The Impact of Rural Mutual Health Care on Access to Care:

Evaluation of a Social Experiment in Rural China

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** The authors would like to thank participants of the Joint BU/Harvard/MIT Health Economics Seminar and the 6th World Congress of Health Economics for their valuable and insightful comments. Excellent research assistance from Andrew Mitchell is greatly acknowledged.

Abstract

This paper evaluates the impact of a community-based health insurance intervention—Rural Mutual Health Care (RMHC) — on access to care in rural China. RMHC provides first dollar coverage for both inpatient and outpatient services, and uses supply-side interventions to improve quality and reduce inefficiencies in health service delivery. Our estimation combines the differences-in-differences (DD) methodology with Propensity Score Matching (PSM), using longitudinal household/individual surveys conducted one year pre-, and two years post-intervention. We find that RMHC has increased the probability of an outpatient visit by 70% and reduced the probability of self-medication by similar percentages. Further, we find evidence of spillover effects in which non-enrollees of the RMHC sites increased the probability of village visits. We further estimate the impacts of an alternative government-supported program which combines medical saving accounts and hospital insurance with high deductibles and find little impact.

I. INTRODUCTION

Around the world, countries are searching for solutions to finance and provide affordable access to health care for the two billion low-income rural residents living in low- and middle-income countries (Hsiao 2001). In recent years, community-based health insurance (CBHI) has gained worldwide attention as a potential solution. Unfortunately, rigorous evaluation of CBHI's impact is limited. A review by the International Labor Organization of 258 community health financing programs found that only two studies were able to derive robust conclusions about the impact on access to health services (Savedoff et al. 2006). In another systematic review of the limited studies deemed to be of higher quality(Ekman 2004), most only narrowly focused on the impacts on hospitalization and the results are mixed (Criel and Kegels 1997, Jütting 2001, Ranson 2001).

The primary objective of this paper is to empirically evaluate the impact of one CBHI intervention, called the Rural Mutual Health Care (RMHC) scheme, on access to care in rural China. In 2002, the Chinese government announced a national policy for rural health care. Under this policy, the governments subsidized rural residents in the Central and Western provinces to prepay into a health insurance scheme, called the New Cooperative Medical Scheme (NCMS). Apart from two guiding principles — voluntary enrollment and coverage of catastrophic health expenditure — local governments are free to design their own programs, thus turning China into a laboratory for experimentation. The RMHC experiment was conducted in response to this policy.

The RMHC provided first-dollar coverage for both outpatient and inpatient services and also incorporated a number of supply-side interventions aimed to reduce waste and inefficiencies in the existing system. Using a pre-post treatment-control study design and longitudinal household/individual surveys conducted one year prior to the interventions and followed up every year after the interventions for three years, we estimated the impact effects of RMHC, combining the difference-in-difference estimation (DD) with propensity score matching (PSM) in order to control for both observable and unobservable time invariant differences between the treatment and control group. We further estimated the impact of another insurance model commonly found in the Western and Central regions of China, which consisted of a medical savings account (MSA) and catastrophic insurance for expensive hospital services, and compared its findings to those of RMHC.

The paper is organized as follows. The next section provides a brief description of China's rural health care and the latest reform initiative. Section III describes the RMHC experiment and the NCMS model combing MSA and catastrophic insurance. Section IV discusses the study design, data and method. Section V presents the results and Section VI concludes and draws policy implications.

II. RURAL HEALTH CARE IN CHINA

From the early 1950s to 1980, China had a strategy for rural health care that emphasized prevention and basic health care. Near-universal insurance coverage was provided by the Cooperative Medical System (CMS) in the rural areas. Primarily

financed by the welfare fund of the communes (collective farming), the CMS organized health stations, paid village doctors to deliver primary care, and provided drugs. It also partially reimbursed patients for services received at township and county facilities. At its peak in 1978, CMS covered 90 percent of China's rural population. This system made basic health care accessible and affordable and also offered peasants financial protection against large medical expenses.

When China reformed its rural economy in 1979 and introduced the Household Responsibility System, the communes disappeared and without its funding base, CMS collapsed, leaving 90% of all peasants uninsured. Village doctors became private practitioners with little government oversight, earning their income from patients on a fee-for-service basis. Furthermore, like all transitional economies, China experienced a drastic reduction in the government's capacity to fund health care as government revenue shrank relative to GDP growth. Government subsidies for public health facilities fell to a mere 10% of the facilities' total revenues by the early 1990s. To keep health care affordable, the government maintained its strict price control by setting prices for basic health care below cost. At the same time, the government wanted facilities to survive financially, so it set prices for new and high-tech diagnostic services above cost and allowed a 15% profit margin on drugs. These created perverse incentives for providers who had to generate 90% of their budget from revenue-generating activities, turning hospitals, township health centers and village doctors all alike into profit seeking entities. Subsequently, providers over-prescribe drugs and tests and hospitals race to introduce high-tech services and expensive imported drugs that give them higher profit margins

(Liu and Mills 1999).[1] Health care expenditure soared, growing at 16% per year—7% faster than the growth of GDP, and patients' out of pocket health expenditure grew at an average rate of 15.7% from 1978-2003 (Blumenthal and Hsiao 2005, Smith et al. 2005). Besides, village doctors often use fake or expired drugs which they bought at a lower cost but charged at the official prices in order to increase their profits(Blumenthal and Hsiao 2005).

In under two decades, China had transformed its rural health care system from one that provided prevention and affordable basic health care for all to one in which people cannot afford basic health care and many families are driven into poverty due to large medical expenses (Hesketh and Zhu 1997a, Hesketh and Zhu 1997b, Hsiao 1984, Lindelow and Wagstaff 2005, Watts 2006, Watts 2007). The 2003 National Health Survey (Center for Health Statistics and Information 2004) found that 46% of the rural Chinese who were ill did not seek health care and among them, 40% cited cost as the main reason. Another 22% of those who were advised by physicians to be hospitalized refused to do so because they could not afford it [2] Studies have found that medical expenditures accounted for 30-40% of poverty (Center for Health Statistics and Information 2004, Watts 2006).

In 2002, the Chinese government announced a new national policy for rural health care — the NCMS. It was to be phased in over 5 years, targeted to reach full coverage by

[1] For example, 75% of patients suffering from a common cold are prescribed antibiotics, as are 79% of hospital patients – over twice the international average of 30% (Zhou).
[2] Of those who did become hospitalized, about 35% discharged themselves against their doctor's advice because of cost.

2008. By 2006, 50% of the rural population was covered. The goals of NCMS were to improve access to health care and to reduce household impoverishment due to medical expenses. The Chinese government has allocated significant new resources to the NCMS, targeted towards the poor western and central regions. For the program's initial waves, the government subsidized each farmer in western and central provinces 20 RMB (1 RMB = US$ 0.125), shared equally between the central and local governments, if the farmer pays an annual premium of at least 10 RMB to enroll in the NCMS (Central Committee of CPC, 2002; Watts, 2006). The NCMS incorporates two important policy guidelines: voluntary enrollment and coverage of catastrophic illnesses[3]. Apart from this, design of the program is left to the local governments, turning China into a laboratory of health insurance experiments.

III. RURAL MUTUAL HEALTH CARE AND AN NCMS MODEL

In this section, we describe our social experiment — Rural Mutual Health Care (RMHC) — and an alternative model of NCMS commonly found in the Western and Central regions of China.

A Social Experiment—Rural Mutual Health Care

In response to the government's 2002 announcement, we conducted a social experiment to implement RMHC, following the two government guidelines, but augmented with other features aimed to tackle the supply-side problems. RMHC is a

[3] The voluntary feature was adopted in order to overcome strong public resistance to paying any money into a government-run insurance program. The emphasis on covering catastrophic illnesses came from the desire to prevent the Chinese from being impoverished by major illnesses.

voluntary scheme wherein the project replicates the government's subsidies and subsidized, 20 RMB (US $2.50) to each farmer who enrolled and paid a premium of 12 RMB.

RMHC was designed with three goals in mind: improve access to health care, prevent impoverishment, and improve efficiency and quality of health care. The RMHC benefit package provides first-dollar coverage of primary care, hospital services and drugs with no deductible, but with varied coinsurance rates and ceilings. First-dollar coverage provides incentives for the patients to use basic and primary health care rather than to seek care in hospitals. It also reduces adverse selection because, in any population, only a small proportion incurs catastrophic medical expenses. Any scheme that covers only catastrophic expenses will be of interest only to those who are old and sick. They will enroll and stay, but younger and healthy people will drop out, making the program unsustainable in the long run.

To improve efficiency and quality, RMHC adopted several features targeted at the village doctors where most of the services take place because they are located most closely to the villagers. First, to reduce the problem of over-prescription and sale of fraudulent drugs, village doctors' incomes were de-linked from their drug dispensing activities. Village doctors were selectively contracted by RMHC and paid by salary plus a bonus. The bonus is based on selected health outcomes, performance of public health functions such as immunization, quantity of services performed, proper use of drugs, and

maintenance of patient records[4]. Second, village doctors were not allowed to purchase drugs directly. Instead, township health centers purchased drugs in bulk from the county distribution centers and distributed them to village doctors. To further combat the drug problems, RMHC introduced essential drug lists based on the health conditions of the local population.

Given the benefit design and the supply-side interventions of RMHC, we hypothesized that RMHC would increase enrollees' utilization of health care services, especially outpatient services at the village level, as a result of reduced prices through insurance coverage, and improved quality. We also hypothesized that low-income individuals who were most affected by unaffordable access in the pre-intervention period would experience greatest increases in utilization.

A Prevailing NCMS Model in the Western and Central Regions

Many counties in the Western and Central regions adopted a model that combines an individual medical savings account with a high-deductible catastrophic insurance (hereafter, we refer to this model as "NCMS"). Typically, this scheme collects 10 RMB from the farmer and assigns an average of 8 RMB (US $1) to an individual savings account that can be used by the farmer to pay for outpatient visits. The government's 20 RMB subsidy plus the 2 RMB remaining premium would be used for risk-pooling to cover inpatient hospital expenses that exceeded a deductible (the NCMS site that we used for our analysis has a deductible of 800 RMB, selected based on its similarity to our

[4] The RMHC fund office regularly audits the village doctors.

RMHC site; see the Study Design section). Besides the deductible, the patients still have to pay 40% to 60% of covered inpatient hospital costs. The benefit package also caps the benefit payment between 10,000-20,000 RMB (US $1,250-$2,000) (Mao 2005, Ministry of Health 2007). However, there is no supply-side intervention to deal with the problems of waste caused by unnecessary treatments and drugs.

We hypothesize that this NCMS model has limited effect on increase in outpatient services because each visit to the village doctor already costs 15-20 RMB (the cost to township health center is even higher) but the individual savings account only has 8 RMB per year. However, we hypothesize that the NCMS will have a positive impact on the hospitalization rate.

The detailed features of the benefit packages of RMHC and NCMS are compared in Table 1. In both models, the premium is about 30 RMB per person.

IV. STUDY DESIGN, DATA and METHOD

Our study design adopts a pre-post, experiment-comparison approach. There are two interventions: RMHC and the NCMS model described above.

We implemented RMHC in three towns within two western provinces. These towns were chosen because they are fairly representative of the socioeconomic conditions of the low-income regions of China and because the local government was willing to support the experiment. Together, the three towns cover about 60,000 people. In 2003,

average annual income per person was about 1,400-1,800 RMB (US $175-225) at the three sites. On average, these farmers spend about 8% to 10% of their annual income on health care.

We further selected two other sites. One control site with no intervention and another which implemented the NCMS model described above around the same time as we implemented RMHC. The sites were selected to match the RMHC intervention sites on socioeconomic conditions, availability of health facilities, distance to city centers, based on available official statistics.

RMHC began its first-time enrollment in December, 2003, and went into full operation immediately thereafter

Data

The data for this analysis are based on longitudinal household/individual surveys conducted one year prior to the intervention (December, 2002) and followed up every year after the intervention in 2004, 2005 and 2006. The analysis presented in this paper compare changes between 2005 and 2002 (baseline). We did not use year 2004 because that was only one year after the intervention so any effect observed may be temporary. We also did not use year 2006 because farmers' utilization may have been affected by the knowledge that the experiment would conclude by the end of 2006.

For each site, we randomly selected villages and then households within the villages. The sample has a total of 22 villages.

Table 2 shows the number of individuals and households and their 2005 follow-up rate or each site. Dropped-out households at each wave were replaced with households with similar income and household size.

In addition to standard socioeconomic and demographic characteristics of the households and individuals, the survey also collected comprehensive data on health care utilization and expenditure and health status. Appendix 1 provides a description of the key variables used in our analysis.

Estimation Method

Our goal is to estimate the impact of RMHC (similarly, NCMS) on the individuals who were exposed to the intervention, that is the average treatment effect on the treated — ATT. Since enrollment in RMHC is voluntary (similarly, in NCMS), the enrolled are likely to be different from the non-enrolled in both observable and unobservable ways. A comparison of the enrolled and non-enrolled would therefore lead to biased estimates. Taking advantage of our pre-post treatment-control study design and panel data, we adopted the differences-in-differences (DD) method. The DD method applied to panel data is equivalent to first differencing, which purges time-invariant unobservable factors that may correlate with the decision of enrollment and the outcome variables of interests — utilization of health care services. However, a simple DD method may still be biased if the initial conditions of the enrolled and non-enrolled are systematically different. We therefore combined the DD method with propensity score matching (PSM), a method that is increasingly used for impact evaluations (Blundell et al. 2005, Imbens 2004, Ravallion

2007, Wagstaff and Yu, 2006). The basic idea behind PSM is to create a counterfactual group who are "similar" to the treatment group as measured by the propensity score, whereby the propensity score is estimated by a logit model predicting the probability of being enrolled against a set of baseline conditions as listed under "control variables" in Table 3.

There are two potential candidates for comparison groups: the non-enrolled in the intervention sites and the control sites. A first strategy would be to compare the enrolled in to the non-enrolled in the intervention sites. However, this approach risks introducing selection bias as the latter group selected out of enrollment voluntarily. A second strategy would be to compare the enrolled in the intervention sites to both the non-enrolled in the intervention sites and the control site sample. Again, however, selection bias could occur among intervention site respondents who opted not to enroll (indeed, both magnitude of effect estimates and statistical significance of our empirical results are stronger when the non-enrolled/control site sample are combined, suggesting that selection may be present). To mitigate such selection problems, our comparison and propensity score estimation is therefore confined to RMHC enrollees and the control sample. A separate propensity score is estimated for the NCMS analyses using the NCMS enrollees and the control sample.

As a number of matching algorithms exist, we selected two of the major methods: nearest four neighbors matching and kernel matching. Under the nearest neighbor method, each individual in the treatment group is matched with the four "closest" individual from

the control group, where "closeness" is defined by the propensity score[5]. Observations not in the common support are excluded from the analysis.[6] Under kernel matching, we use all the observations in the control group to construct the counterfactual outcome for the enrolled in the interventions sites, with each observation weighted by its closeness to the intervention observation, where the weights equal to a transformation of the absolute difference in propensity score between the treated and untreated unit (Smith and Todd 2005).[7]

To estimate the differential impacts of RMHC (or NCMS) on individuals in different income quartiles, we repeated the matching process to obtain subgroup-specific propensity scores and weights[8]. Similarly, we carried out sub-group analysis for individuals with and without chronic conditions in the baseline. All the standard errors are bootstrapped with 100 replications.

V. RESULTS

Descriptive Statistics

Table 3 provides an overview of our study sample's characteristics in the baseline (2002) by intervention/control site and by enrollment status. Enrollment rates for

[5] Varying the number of matches from one to five neighbors resulted in very similar estimates.
[6] This leads to exclusion of nineteen observations from our RMHC sites and 52 observations from our NCMS site.
[7] We used a normal (Gaussian) kernel and a bandwidth of 0.06.
[8] An alternative method to estimate the distributional effect is to include interaction variables between the intervention variable and dummy variables indicating the subgroups. However, matching within subgroups reduced differences between the intervention and control samples even further and therefore we opted for this approach.

RMHC and NCMS were 68% and 77%, respectively. Comparing the RMHC enrollees (RMHC treatment group) with the control group, we found that the RMHC enrollees have higher utilization rates for outpatient services and self-medication and have slightly worse health status. They also have lower income and wealth and are more likely to be single and being a migrant worker. In contrast, comparing the NCMS enrollees and the control group, the NCMS enrollees have lower utilization and have better reported health status. They have lower income, but greater wealth than the control sample. They also have higher proportion with at least junior high education and are younger, more likely to be unmarried and more likely to be a migrant worker in the past year.

A comparison of the enrolled and non-enrolled in the RMHC site shows that selection is present. RMHC enrollees exhibited generally higher utilization of services and worse health compared to non-enrollees. This supports that exclusion of the non-enrolled in the RMHC site as a control group is an appropriate strategy. In contrast, descriptive baseline statistics from the NCMS site fit less well into theories of adverse selection and health insurance. Compared to non-enrollees, NCMS enrollees have lower utilization rates. Also, differences in health status between the enrolled and non-enrolled samples are minor compared to those observed for the RMHC sample. This may be because given that the NCMS site is a government pilot site, local officials use administrative strategies to enforce enrollment. As a result, enrollment decision is less voluntary.

Matching

Table 4 presents results from the first-stage logit model for predicting the propensity score. The findings are largely consistent with those from the descriptive statistics at baseline presented in Table 3.

Table 5 and Table 6 show the balancing properties of the propensity score matching and resulting reductions in observable differences between the treatment and control groups, for the RMHC and NCMS models, respectively. The first column of each table indicates the pre-matching standardized difference (in percentage terms) in means for each matching variable between the intervention and control sites[9]; the second column provides the associated two-sample t-statistic (t-statistics ≥ 1.97 are bolded). The next sets of columns compare post-matching differences in means using our two matching methods: nearest four neighbors and kernel matching. In addition to associated t-statistics, the last column for each matching method indicates the degree of bias reduction (i.e, the percentage reduction in standardized differences). The last row of each table provides a likelihood ratio chi-square statistic for the model (i.e., testing whether the right-hand side variables included in the propensity score estimation model are jointly significant).

For the RMHC-control match, both nearest four neighbor and kernel matching reduce initial differences in observable characteristics between the treated and control

[9] The standardized difference is the raw differences in intervention/control sample means as a percentage of the square root of the average of the intervention/control sample variances respectively; see Rosenbaum, P. R. and Rubin, D. B. 1985, 'Constructing a Control Group Using Multivariate Matched Sampling Methods that Incorporate the Propensity Score', *The American Statistician*, vol. 39, no. 1, pp. 33-38.).

samples substantially. In particular, observable health status indicators, which are most likely to be correlated with unobservable health status that would lead to selection bias, are statistically similar between the RMHC enrollees and the control group after matching. Among the set of socioeconomic and demographic variables, some differences remain for selected variables, but overall, the differences have been reduced. Although differences in age and distance to county facilities have increased slightly after matching, these variables do not change over time and therefore would be controlled for by a first difference estimation method. Matching between the NCMS enrollees and the control sample have also reduced differences between the two samples. However, the reduction achieved is not as great as that of the RMHC-control match. Statistically significant differences among the health status variables remain.

Impact Estimates of RMHC

Table 7 presents the impact estimates of RMHC on changes in outpatient utilization, self-medication and inpatient utilization. For comparison purposes, four estimates are presented: univariate difference-in-difference (DD), multivariate DD that controls for time-varying characteristics; ATT based on nearest four neighbor matching; and ATT based on kernel weights. For the latter two, time varying factors were controlled for to remove biases that may result from remaining differences between the treatment and control samples[10]. Focusing on the DD with kernel matching method, the ATT estimates showed that RMHC increased the probability of outpatient visit by 0.12 (or a

[10] We compare our results to matching using weights based directly on the propensity score, where the weights for the treatment group are equal to one and the weights for the control group are the log odds of the propensity score (Imbens 2004). Resulting estimates are very similar to those of nearest neighbor and kernel matching and are thus omitted from presentation.

70% increase), from a baseline of 0.173. The increase was primarily to village doctors, followed by township health centers. The number of visits increased by 0.15 from a baseline of 0.35. At the same time, RMHC reduced the probability of self-medication by about two-thirds (by 0.039 from a baseline of 0.056). However, RMHC did not have any effect on inpatient utilizations. The results from the DD with nearest neighbor matching are very similar, while the DD estimates without matching are smaller for most cases.

Distribution effect of RMHC

Table 8 and Table 9 present results by income groups and whether the individual had at least one chronic condition at the baseline, respectively. We used whether the individual had a chronic condition as baseline health status measure because this variable is not based on the individual's self-perception. Respondents were asked whether they had been informed by a health professional whether they had a chronic condition. Thus, this variable is less likely to be endogenous. Focusing on the matching estimates, among individuals in the lowest income quartiles, RMHC almost doubled their outpatient visit rates, from a baseline probability of 0.15 ($\beta = 0.15$). The majority of the increase took place at the village level: visits to village clinics more than doubled with no statistically significant changes at both the township and county levels. Among individuals in the middle two income quartiles, RMHC increased their probability of outpatient visit by 0.104-0.147, from a baseline of 0.168. In contrast to the results of the lowest income quartile individuals, the majority of increase took place at the township level. The middle income individuals also experienced the greatest reduction in self-medication rate, in terms of both magnitude and statistical significance. The RMHC also increased their

hospitalization rate, although the facility-level hospitalization rates are not significant, probably due to small sample size with positive outcome. As for the highest income individuals, RMHC increased their outpatient visit rate significantly and like the low income individuals, their increase is the greatest at the village level. There is also some evidence that RMHC reduced hospitalization rates for this group, although only the nearest neighbor estimates are significant. None of the estimates for the number of outpatient visits are significant, probably due to small subgroup sample size.

Table 9 presents ATT estimates stratified by chronic disease status at baseline. Outpatient utilization increased among both groups with those reporting chronic conditions experiencing a bigger increase. Those without chronic conditions experienced about 60% increase while those with chronic conditions experienced a doubling of the increase. Again, the majority of increase took place at the village level. Additionally, the number of visits also increased significantly. ATT estimates also provide some suggestion that self-medication dropped among both groups, somewhat more significantly among those without chronic conditions (e.g., kernel matching $\beta = -0.03$). There was also no significant change in inpatient utilization among either group.

Impact Estimates for NCMS

Compared to the findings from the RMHC analyses, Table 10 indicates that the ATT estimates from the NCMS analyses are generally much weaker. While the univariate DD estimate indicates that NCMS is associated with increased outpatient utilization of over 100% the baseline rate ($\beta = 0.06$), the multivariate DD estimate and the

ATTs combining DD and PSM show that the DD univariate result is biased upwards. None of the ATT estimates is significant. This shows that the DD univariate results are confounded by differences between the treatment and control samples. Subgroup analysis by income and chronic conditions at baseline did not reveal any significant impact of the NCMS also. The results are not presented here.

VI. DISCUSSION

Our analysis finds that RMHC, a form of CBHI, has had a positive effect on health care utilization. Specifically, our nearest neighbor and kernel ATT estimates show that enrollment in RMHC led to approximately 70% increase in the probability of outpatient utilization. This, together with the finding that the self-medication rate reduced by about 70%, suggest that RMHC enrollees substitute self-medication for formal health care services as a result of RMHC. Thus, RMHC is successful in achieving the objective of improving access to health care. The results are due to a combination of both the demand- and supply-side interventions. On the demand side, RMHC reduces the cost of service borne by patients as the scheme provides partial reimbursement of services. In particular, RMHC provides first dollar coverage for both outpatient and inpatient services. On the supply sides, de-linking village doctors' income from revenues generated from selling drugs, tying village doctors' income to quality of services, introducing bulk purchasing for drugs and the use of essential drug list, and frequent audit of drug prescriptions from the RMHC fund office, have resulted in improved quality, reductions in drug prices and use of inappropriate drugs. Our secondary data show that drug prices fell by almost thirty percent between baseline and 2005. We also found that the majority

of increased utilization took place at the village clinic level, possibly as a result of the supply-side interventions which primarily target improved quality and waste reduction at the village level. Contrary to our hypothesis, we did not find any impact of RMHC on hospitalization. This may be because by making outpatient services accessible and affordable under RMHC, there is less need to use inpatient services. But the lack of finding may also be due to the fact that only 2% to 4% of the sample has any hospital use, thus, our sample size may be too small to detect any significant change.

The RMHC also has some distribution effects. While we found that the lowest- and highest-income individuals experienced the greatest increase in outpatient utilization with village doctors, the middle-income group also experienced a substantial increase of township health center services. However, a full benefit-incidence analysis is beyond the scope of this paper. In addition, without knowing the content of the services, we cannot assess how much of the increase in township health center use is health improving and how much is wastage.

Do non-enrollees also benefit from our RMHC intervention? That is, is there any spillover effect? RMHC includes a number of supply-side interventions aimed to affect providers' behavior. These may have an effect on the non-enrolled in the RMHC sites. Table 11 presents analyses of outpatient utilization and self-medication in which non-enrollees are compared to the control sample. While there is no evidence of an overall increase in outpatient utilization or number of visits, there is evidence to suggest that RMHC has a spillover effect in increasing the probability of a village visit and reducing

self-medication. More specifically, the probability of visiting a village clinic almost doubled, whereas the probability of self medication dropped by 0.038 from a baseline rate of 0.041.

In contrast, we found little impact of the NCMS, which combined individual savings account and hospital insurance with high deductible, on the enrollee's outpatient utilization. This is not surprising given that the savings per year per person in the individual account is only 8RMB, whereas each visit to the village doctor cost 15-20 RMB, so the savings account has limited effect on patients' health seeking behavior. In addition, since the hospital insurance involves a deductible of 800 RMB, few hospitalizations qualify for reimbursement. These results would suggest that with similar premium, the RMHC model is more effective in improving access to care than the NCMS model. However, a caveat is in order in comparing the RMHC and NCMS findings. As the data show, the baseline utilization rates between the RMHC and NCMS enrollees are rather different. So, strictly speaking, the two groups are not directly comparable.

These results offer important policy implications for China's rural health care reform. In 2006, the Chinese government increased its subsidies for NCMS in the Western and Central regions from 20 RMB to 40 RMB per person per year, equally shared between the Central and local government. NCMS is targeted to cover the entire rural population by 2010. Our results show that the most commonly found model of NCMS is not effective in improving access to care, thus, the government's investment is unlikely to produce measurable benefits for the population. However, this study only

focuses on one impact of RMHC and NCMS — access to care. These schemes' impacts on other important policy objectives, including financial risk protection and health outcomes, are addressed in separate analyses (Yip et al, 2007; Hong et al, 2007). Thus, the conclusion of this paper only pertains to the impacts on access to care.

There are several limitations to our study. Methodologically, our estimation strategy combining the DD estimation and PSM controls for both time-invariant unobservables and observable differences between the treatment and control groups. Compared to cross-section and time-series analyses, or DD estimation without panel data or PSM, this is a superior strategy. However, if there are unobserved factors that change between 2002 and 2005, our DD and PSM method will still lead to biased estimates. To control for these factors require instrumental variables or data in trends of utilization before the intervention, which are not available. While we admit that a potential bias exists, we argue that the potential threat is limited because we have included a rather comprehensive set of variables in the propensity score estimation which help to remove time-varying unobservables that are correlated with these observable factors. Second, our impact estimate does not allow us to decompose the total impact into those caused by the insurance effect versus those that result from the supply-side interventions. To do so would require phasing in these design features. Third, the NCMS-control matching still leaves many variables between the intervention and control groups different. Thus, caution is required in interpretation of this set of results. However, the difference-in-difference method with controls for a number of time-varying factors would have helped in reducing the differences between the NCMS treatment and control samples. Finally,

our NCMS results only refer to the specific design of the NCMS site that we use in the empirical estimation, which is commonly found in the western and central regions of China, and do not apply to other NCMS designs more commonly found in the eastern region. Nonetheless, given the scarcity of impact evaluations of CBHI on access to care, the findings in this study will make a significant contribution to the literature despite these limitations.

REFERENCES

Blumenthal, D. and Hsiao, W. 2005, Privatization and its discontents--the evolving Chinese health care system, *N Engl J Med*, vol. 353, no. 11, pp. 1165-70.

Blundell, R., Dearden, L., Sianesi, B., 2005. Evaluating the effect of education on earnings: models, methods and results from the National Child Development Survey. Journal of the Royal Statistical Society: Series A (Statistics in Society) 168(3), 473-512.

Center for Health Statistics and Information 2004, *An analysis report of the National Health Survey in 2003*, Ministry of Health, Beijing, China.

Central Committee of CPC. 2002. Decisions of the central committee of the communist party of China and the State Council on further strengthening rural health work. Beijing, China.

Criel, B. and Kegels, G. 1997, A health insurance scheme for hospital care in Bwamanda District, Zaire: lessons and questions after 10 years of functioning, *Trop Med Int Health*, vol. 2, no. 7, pp. 654-72.

Deaton, A. and Zaidi, S. 2002, *Guidelines for constructing consumption aggregates for welfare analysis*, LSMS Working Paper 135, World Bank, Washington, DC.

Ekman, B. 2004, Community-based health insurance in low-income countries: a systematic review of the evidence, *Health Policy Plan*, vol. 19, no. 5, pp. 249-70.

Hesketh, T. and Zhu, W. 1997a, Health in China: From Mao to market reform, *BMJ*, vol. 314, p. 1543.

Hesketh, T. and Zhu, W. 1997b, Health in China: The healthcare market, *BMJ*, vol. 314, p. 1616.

Hsiao, W. C. 1984, Transformation of health care in China, *New England Journal of Medicine*, vol. 310, pp. 932-6.

Hsiao, W. C. 2001, *Unmet Health Needs of Two Billion: Is Community Financing a Solution?*, Health, Nutrition and Population (HNP) Discussion Paper, The World Bank, Washington, DC.

Imbens, G.W. 2004. Nonparametric estimation of average treatment effects under exogeneity: a review. Review of Economics and statistics 86(1), 4-29.

Jütting, J. 2001, *The impact of health insurance on the access to health care and financial protection in rural areas of developing countries: the example of Senegal.*, Center for Development Research, Bonn, Germany.

Lindelow, M., A. Wagstaff 2005, *China's health sector - why reform is needed*, World Bank, Washington, DC.

Liu, X. and Mills, A. 1999, Evaluating payment mechanisms: how can we measure unnecessary care? *Health Policy Plan*, vol. 14, no. 4, pp. 409-13.

Mao, Z. 2005, *Pilot program of NCMS in China: System design and progress*, World Bank, Washington, DC.

Ministry of Health 2007, *China's New Cooperative Medical Scheme: Report on Development and Results [in Chinese]*, Peking Union Medical College Press, Beijing, China.

Rabin, R. and de Charro, F. 2001, EQ-5D: a measure of health status from the EuroQol Group, *Ann Med*, vol. 33, no. 5, pp. 337-43.

Ranson, K. 2001, *The impact of SEWA's medical insurance fund on hospital utilization and expenditure: Results of a household survey.*, World Bank, Washington, DC.

Ravallion, M. 2007, Evaluating Anti-Poverty Programs. Handbook of Agricultural Economics. vol.4. R. Evenson and T. Schultz. Amsterdam, North Holland.

Rosenbaum, P. R. and Rubin, D. B. 1985, Constructing a Control Group Using Multivariate Matched Sampling Methods that Incorporate the Propensity Score, *The American Statistician*, vol. 39, no. 1, pp. 33-38.

Savedoff, W. D., Levine, R. and Birdsall, N. 2006, *When Will We Ever Learn? Improving Lives through Impact Evaluation*, Report of the Evaluation Gap Working Group, Center for Global Development, Washington, DC.

Smith, J. A. and P. E. Todd (2005). Does matching overcome LaLonde's critique of non-experimental estimators? Journal of Econometrics 125: 305-353.

Smith, P., Wong, C. and Zhao, Y. 2005, *Public expenditure and the role of government in the Chinese health sector*, World Bank, Washington, DC.

Wagstaff, A. and S. Yu (2007). Do health sector reforms have their intended impacts? The World Bank' Health VIII project in Gansu province, China. Journal of Health Economics 2**6:** 505-535.

Wang, H, W. Yip and W. Hsiao. 2007, The Impact of Rural Mutual Health Care on Health-Related Quality of Life: Evaluation of a Social Experiment in Rural China. Harvard School of Public Health, working paper.

Watts, J. 2006, China's rural health reforms tackle entrenched inequalities, Lancet, vol. 367, pp. 1564-5.

Watts, J. 2007, Protests in China over suspicions of a pay-or-die policy, Lancet, vol. 369, pp. 93-4.

Yip, W., H. Wang, and W. Hsiao. 2007, The Impact of Rural Mutual Health Care on Catastrophic Health Spending and Medical Impoverishment: Evaluation of a Social Experiment in Rural China. Harvard School of Public Health, working paper.

Zhou, R. (unknown date) *Responsible utilization of antibiotics should be a societal responsibility*, Paper No. 223, Sanmenxia Central Hospital.

Table 1. Comparison of the RMHC and NCMS Benefit Packages

	RMHC	NCMS
Deductible	0	800 RMB
Individual Savings Account (MSA)	0	Deposit 8 RMB each year
Reimbursement rate for outpatient visit		
Village Health Posts	45%	0
Township Health Centers and above	40%	0
Reimbursement rate and caps for hospitalization		
Township Health Centers	40%, capped at 400 RMB	50% of the amount exceeded the deductible, capped at 20,000 RMB
County Hospitals and above	40%, capped at 8,000 RMB	50% above deductible, capped at 20,000 RMB

Table 2. Interview Follow-up (F/U) Rates

Site	Individuals		Households	
	N	% F/U	N	% F/U
RMHC1	4,160	0.80	1,169	0.84
RMHC2	2,676	0.79	695	0.85
RMHC3	1,746	0.83	465	0.90
NCMS	3,063	0.72	805	0.75
Control	2,865	0.88	752	0.93

Table 3. Descriptive Statistics at Baseline

	RMHC		NCMS		Control (N = 1219)
	Enrolled (N = 2956)	Non-enrolled (N = 1115)	Enrolled (N = 932)	Non-enrolled (N = 236)	
Outcome Variables					
Outpatient Visit (any level)	0.173	0.094	0.026	0.047	0.132
Village Clinic	0.141	0.056	0.008	0.025	0.087
Township Health Center	0.022	0.032	0.005	0.013	0.028
County Hospital and above	0.010	0.006	0.013	0.008	0.017
# Outpatient Visits	0.352	0.185	0.033	0.093	0.220
Inpatient Visit (any level)	0.033	0.022	0.015	0.021	0.039
Township Health Center	0.012	0.013	0.002	0.000	0.017
County Hospital and above	0.021	0.010	0.013	0.021	0.021
Self-Medicating	0.056	0.040	0.006	0.000	0.028
Control Variables					
Socio-economics					
Income per capita	1885	1700	2308	2762	2481
HH Wealth	-0.65	-0.68	-0.42	-0.12	-0.51
Illiterate Education	0.27	0.25	0.16	0.19	0.26
Primary Education	0.46	0.44	0.41	0.33	0.40
Junior High Education	0.22	0.25	0.34	0.34	0.27
Senior High Education	0.03	0.04	0.07	0.08	0.05
Tertiary Education	0.01	0.02	0.01	0.03	0.02
Socio-demographics					
Male	0.50	0.59	0.55	0.56	0.51
Age	40	36	36	38	42
Single	0.17	0.34	0.30	0.29	0.09
Married	0.76	0.61	0.68	0.67	0.86
Divorced/Separated	0.01	0.01	0.00	0.00	0.01
Widowed/other	0.06	0.04	0.02	0.04	0.04
Migrant	0.07	0.11	0.18	0.11	0.04
Health Status					
Ill in last month	0.26	0.16	0.04	0.08	0.17
1+ Chronic conditions	0.17	0.13	0.04	0.05	0.14
Current Smoker	0.34	0.32	0.24	0.25	0.41
Current Drinker	0.27	0.27	0.24	0.29	0.19
EQ-5D score	5.7	5.5	5.2	5.4	5.8
Very Good SRH	0.10	0.14	0.22	0.23	0.11
Good SRH	0.24	0.31	0.31	0.33	0.19
Average SRH	0.41	0.38	0.38	0.33	0.51
Bad/Very Bad SRH	0.24	0.17	0.09	0.10	0.18
Household Characteristics					
HH Size	4.0	4.1	3.8	3.5	3.8
Distance from Village Clinic (miles)	2.1	2.1	1.9	1.7	2.5
Distance from Township Health Center (miles)	14	13	8	5	10
Distance from County Hospital (miles)	65	74	86	78	63

Table 4. Propensity Score Estimation

	RMHC		NCMS	
Socio-economics	**β**	**S.E.**	**β**	**S.E.**
Log (Income / capita)	4.285	(1.474)**	-3.136	(2.053)
Log (Income / capita) - squared	-0.331	(0.096)**	0.186	(0.134)
HH Wealth	-0.108	(0.056)	0.277	(0.094)**
HH Wealth - squared	-0.078	(0.043)	-0.305	(0.075)**
Primary Education	0.036	(0.105)	0.393	(0.180)*
Junior High Education	-0.278	(0.127)*	0.508	(0.203)*
Senior High Education	-0.692	(0.207)**	0.249	(0.295)
Tertiary Education	-0.451	(0.365)	0.226	(0.487)
Socio-demographics				
Male	0.082	(0.114)	0.175	(0.172)
Age	-0.031	(0.015)*	-0.043	(0.025)
Age - squared	0	(0.000)*	0.001	(0.000)*
Married	-0.756	(0.194)**	-1.077	(0.282)**
Divorced/Separated	-0.356	(0.494)	-2.189	(1.601)
Widowed/other	-0.594	(0.264)*	-1.347	(0.446)**
Migrant	0.613	(0.185)**	1.644	(0.257)**
Health Status				
Ill in last month	0.783	(0.108)**	-0.778	(0.257)**
1+ Chronic conditions	0.272	(0.119)*	-0.381	(0.277)
Current Smoker	-0.557	(0.121)**	-1.08	(0.195)**
Current Drinker	0.885	(0.107)**	0.877	(0.177)**
EQ-5D score	-0.17	(0.034)**	-0.329	(0.074)**
Good SRH	0.283	(0.141)*	0.041	(0.205)
Average SRH	-0.111	(0.130)	-0.419	(0.187)*
Bad/Very Bad SRH	0.417	(0.161)**	-0.008	(0.267)
Household Characteristics				
HH Size	0.061	(0.033)	-0.239	(0.059)**
Distance from Village Clinic (0 - 10+ miles)	-0.204	(0.018)**	-0.184	(0.033)**
Distance from Township Health Center (0 - 10+ miles)	0.219	(0.014)**	0.007	(0.023)
Distance from County Hospital (0 - 100+ miles, increments of 10 miles)	0.002	(0.002)	0.1	(0.005)**
Constant	-12.222	(5.670)*	10.484	(7.969)
Observations	4166		2145	
Pseudo R-squared	0.16		0.43	
LR-Chi square (27 df)	807.18		1271.28	

Table 5. Matching Balancing Properties Between RMHC and Control

	Pre-Matching		Post-Matching					
			Nearest 4 Neighbors			Kernel		
	Std Diff*	t-stat	Std Diff*	t-stat	Bias**	Std Diff*	t-stat	Bias**
Socio-economics								
Log (Income / capita)	-42.2	**-12.86**	2.1	0.89	95	-1.4	-0.59	96.6
Log (Income / capita)-squared	-42.8	**-13.1**	2.1	0.89	95.1	-1.5	-0.62	96.6
HH Wealth	-17.3	**-5.25**	-4.6	-1.9	73.6	-5.7	**-2.34**	67
HH Wealth - squared	-1.6	-0.49	6.3	**2.53**	-282.8	4.1	1.62	-149.9
Primary Education	12.7	**3.72**	4.1	1.57	67.5	6.1	**2.32**	52
Junior High Education	-11.1	**-3.32**	-3.9	-1.54	64.6	-2.9	-1.12	74.4
Senior High Education	-9.9	**-3.05**	-5.5	**-2.22**	44.3	-6.1	**-2.43**	38.6
Tertiary Education	-7.5	**-2.37**	-2.8	-1.2	62.8	-1.8	-0.81	75.6
Socio-demographics								
Male	-0.5	-0.16	-7.4	**-2.83**	-1250.5	-1.9	-0.71	-239.4
Age	-10.4	**-2.95**	-11.2	**-3.97**	-8.1	-11.1	**-4.04**	-7.1
Age - squared	-4	-1.15	-11.4	**-3.91**	-186	-9	**-3.21**	-126
Married	-25	**-7.07**	-5.5	-1.96	78.1	-11.8	**-4.3**	53
Divorced/Separated	4	1.12	3.2	1.18	20.1	2.5	0.9	37.9
Widowed/other	6.5	1.86	0.2	0.06	97.6	3.7	1.36	43.9
Migrant	15.4	**4.28**	-2.3	-0.76	85.2	-1.5	-0.51	90.1
Health Status								
Ill in last month	24.4	**6.93**	-13.2	**-4.55**	45.9	-3.5	-1.24	85.6
1+ Chronic conditions	10.5	**3.02**	0.1	0.03	99.3	1.6	0.58	84.9
Current Smoker	-13.1	**-3.89**	-2.4	-0.92	82	-4.9	-1.9	62.7
Current Drinker	17.6	**5.06**	-13	**-4.59**	26.3	-4.3	-1.56	75.4
EQ-5D score	-7.7	**-2.27**	-0.9	-0.34	88.8	-1.8	-0.71	76.8
Good SRH	11.8	**3.4**	3.3	1.24	71.7	0.8	0.29	93.4
Average SRH	-19.7	**-5.81**	-3.1	-1.18	84.5	-5.4	**-2.08**	72.5
Bad/Very Bad SRH	14.7	**4.23**	0.5	0.17	96.9	4.4	1.61	70.4
Household Characteristics								
HH Size	16.3	**4.71**	-2	-0.75	87.9	1.4	0.52	91.6
Distance from Village Clinic†	-22.6	**-6.79**	-3.9	-1.63	82.8	-6.8	**-2.85**	69.8
Distance from Township Health Center†	47.5	**14.06**	5	**2.13**	89.6	8.2	**3.48**	82.8
Distance from County Hospital††	6	1.64	23.8	**9.1**	-294.5	18.7	**7.33**	-209.8
LR-Chi square (27 df)	1242.52		231.3			180.68		

*The standardized difference is the raw differences in intervention/control sample means as a percentage of the square root of the average of the intervention/control sample variances respectively.

** Bias reduction is the percentage reduction in standardized differences.

† 0 to 10+ miles, increments of 1 mile †† 0 to 100+ miles, increments of 10 miles

Table 6. Matching Balancing Properties Between NCMS and Control

	Pre-Matching		Post-Matching					
			Nearest 4 Neighbors			Kernel		
	Std Diff*	t-stat	Std Diff*	t-stat	Bias**	Std Diff*	t-stat	Bias**
Socio-economics								
Log (Income / capita)	-10.4	**-2.39**	-15.7	**-3.02**	-51	-10.1	**-1.99**	3.2
Log (Income / capita)-squared	-10.6	**-2.43**	-17.3	**-3.29**	-62.8	-11.1	**-2.18**	-4.8
HH Wealth	11.4	**2.57**	19.3	**4.44**	-69.4	10.4	**2.37**	8.3
HH Wealth - squared	-40.7	**-9.17**	-23.7	**-5.97**	41.8	-18.4	**-4.63**	54.7
Primary Education	1.7	0.39	4.7	0.98	-171.1	5.1	1.08	-198.7
Junior High Education	14.7	**3.4**	-7.2	-1.46	51.1	-5.5	-1.11	62.9
Senior High Education	8.2	1.9	4.4	0.88	46.7	-1.7	-0.32	79.8
Tertiary Education	-1.9	-0.44	-1.9	-0.38	3.4	-2.9	-0.59	-52.6
Socio-demographics								
Male	7.7	1.76	-20.3	**-4.32**	-163.8	-16.3	**-3.45**	-112.1
Age	-38.4	**-8.89**	7	1.39	81.8	2.7	0.54	93
Age - squared	-30.6	**-7.01**	6.8	1.41	77.7	4	0.83	86.9
Married	-43.1	**-10.09**	21.1	**3.84**	51.2	8.5	1.57	80.3
Divorced/Separated	-8	-1.76	1	0.41	87.7	0.7	0.29	90.9
Widowed/other	-12.7	**-2.86**	-12	**-2.49**	5.5	-8	-1.74	37.3
Migrant	46.7	**11.19**	28.8	**6.16**	38.4	23.7	**4.88**	49.3
Health Status								
Ill in last month	-42.8	**-9.45**	-4.9	-1.42	88.5	-8.4	**-2.32**	80.2
1+ Chronic conditions	-34.4	**-7.64**	-27.1	**-5.89**	21.2	-28.9	**-6.18**	16.2
Current Smoker	-35.5	**-8.08**	7	1.6	80.3	2.6	0.58	92.7
Current Drinker	10.9	**2.52**	-12.8	**-2.52**	-17.5	-16.8	**-3.26**	-53.7
EQ-5D score	-53.7	**-11.98**	-46.5	**-10.75**	13.3	-46.3	**-10.35**	13.8
Good SRH	27.1	**6.27**	33.5	**7.18**	-23.9	31.3	**6.64**	-15.6
Average SRH	-28	**-6.4**	-24.2	**-5.05**	13.4	-21	**-4.38**	24.9
Bad/Very Bad SRH	-27.1	**-6.1**	-24.8	**-5.17**	8.6	-19.7	**-4.21**	27.5
Household Characteristics								
HH Size	-5.8	-1.33	-4.7	-1.04	19	-3.9	-0.87	32.6
Distance from Village Clinic†	-30.7	**-6.85**	16.8	**3.95**	45.1	16.1	**3.82**	47.4
Distance from Township Health Center†	-22	**-5.11**	39.9	**8.75**	-81.4	38.4	**8.36**	-74.3
Distance from County Hospital††	135.8	**31.24**	-22.8	**-4.4**	83.2	-11.1	**-2.14**	91.8
LR-Chi square (27 df)	1242.52		330.25			267.56		

*The standardized difference is the raw differences in intervention/control sample means as a percentage of the square root of the average of the intervention/control sample variances respectively.

** Bias reduction is the percentage reduction in standardized differences.

† 0 to 10+ miles, increments of 1 mile †† 0 to 100+ miles, increments of 10 miles

Table 7. Impact Estimates of RMHC on Outpatient/Inpatient Utilization and Self-Medication

	Baseline	DD (univariate) (N = 4175)		DD (multivariate)† (N = 4175)		Nearest 4 neighbor† (N = 4066)		Kernel† (N = 4147)	
		β	s.e.	β	s.e.	β	s.e.	β	s.e.
Outpatient Visit (0/1)	0.173	0.022	(0.016)	0.036	(0.010)**	0.121	(0.026)**	0.12	(0.018)**
Visit to Village Clinic	0.141	0.023	(0.014)	0.033	(0.011)**	0.108	(0.027)**	0.098	(0.015)**
Visit to Township Health Center	0.022	0.013	(0.007)	0.016	(0.007)*	0.018	(0.013)	0.02	(0.010)*
Visit to County Hospital and above	0.010	-0.014	(0.006)*	-0.013	(0.006)*	-0.005	(0.015)	0.001	(0.009)
# Outpatient Visits	0.352	-0.018	(0.040)	0.007	(0.033)	0.155	(0.052)**	0.148	(0.040)**
Self-Medication	0.056	-0.052	(0.010)**	-0.045	(0.009)**	-0.032	(0.015)*	-0.039	(0.013)*
Inpatient Visit	0.033	0.006	(0.009)	0.01	(0.009)	-0.023	(0.012)	-0.011	(0.011)
Visit to Township Health Center	0.012	0.001	(0.005)	0.001	(0.005)	-0.018	(0.013)	-0.007	(0.007)
Visit to County Hospital and above	0.021	0.005	(0.007)	0.009	(0.007)	-0.005	(0.008)	-0.004	(0.006)

* Significant at 5% ** Significant at 1%

† Control variables include changes in: ln(income) and ln(income)-squared; ln(wealth) and ln(wealth)-squared; marital status; migrant worker status; illness in previous month; presence of one or more chronic conditions; current drinking/smoking status; EQ-5D score; and SRH.

Table 8. Estimates of RMHC on Outpatient/Inpatient Utilization and Self-Medication – by income at baseline

	Baseline	DD (univariate)		DD (multivariate)		Nearest 4 neighbor		Kernel	
		β	s.e.	β	s.e.	β	s.e.	β	s.e.
Outpatient Visit (0/1)									
Bottom 25%	0.149	0.025	(0.031)	0.036	(0.021)	0.149	(0.051)**	0.143	(0.041)**
Middle 50%	0.168	0.015	(0.023)	0.029	(0.015)	0.147	(0.056)*	0.104	(0.034)**
Top 25%	0.204	0.032	(0.033)	0.057	(0.021)**	0.257	(0.092)**	0.191	(0.058)**
Visit to Village Clinic									
Bottom 25%	0.127	0.044	(0.028)	0.051	(0.022)*	0.145	(0.051)**	0.141	(0.035)**
Middle 50%	0.137	-0.002	(0.020)	0.005	(0.016)	0.072	(0.057)	0.039	(0.032)
Top 25%	0.160	0.05	(0.028)	0.071	(0.022)**	0.224	(0.081)**	0.194	(0.045)**
Visit to Township Health Center									
Bottom 25%	0.019	-0.004	(0.013)	-0.001	(0.013)	0.023	(0.025)	0.026	(0.019)
Middle 50%	0.022	0.024	(0.010)*	0.028	(0.010)**	0.026	(0.014)	0.039	(0.015)**
Top 25%	0.023	0.009	(0.015)	0.016	(0.015)	-0.013	(0.041)	-0.006	(0.029)
Visit to County Hospital and above									
Bottom 25%	0.003	-0.015	(0.007)*	-0.014	(0.007)	-0.018	(0.016)	-0.025	(0.015)
Middle 50%	0.009	-0.007	(0.008)	-0.005	(0.008)	0.05	(0.036)	0.026	(0.022)
Top 25%	0.021	-0.027	(0.013)*	-0.03	(0.013)*	0.045	(0.048)	0.003	(0.034)
# Outpatient Visits									
Bottom 25%	0.291	-0.03	(0.067)	0.008	(0.055)	0.163	(0.085)	0.132	(0.076)
Middle 50%	0.330	-0.003	(0.051)	0.03	(0.042)	0.156	(0.095)	0.083	(0.058)
Top 25%	0.447	-0.035	(0.098)	-0.02	(0.087)	0.241	(0.217)	0.192	(0.155)
Self-Medication									
Bottom 25%	0.064	-0.061	(0.020)**	-0.052	(0.019)**	-0.034	(0.028)	-0.026	(0.023)
Middle 50%	0.051	-0.051	(0.013)**	-0.044	(0.013)**	-0.037	(0.018)*	-0.043	(0.017)*
Top 25%	0.061	-0.045	(0.020)*	-0.033	(0.019)	-0.034	(0.030)	-0.028	(0.022)
Inpatient Visit									
Bottom 25%	0.015	-0.008	(0.014)	-0.009	(0.015)	-0.012	(0.022)	-0.014	(0.018)
Middle 50%	0.023	0.018	(0.012)	0.027	(0.012)*	0.032	(0.020)	0.043	(0.020)*
Top 25%	0.068	-0.005	(0.020)	-0.004	(0.020)	-0.065	(0.031)*	-0.056	(0.030)
Visit to Township Health Center									
Bottom 25%	0.007	-0.008	(0.010)	-0.01	(0.010)	-0.01	(0.016)	-0.012	(0.015)
Middle 50%	0.012	0.005	(0.007)	0.007	(0.007)	0.01	(0.012)	0.009	(0.011)
Top 25%	0.017	0	(0.011)	0.004	(0.011)	-0.016	(0.012)	-0.01	(0.013)
Visit to County Hospital and above									
Bottom 25%	0.007	0	(0.011)	0.001	(0.011)	-0.002	(0.013)	-0.003	(0.012)
Middle 50%	0.011	0.013	(0.009)	0.02	(0.009)*	0.022	(0.018)	0.035	(0.018)
Top 25%	0.051	-0.005	(0.017)	-0.009	(0.017)	-0.049	(0.032)	-0.046	(0.026)

* Significant at 5% ** Significant at 1%

Table 9. Estimates of RMHC on Outpatient/Inpatient Utilization and Self-Medication – by chronic disease

	Base-line	DD (univariate)		DD (multivariate)		Nearest neighbor		Kernel	
		β	s.e.	β	s.e.	β	s.e.	β	s.e.
Outpatient Visit (0/1)									
0 chronic conditions	0.140	-0.002	(0.016)	0.021	(0.010)*	0.106	(0.029)**	0.098	(0.022)**
1+ chronic conditions	0.327	0.184	(0.054)**	0.128	(0.040)**	0.331	(0.084)**	0.324	(0.067)**
Visit to Village Clinic									
0 chronic conditions	0.118	0.003	(0.014)	0.019	(0.011)	0.082	(0.029)**	0.074	(0.019)**
1+ chronic conditions	0.248	0.151	(0.049)**	0.116	(0.041)**	0.303	(0.072)**	0.282	(0.063)**
Visit to Township Health Center									
0 chronic conditions	0.017	0.008	(0.007)	0.012	(0.007)	0.011	(0.012)	0.015	(0.009)
1+ chronic conditions	0.045	0.049	(0.025)	0.043	(0.025)	0.048	(0.038)	0.053	(0.031)
Visit to County Hospital and above									
0 chronic conditions	0.005	-0.013	(0.005)*	-0.01	(0.005)	0.013	(0.012)	0.009	(0.010)
1+ chronic conditions	0.035	-0.016	(0.023)	-0.031	(0.023)	-0.02	(0.039)	-0.011	(0.035)
# Outpatient Visits									
0 chronic conditions	0.274	-0.033	(0.040)	0.013	(0.033)	0.168	(0.049)**	0.136	(0.036)**
status at baseline									
1+ chronic conditions	0.721	0.127	(0.134)	0.002	(0.118)	0.244	(0.176)	0.275	(0.133)*
Self-Medication									
0 chronic conditions	0.041	-0.041	(0.009)**	-0.031	(0.009)**	-0.021	(0.014)	-0.028	(0.013)*
1+ chronic conditions	0.129	-0.102	(0.034)**	-0.11	(0.033)**	-0.083	(0.045)	-0.083	(0.043)
Inpatient Visit									
0 chronic conditions	0.026	0.003	(0.009)	0.01	(0.009)	-0.02	(0.014)	-0.015	(0.011)
1+ chronic conditions	0.067	0.027	(0.030)	0.02	(0.031)	0.027	(0.042)	0.028	(0.044)
Visit to Township Health Center									
0 chronic conditions	0.009	0.001	(0.005)	0.002	(0.005)	-0.01	(0.011)	-0.006	(0.007)
1+ chronic conditions	0.029	0.005	(0.019)	-0.002	(0.020)	-0.03	(0.024)	-0.032	(0.021)
Visit to County Hospital and above									
0 chronic conditions	0.017	0.002	(0.007)	0.008	(0.007)	-0.01	(0.010)	-0.01	(0.010)
1+ chronic conditions	0.037	0.022	(0.023)	0.022	(0.024)	0.057	(0.035)	0.06	(0.032)

Table 10. Estimates of NCMS on Outpatient/Inpatient Utilization and Self-Medication

	Baseline	DD (univariate) (N = 2151)		DD (multivariate) (N = 2151)		Nearest neighbor (N = 1467)		Kernel (N = 2093)	
		β	s.e.	β	s.e.	β	s.e.	β	s.e.
Outpatient Visit (0/1)	0.026	0.053	(0.016)**	0.014	(0.009)	-0.029	(0.048)	-0.041	(0.036)
Visit to Village Clinic	0.008	0.053	(0.013)**	0.032	(0.010)**	-0.043	(0.036)	-0.051	(0.044)
Visit to Township Health Center	0.005	0.015	(0.008)	0.008	(0.008)	0.015	(0.025)	0.018	(0.017)
Visit to County Hospital and above	0.013	-0.015	(0.008)	-0.027	(0.008)**	-0.001	(0.014)	-0.008	(0.009)
# Outpatient Visits	0.033	0.119	(0.032)**	0.056	(0.024)*	0.001	(0.063)	-0.021	(0.045)
Self-Medication	0.008	-0.027	(0.010)**	-0.028	(0.010)**	-0.023	(0.013)	-0.024	(0.015)
Inpatient Visit	0.015	0.016	(0.010)	0.01	(0.010)	0.037	(0.030)	0.041	(0.027)
Visit to Township Health Center	0.002	0.012	(0.006)*	0.008	(0.006)	0.025	(0.025)	0.028	(0.022)
Visit to County Hospital and above	0.013	0.004	(0.008)	0.001	(0.008)	0.012	(0.013)	0.013	(0.014)

* Significant at 5% ** Significant at 1%

Table 11. Spillover Estimates of RMHC on Outpatient/Inpatient Utilization and Self-Medication (RMHC community non-enrollees vs. control)

	Baseline	DD (univariate) (N = 2334)		DD (multivariate) (N = 2334)		Nearest neighbor (N = 1988)		Kernel (N = 2267)	
		β	s.e.	β	s.e.	β	s.e.	β	s.e.
Outpatient Visit (0/1)	0.094	-0.018	(0.016)	0.006	(0.011)	0.028	(0.030)	0.019	(0.024)
Visit to Village Clinic	0.056	0.01	(0.013)	0.023	(0.011)*	0.051	(0.033)	0.05	(0.025)*
Visit to Township Health Center	0.032	-0.011	(0.009)	-0.003	(0.009)	-0.009	(0.015)	-0.011	(0.013)
Visit to County Hospital and above	0.006	-0.017	(0.007)*	-0.014	(0.007)	-0.014	(0.015)	-0.02	(0.012)
# Outpatient Visits	0.185	-0.049	(0.035)	-0.002	(0.029)	0.024	(0.051)	0.015	(0.039)
Self-Medication	0.041	-0.047	(0.011)**	-0.036	(0.011)**	-0.044	(0.013)**	-0.038	(0.010)**

* Significant at 5% ** Significant at 1%

Appendix I: Description of Variables

Variable(s)	Description/coding
Health Care	
▪ Outpatient visit (any level); ▪ Outpatient visit to village clinic / town health center / hospital; ▪ Inpatient visit (any level); ▪ Inpatient visit to town health center / hospital	For outpatient, any visit in the last month: 0 = no; 1 = yes For inpatient, any admission in the last year: 0 = no; 1 = yes
▪ Number of outpatient visits in the last month	0 – 30
▪ RMHC enrollment in 2005	0 = not enrolled; 1 = enrolled
Health Status	
▪ Self-Rated Health (SRH)	1 = very poor; 2 = poor; 3 = average; 4 = good; 5 = excellent
▪ Presence of one or more chronic conditions (as diagnosed by a health care professional)	0 = no chronic conditions; 1 = 1+ chronic conditions
▪ European Health Related Quality of Life 5 dimensions (mobility, self care, pain, anxiety and depression) (Rabin and de Charro 2001)	5 (no impairment) – 25 (total impairment)
▪ Current smoker/drinker	0 = no; 1 = yes
Socioeconomic and Demographic Characteristics	
▪ Income index	Aggregation of consumption and expenditures across four categories — self-produced goods (namely foodstuffs), non-durable goods (e.g., utilities, transportation, clothing), durable goods (e.g., radio, motorcycle), and housing — following (Deaton and Zaidi 2002).
▪ Wealth index	Factor analysis score of ownership of durable goods and housing conditions, following (Deaton and Zaidi 2002). The index ranges from -1 to 1 (centered around 0) with lower values representing lower wealth.
▪ Age	Numeric
▪ Gender	0 = female; 1 = male
▪ Married, divorced/separated, widowed/other	0 = no; 1 = yes
▪ Worked out-of-town in previous year (“migrant”)	0 = no; 1 = yes
▪ Household size	Numeric
▪ Household distance from nearest village clinic / township health center / hospital	Numeric