township health centers' scores. This gave each center an incentive to improve the quality of care at the village posts it supervised. Each center gave those village posts a share of its performance payment, based on the score each post received in comparison to the average of all the posts supervised by the center.

We designed performance indicators to be used during the study period, which began in July 2010. The indicators included antibiotic prescription rates (oral and by injection) and measures of patient satisfaction (see online Appendix Exhibit A1).[26] To prevent providers from reducing service volume under a capitation budget, the NCMS specified quantity thresholds. Providers who did not meet the threshold had to return prepaid funds to the NCMS.

DATA The main outcome measures were the proportion of patient visits that included one or more prescriptions for antibiotics, total health care expenditure per visit, drug expenditure per visit, the number of patient consultations per day in a facility, and patient satisfaction. We analyzed each outcome by township health center and village post. We also examined the results by oral or injectable antibiotics separately. We did this because under the fee-for-service system and the provincewide policy of no drug profits, providers had greater incentives to prescribe injectable antibiotics than oral ones: They earned a profit by charging a fee for administering an injection but no profit for selling oral antibiotics.

Data were mostly drawn from an electronic management information system that was set up for the purposes of the study. It recorded every outpatient visit to township health centers and village posts for all NCMS enrollees. Each record included the patient's characteristics (age, sex, and residence) and diagnoses, details of drugs prescribed and tests and examinations ordered, and expenditure.

Downloaded from content.healthaffairs.org by *Health Affairs* on February 10, 2015
at WORLD BANK

The intervention appears to have reduced the rate of antibiotic use across the entire distribution in both the centers and the posts.

We used deidentified data for visits from January 1, 2011, through June 30, 2012, because the data input process was not standardized before this period. Data on drugs prescribed and expenditures were validated by the provincial and county NCMS offices as part of their routine audits of services eligible for payment by the NCMS.

Data on patient satisfaction were taken from a household survey conducted in 2009 and 2012 whose respondents were representative of people in the study area. Respondents were asked to rate their satisfaction with health services provided by township health centers and village posts on a scale of one (least satisfied) to five (most satisfied). We aggregated the scores across seven different dimensions of service quality (see Appendix Exhibit A2).[26]

To compare the characteristics of intervention and control clusters (described below) at baseline in 2009, we used data from a survey of township health centers and village posts and from the survey of households. (Appendix Exhibit A2 describes each data source.)[26]

EXPERIMENTAL DESIGN We used matched-pair cluster randomization to assign the twenty-eight towns in the study area to intervention and control groups. Each cluster consisted of one of the twenty-eight township health centers, the village posts under that center's supervision, and the population in its catchment area. On average, each cluster included eleven village posts, and each post served 1,500 people. The majority of village posts had only one doctor on staff.

We paired clusters before randomly assigning them to the two groups, ensuring that the clusters in each pair were as similar as possible on a range of baseline characteristics (see the Appendix).[26,27] We flipped a coin to randomly assign one cluster from each pair to receive the policy intervention described above, starting in July 2010. The other cluster in the pair was assigned to the control group.

All towns agreed to their assignment. However, a small township health center in the control group lost its manager after the intervention began. The county health bureau requested that one of the intervention township health centers (not in the same matched pair) assume management responsibility for the center that had lost its manager. As a result, the center in the control group was subjected to capitation plus pay-for-performance incentives. We therefore dropped from our analysis the paired cluster to which this control center belonged. These events could not have been anticipated, and they serve to illustrate the "politically robust" usefulness of the pair-cluster randomized design in this setting.[27]

Identical training on appropriate drug prescription was provided to both intervention and control township health centers and village posts. At the time of writing, the intervention is ongoing in the intervention clusters.

In the Appendix we present evidence to show that there was no patient sorting, which occurs when patients with different health conditions or severity of illness systematically choose providers in the intervention or control group. We also present evidence that there was little contamination—which occurs when a control group adopts incentives similar to those of the intervention group—across clusters.[26]

STATISTICAL ANALYSIS We examined the effect of the intervention by estimating regressions of each outcome on a binary indicator of treatment status. We used a logistic regression and least squares regressions for binary and continuous outcomes, respectively. We report both unadjusted estimates and those adjusted for patients' sex, patients' age, and a dummy variable for cluster-pair fixed effects. Robust standard errors were clustered at the town level.

For all outcomes except patient satisfaction, we conducted a subgroup analysis by sex. For antibiotic use, we report results for a sample of patients diagnosed with a cold to provide more clear-cut evidence on the extent of unnecessary prescribing practices. See the Appendix for details.[26]

LIMITATIONS Our study has a few limitations. First, our study design did not allow us to isolate the separate effects of capitation and pay-for-performance. In the policy evaluation we conducted in close collaboration with the provincial government, we did not have the opportunity to test multiple intervention arms.

Second, we examined only one measure of quality: antibiotic prescriptions. Scientific and rigorous evidence is urgently needed on the impact of pay-for-performance on primary health

Downloaded from content.healthaffairs.org by *Health Affairs* on February 10, 2015
at WORLD BANK

care providers' success in preventing and managing noncommunicable diseases, given the growing burden of such diseases in both urban and rural China. The next few phases of the intervention we studied, which will reward providers who do well at preventing and managing tuberculosis and hypertension, are designed to shed light on this point.

Third, we were not able to test whether the impact of the intervention would vary with different study designs. For example, we could not assess the amount of performance-based income needed to elicit changes in providers' behavior, the relative effectiveness of using rewards versus penalties, or the impact of relative versus absolute performance standards.

Fourth, our study took place in two poor counties in northwestern China. To what extent the results are replicable in areas with different socioeconomic characteristics should be tested. Heterogeneity in the management and implementation of a complex intervention is likely to be a key determinant of its effectiveness.

Study Results

The characteristics of people living in the study clusters assessed at baseline in the household survey were found to be similar in the intervention and control groups, with the exception of ethnicity: The intervention group was 61 percent Han and 39 percent Hui, whereas the control group was 47 percent Han and 53 percent Hui. Educational attainment and per capita consumption expenditure in the study population were low by Chinese standards.

Township health center and village post characteristics in the two groups also appeared to be similar (see Appendix Exhibits A3 and A4).[26] There were no notable differences on a wide range of variables measured at baseline in the health care provider survey.

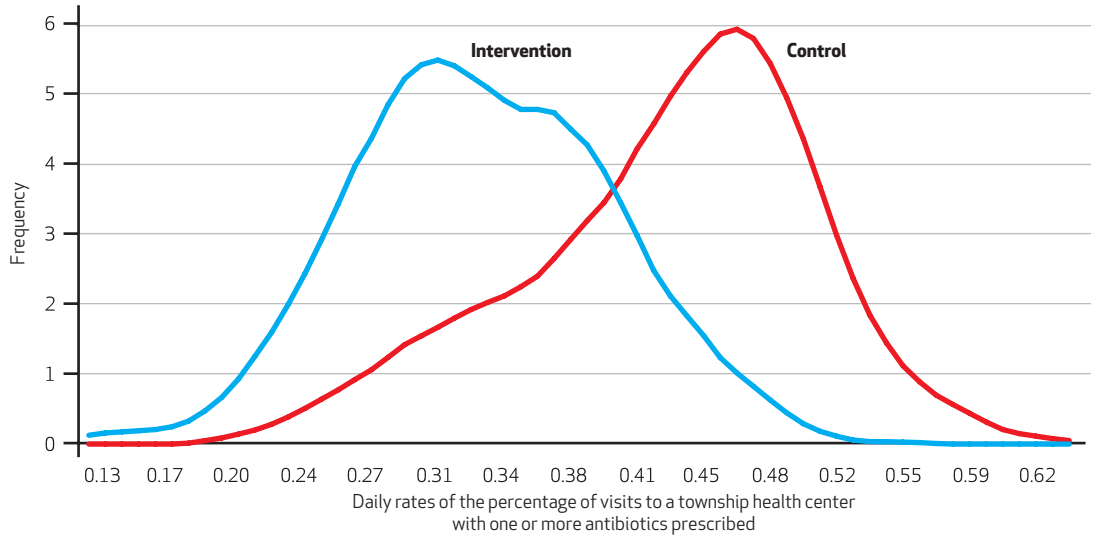
The primary purpose of the study was to assess the causal effect of capitation with pay-for-performance (relative to fee-for-service) on antibiotic prescribing practices. Exhibits 1 and 2 show the distribution of daily rates of visits to a center or post in which the provider prescribed one or more antibiotics. They show that visits to intervention facilities were less likely than visits to control facilities were to include an antibiotic prescription. The intervention appears to have reduced the rate of antibiotic use across the entire distribution in both the centers and the posts.

Antibiotic use in the study area was high. In the control group, antibiotics were prescribed in 44 percent of patient visits at the town level and 34 percent of visits at the village level (Exhibit 3). The intervention of capitation with pay-for-performance led to a reduction in the use of antibiotics of 6.6 percentage points at the township health centers (an adjusted risk ratio of 15 percent) and 6.0 percentage points at the village posts (an adjusted risk ratio of 16 percent).

At both the centers and the posts, the effect

EXHIBIT 1

Frequency Distribution Of The Percentage Of Visits In A Day To A Township Health Center In Which The Provider Prescribed One Or More Antibiotics, In Two Study Counties In Ningxia Province, China, January 2011–June 2012

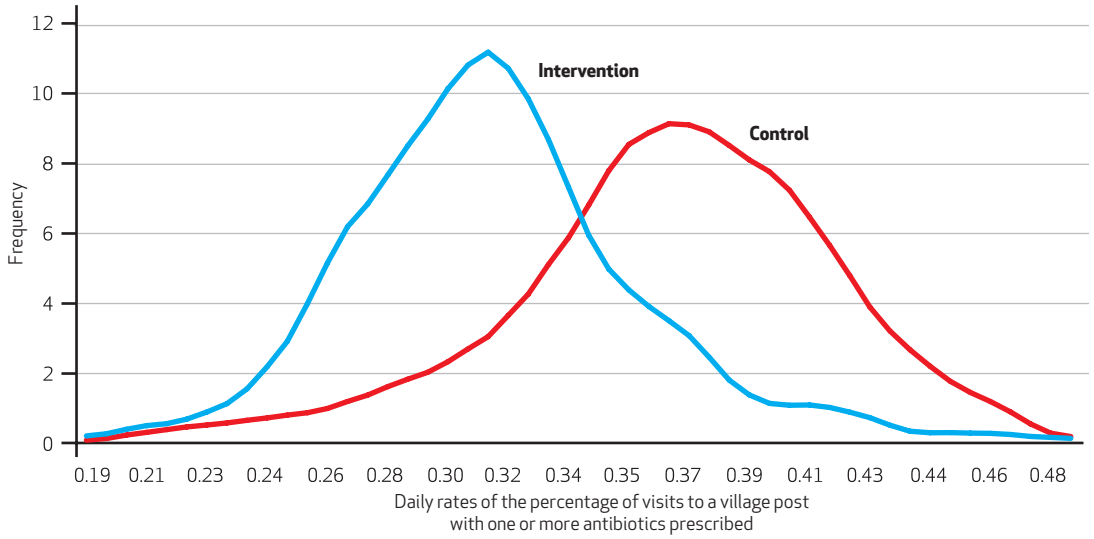


SOURCE Authors' analysis of study data. **NOTE** The probability density functions show the probabilities over ranges of daily rates of the percentage of visits to a center resulting in one or more antibiotics' being prescribed.

Downloaded from content.healthaffairs.org by *Health Affairs* on February 10, 2015
at WORLD BANK

EXHIBIT 2

Frequency Distribution Of The Percentage Of Visits In A Day To A Village Post In Which The Provider Prescribed One Or More Antibiotics, In Two Study Counties In Ningxia Province, China, January 2011–June 2012



SOURCE Authors' analysis of study data. **NOTE** The probability density functions show the probabilities over ranges of daily rates of the percentage of visits to a village post resulting in one or more antibiotics' being prescribed.

was driven largely by a reduction in the use of injectable antibiotics (Exhibit 3), although the result for the centers was not significant if it was subjected to a multiple outcome comparison test. The intervention also led to a reduction in the use of oral antibiotics, but that was insignificant.

When we considered only patients diagnosed with a cold, a self-limiting condition for which antibiotics are unequivocally unnecessary, the adjusted estimates for the treatment effect were large (Exhibit 3). This suggests that the intervention led to a reduction in the inappropriate use of antibiotics. The treatment effect in the subgroup of patients with a cold was considerably different from that in the subgroup of patients without a cold at both township health centers and village posts (data not shown).

At both the township and village levels, the change in the payment system had comparable effects on male and female patients (Exhibit 3).

The total expenditure per visit in the control group was 20.9 yuan at the township health centers and 16.6 yuan at the village posts (Exhibit 4). The intervention had no effect on total expenditure or the expenditure for drugs alone at the township level, regardless of patients' sex. The distribution of expenditures per visit in the control and intervention groups lends further support to this finding (see Appendix Exhibits A7 and A8).[26]

However, at the village level, adjusted estimates show that the intervention led to a significant reduction in total expenditures: 1.04 yuan per visit, equivalent to a 6 percent decrease (Exhibit 4). With respect to drug expenditures alone, the treatment effect at the village level was close to zero.

EXHIBIT 3

Visits With Antibiotic Prescription To Township Health Centers And Village Posts In Two Study Counties In Ningxia Province, China, January 2011–June 2012

	Visits with antibiotic prescription, control group (%)	Treatment effect (percentage points)	
		Unadjusted	Adjusted[a]
ANTIBIOTIC USE IN TOWNSHIP HEALTH CENTERS			
All antibiotics	44.2	−10.7**	−6.6**
Oral antibiotics	27.9	−4.2	−1.4
Injectable antibiotics	20.8	−7.8*	−5.1*
For patients diagnosed with a cold	50.6	−4.9	−9.3**
For male patients	43.6	−9.7*	−6.3**
For female patients	44.7	−11.8**	−6.8**
ANTIBIOTIC USE IN VILLAGE POSTS			
All antibiotics	34.2	−5.2	−6.0**
Oral antibiotics	27.5	−2.5	−2.7
Injectable antibiotics	12.3	−3.9**	−4.1***
For patients diagnosed with a cold	38.4	−12.9*	−16.0****
For male patients	33.0	−6.0	−6.8**
For female patients	35.4	−4.4	−5.2*

SOURCE Authors' analysis of study data. **NOTES** There were 440,473 patient visits (208,482 in the treatment group and 231,991 in the control group) in the township health center analysis and 714,661 patient visits (338,185 in the treatment group and 376,476 in control group) in the village post analysis. [a]Adjusted for cluster-pair fixed effects and patients' sex and age. *$p < 0.10$ **$p < 0.05$ ***$p < 0.01$ ****$p < 0.001$

Downloaded from content.healthaffairs.org by *Health Affairs* on February 10, 2015
at WORLD BANK

EXHIBIT 4

Expenditures Per Visit To Township Health Centers And Village Posts In Two Study Counties In Ningxia Province, China, January 2011–June 2012

Patients	Expenditure, control group (yuan)[a]	Treatment effect (yuan)	
		Unadjusted	Adjusted[b]
TOTAL EXPENDITURE PER VISIT, TOWNSHIP HEALTH CENTERS			
All	20.91	−0.45	0.02
Male	20.25	−0.46	−0.04
Female	21.56	−0.40	0.12
TOTAL EXPENDITURE PER VISIT, VILLAGE POSTS			
All	16.57	−0.47	−1.04***
Male	15.95	−0.41	−1.01***
Female	16.81	−0.51	−1.07***
DRUG EXPENDITURE PER VISIT, TOWNSHIP HEALTH CENTERS			
All	18.55	−1.07	−0.88
Male	18.31	−1.05	−0.79
Female	18.78	−1.07	−0.97
DRUG EXPENDITURE PER VISIT, VILLAGE POSTS			
All	11.41	0.10	−0.24
Male	11.07	0.15	−0.22
Female	11.78	0.06	−0.27

SOURCE Authors' analysis of study data. **NOTES** Total expenditures and drug expenditures were trimmed at the 99.95 percentile. There were 440,144 observations (208,300 in the treatment group and 231,844 in the control group) in the township health center trimmed sample and 714,304 observations (338,031 in the treatment group and 376,273 in the control group) in the village post trimmed sample. Total expenditure is visit fee and spending on drugs, tests, and diagnostics. [a]In 2011, $1 equaled 6.4614 yuan. [b]Adjusted for cluster-pair fixed effects and patients' sex and age. ***$p < 0.01$

In theory, capitation could provide incentives to underprovide health care. Thus, we examined the effect of the intervention on patient volume. We did not find any substantial effect at either the township health centers or the village posts (see Appendix Exhibit A9).[26] The estimated treatment effects were negative but insignificant, possibly because of the volume-threshold requirement (described above) that was built into the intervention.

Finally, we found no evidence that the intervention had an impact on patients' satisfaction with the health care services provided by township health centers or village posts (Appendix Exhibit A9).[26]

In Appendix Exhibits A11 and A12,[26] we explore household data to test whether providers "task shifted"—that is, reduced the time they devoted to tasks that were not incentivized by the intervention, such as providing maternal and child health services, and increased the time devoted to tasks that were incentivized. These results reveal no evidence of task shifting. However, given the small sample sizes, these results should be interpreted with caution.

Discussion

This study provides new evidence on the impact of using capitation with pay-for-performance on antibiotic prescribing practices and other outcomes in a developing country. Rigorous policy evaluations of performance-based incentives are difficult to conduct because the incentives usually have to be embedded in complex health system reforms, in which assignment of the intervention is done in a nonrandom way. In our collaboration with the Ningxia Province government, we were able to implement an experimental design and contribute to the small but growing body of evidence on pay-for-performance in developing countries.[6]

We found that the intervention had a moderate but demonstrable effect in reducing primary health care providers' prescriptions of antibiotics, especially injectable antibiotics. We did not analyze whether this change in prescribing behavior was appropriate or not from a clinical perspective. However, these results are encouraging, given China's overuse of antibiotics and the drug resistance associated with that overuse. A reduction in the use of injectable antibiotics could also reduce the risks of spreading bloodborne viruses and infusion site infections.[28]

The effect of the intervention on prescriptions for oral antibiotics was smaller (and statistically insignificant), compared to the effect on prescriptions for injectable antibiotics. This was the case in spite of the fact that oral and injectable antibiotic prescriptions carried equal weight (25 percent each) in the total performance scores of the centers and posts. The difference is probably because capitation with pay-for-performance not only provided rewards for giving fewer injections, such as oral antibiotics, but it also eliminated the service fee of 5 yuan per injection that existed under fee-for-service.

These findings have important implications beyond China, given the widespread overuse and inappropriate use of antibiotics worldwide. One study estimated that the overuse of antibiotics to treat acute respiratory tract infections in low- and middle-income countries contributes an additional 36 percent to the average cost of care.[29] If the overuse of antibiotics were reduced, the savings could be spent on interventions that are more cost-effective than unnecessary antibiotics.

Our study did not find that capitation with pay-for-performance had significant effects on visit spending, except for total spending at the village level—and even there the magnitude of the effect was small. One plausible explanation of this result is that the effects on spending were muted by other ongoing policies.

Health spending is determined by the price, quantity and intensity of the services provided. Towns in both the intervention and control

Downloaded from content.healthaffairs.org by *Health Affairs* on February 10, 2015
at WORLD BANK

Capitation combined with pay-for-performance offers a promising way to improve specific dimensions of the quality of primary care.

groups in our study were subject to various provincewide policies intended to reduce drug prices, including centralized competitive tendering and purchasing, the use of an essential drugs list, and a policy of no profits for providers from selling drugs. If the policies had already reduced drug prices by a substantial amount, the effect of our intervention on expenditures would have been diluted. Unfortunately, we cannot know for certain if that happened, since there is no rigorous evidence on the impact of the other policies.

Policy Lessons

From a policy perspective, our study showed that capitation combined with pay-for-performance offers a promising way to improve specific dimensions of the quality of primary care—an improvement that is a pillar of China's health care reform. The government of Ningxia Province has decided to scale the intervention up to the entire province. Our study offers a few additional lessons.

PREVALENCE OF ANTIBIOTIC PRESCRIBING First, despite the implementation of the policy of no profits for providers from selling drugs, the prescribing of antibiotics remains prevalent. The policy of zero drug profits needs to be accompanied by appropriate financial incentives to motivate providers to adopt clinical practices that will improve the quality of care.

EFFECT OF FINANCIAL INCENTIVES ALONE Second, financial incentives may not be able to improve clinical practices on their own—although they might succeed in doing so if they are aligned with quality improvement goals. The persistently high rates of use of oral and injectable antibiotics even after the intervention probably reflect both inertia in physicians' practice patterns and continued demand from patients, for whom antibiotics and injections are synonymous with high-quality care. Provider payment reform probably needs to be accompanied by training for providers and health education for patients.

TIME HORIZON FOR PAYMENT SYSTEM EFFECTS Third, a new payment system may not have immediate effects. Providers' behavior cannot be changed overnight. It took almost a year for providers at the township health centers and village posts to understand the incentives embedded in the new payment system and to change their management and clinical practices accordingly. Any provider payment reform should be combined with training for managers on financial, human resource, and quality issues to maximize the reform's benefits. A management information system and an organizational structure that make it possible to assess providers' performance objectively are also necessary for pay-for-performance to work.

Conclusion

China and other countries often introduce a set of reforms simultaneously and across the board, without building into the reforms' design the collection of data needed to evaluate the relative contribution of each reform individually and to permit midcourse corrections before the large-scale adoption of a given policy or the making of future policy. Our study shows that collaborating with local governments to conduct policy evaluations of health system interventions is a powerful way to generate scientifically rigorous evidence on health system policies. ■

The authors thank policy makers in Ningxia Province for their collaboration, and they thank faculty members and researchers at Ningxia Medical University for conducting surveys and monitoring the implementation of the interventions. The study was funded by the Bill & Melinda Gates Foundation and a European Commission Seventh Framework Programme research grant (Grant No. HEALTH-F2-2009-223166-HEFPA). The World Bank's Strategic Impact Evaluation Fund (Grant No. TF094336) provided seed funding at the planning stage. The funders had no role in study design, data collection and analysis, decision to publish, or manuscript preparation. [*Published online February 26, 2014.*]

Downloaded from content.healthaffairs.org by *Health Affairs* on February 10, 2015
at WORLD BANK

NOTES

1 World Health Organization. The world health report—health systems financing: the path to universal coverage. Geneva: WHO; 2011.
2 Doran T, Fullwood C, Gravelle H, Reeves D, Kontopantelis E, Hiroeh U, et al. Pay-for-performance programs in family practices in the United Kingdom. N Engl J Med. 2006;355(4):375–84.
3 Epstein AM, Lee TH, Hamel MB. Paying physicians for high-quality care. N Engl J Med. 2004;350(4):406–10.
4 Sutton M, Nikolova S, Boaden R, Lester H, McDonald R, Roland M. Reduced mortality with hospital pay for performance in England. N Engl J Med. 2012;367(19):1821–8.
5 Eichler R, Levine R, Performance-Based Incentives Working Group. Performance incentives for global health: potential and pitfalls [Internet]. Washington (DC): Center for Global Development; 2009 [cited 2014 Jan 23]. Available from: http://www.cgdev.org/sites/default/files/9781933286297-Levine-performance-incentives.pdf
6 Witter S, Fretheim A, Kessy FL, Lindahl AK. Paying for performance to improve the delivery of health interventions in low- and middle-income countries. Cochrane Database Syst Rev. 2012;2:CD007899.
7 Peabody J, Shimkhada R, Quimbo S, Florentino J, Bacate M, McCulloch CE, et al. Financial incentives and measurement improved physicians' quality of care in the Philippines. Health Aff (Millwood). 2011;30(4):773–81.
8 Basinga P, Gertler PJ, Binagwaho A, Soucat ALB, Sturdy J, Vermeersch CMJ. Effect on maternal and child health services in Rwanda of payment to primary health-care providers for performance: an impact evaluation. Lancet. 2011;377(9775):1421–8.
9 Chen Z. Launch of the health-care reform plan in China. Lancet. 2009;373(9672):1322–4.
10 Meng Q, Xu L, Zhang Y, Qian J, Cai M, Xin Y, et al. Trends in access to health services and financial protection in China between 2003 and 2011: a cross-sectional study. Lancet. 2012;379(9818):805–14.
11 Yip WC, Hsiao WC, Chen W, Hu S, Ma J, Maynard A. Early appraisal of China's huge and complex health-care reforms. Lancet. 2012;379(9818):833–42.
12 Li Y, Xu J, Wang F, Wang B, Liu L, Hou W, et al. Overprescribing in China, driven by financial incentives, results in very high use of antibiotics, injections, and corticosteroids. Health Aff (Millwood). 2012;31(5):1075–82.
13 Isah AO, Ross-Degnan D, Quick J, Laing R, Mabadeje AFB. The development of standard values for the WHO drug use prescribing indicators [Internet]. Geneva: World Health Organization; 1997 [cited 2014 Jan 31]. Available from: http://archives.who.int/icium/icium1997/posters/1a2_txt.html
14 World Health Organization. Using indicators to measure country pharmaceutical situations: fact book on WHO Level I and Level II monitoring indicators [Internet]. Geneva: WHO; 2006 [cited 2014 Jan 30]. Available from: http://www.who.int/entity/ medicines/publications/WHOTCM2006.2A.pdf
15 Dong L, Yan H, Wang D. Antibiotic prescribing patterns in village health clinics across 10 provinces of Western China. J Antimicrob Chemother. 2008;62(2):410–5.
16 People's Republic of China Ministry of Health. Regulation on the clinical application of antibiotics. Beijing: Government of China; 2012. Chinese.
17 Yezli S, Li H. Antibiotic resistance amongst healthcare-associated pathogens in China. Int J Antimicrob Agents. 2012;40(5):389–97.
18 Yip WC, Hsiao WC, Meng Q, Chen W, Sun X. Realignment of incentives for health-care providers in China. Lancet. 2010;375(9720):1120–30.
19 People's Republic of China Ministry of Human Resources and Social Security. Guidance on promoting provider payment reform. Beijing: Government of China; 2011. Chinese.
20 People's Republic of China State Council. Plan on health care system reform (2012–2015). Beijing: Government of China; 2012. Chinese.
21 Cheng T-M. A pilot project using evidence-based clinical pathways and payment reform in China's rural hospitals shows early success. Health Aff (Millwood). 2013;32(5):963–73.
22 Wang H, Zhang L, Yip W, Hsiao W. An experiment in payment reform for doctors in rural China reduced some unnecessary care but did not lower total costs. Health Aff (Millwood). 2011;30(12):2427–36.
23 Ningxia Bureau of Statistics. Ningxia statistical yearbook. Beijing: China Statistics Press; 2010. Chinese.
24 Ningxia Centers for Disease Control and Prevention. Report on infectious diseases in Ningxia [Internet]. Yinchuan: The Centers; 2013 Sep 12 [cited 2014 Jan 31]. Chinese. Available from: http://www.nxcdc.com.cn/index.php?m=content&c=index&a=show&catid=42&id=1975
25 Yang J, Song L, Li L. Death spectrum and burden of disease of Ningxia in 2008. J Ningxia Med Univ. 2011;33(4):352–5. Chinese.
26 To access the Appendix, click on the Appendix link in the box to the right of the article online.
27 King G, Gakidou E, Ravishankar N, Moore RT, Lakin J, Vargas M, et al. A "politically robust" experimental design for public policy evaluation, with application to the Mexican universal health insurance program. J Policy Anal Manage. 2007;26(3):479–506.
28 Reynolds L, McKee M. Factors influencing antibiotic prescribing in China: an exploratory analysis. Health Policy. 2009;90(1):32–6.
29 Abegunde D. Inefficiencies due to poor access to and irrational use of medicines to treat acute respiratory tract infections in children. Geneva: World Health Organization; 2010.

Downloaded from content.healthaffairs.org by *Health Affairs* on February 10, 2015
at WORLD BANK