INSURANCE COVERAGE AND AGENCY PROBLEMS IN DOCTOR PRESCRIPTIONS: EVIDENCE FROM A FIELD EXPERIMENT IN CHINA

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March 2011

Abstract

Do doctors write more expensive prescriptions for insured patients, and if so, why? I conducted a randomized audit experiment using undercover visits to Chinese hospitals. The results show that prescriptions for insured patients are 43% more expensive than those for uninsured patients when doctors expect to obtain a proportion of their patients' drug expenditures. The differences in prescriptions are largely explained by a *differential agency problem hypothesis* that doctors act of self-interest and prescribe more unnecessary or expensive drugs to insured patients, rather than by a *considerate doctor hypothesis* that doctors consider the trade-off between drug efficacy and patients' ability to pay.

Keywords: health insurance, agency problems, incentive, drug prescription, field experiment
JEL codes: D82, I11, I18, L15

I owe great thanks to my advisors, Jeffrey Perloff and Michael Anderson, for invaluable guidance throughout the entire process. I also want to thank Jeremy Magruder, William Dow, Enrico Moretti, Ethan Ligon, Elizabeth Sadoulet, Alain de Janvry, Edward Miguel, Frederico Finan, Meredith Fowlie, Brian Wright, Sofia Berto Villas-Boas, Peter Berck, and seminar participants for their valuable comments. Special thanks to Henry Schneider and the Committee for Protection of Human Subjects for help with human subject protocols. I want to thank Dr. Brad Buchman and several Chinese doctors for help in the experiment design. I also want to thank IBER, CEGA and the Graduate Division at UC Berkeley for providing the financial supports for conducting this research.

1. Introduction

Health insurance coverage is expanding rapidly in China, the United States, and many other countries. Empirical evidence shows that insurance coverage is associated with rising health expenditure (see Rice and Matsuoka (2004) and Gemmill et al. (2008) for reviews). Because doctors' prescriptions are a major source of health expenditures, exploring whether and why doctors respond to patients' insurance is essential for understanding why expanding insurance coverage leads to rising expenditures. This study uses a randomized field experiment to determine whether Chinese doctors write more expensive prescriptions for insured patients than for uninsured patients. It tests two competing hypotheses explaining such an increase in drug expenditures. The *considerate doctor hypothesis* holds that doctors are concerned about the wellbeing of their patients so that they prescribe medicine taking into account drug efficacy and what they believe that each of their patients can afford to pay. The *differential agency problem hypothesis* contends that doctors act of self-interest, prescribing more expensive drugs to insured patients to increase their own profits.

Arrow (1963) identifies the principle-agent problems between patients and doctors as one of the fundamental market failures in the health care market. In many societies, doctors can pocket profits from selling drugs and services. As patients have limited knowledge about proper treatments, doctors with such financial incentives may recommend treatments to increase their own income rather than their patients' well-being. Although incentives possibly motivate doctors to prescribe more drugs than what are optimal for both insured patients and uninsured patients, insurance coverage allows doctors to increase drug expenditures by a larger amount to insured patients than to uninsured patients. In other words, insurance coverage may exacerbate the extent of agency problems and contribute to the greater health expenditures for insured patients.

Separating these two different motivations is important for evaluating the welfare implications of insurance expansion projects in many countries, but this issue has been overlooked due to identification challenges. First, insurance might be endogenous; patients with insurance may have different health needs from those without insurance, so the difference in health expenditures across insurance statuses may simply reflect different medical needs. Second, doctors' financial incentives also may be endogenous. For example, the markup from prescribing a drug is sometimes used to measure doctors' incentives for prescribing the drug, but the markup may be associated with product characteristics, or marketing strategies. Third, and most challenging, insured patients may request and then receive more drugs or more expensive drugs (e.g., Kravitz et al. 2005), which makes it difficult for studies with observational data to identify whether a doctor may initiate more expensive prescriptions to insured patients.

This study avoids these three identification challenges by using a randomized audit experiment based on undercover hospital visits in Beijing, China. Audit experiments have been used to study a wide range of social life, such as job market, car sale, car repair, sports card trading and also doctor prescribing behaviors (Bertrand and Mullainathan, 2004; Ayres and Siegelman, 1995; Schneider, 2009; List, 2004 and 2006; Kravitz et al, 2005; Currie, Lin and Zhang, 2010). In the experiment, the same "patients" are randomly presented as having insurance or not having insurance during hospital visits. Further, doctors are randomly told either that the patient will buy drugs at the doctor's hospital (providing doctors with a financial incentive to prescribe more drugs) or that the drugs will be purchased elsewhere (eliminating the doctor's financial incentive). The Chinese hospitals are allowed to sell drugs with a 15% markup over the wholesale price and keep the profits. Doctors receive a share of these profits from prescribed drugs sold in their own hospitals; however, doctors do not have a financial incentive for prescribing more drugs if patients buy the drugs elsewhere.

An institutional feature in Beijing helps to circumvent the third identification challenge. In Beijing, doctors in top-rated hospitals are frequently consulted by family members for patients who live elsewhere, and they write prescriptions without seeing patients in person if their family members provide adequate medical information. In the experiment, a "family member" describes the patient problems and provides medical test results using a standard script. Thus, the problems due to differences between patients in observational studies are eliminated.

The analysis shows that when doctors are presented with incentives, insured patients receive prescriptions that cost 43 percent more on average than those of uninsured patients. Perhaps more telling, doctors are more likely to prescribe unneeded drugs to the insured (64%) than to the uninsured (40%). In contrast, doctors without a personal financial incentive are not more likely to prescribe unneeded drugs to the insured, and drug expenditures are similar for both insured and uninsured patients, which suggests that insurance status by itself is not responsible for this behavior.

For an insured patient, doctors with incentives write much more expensive prescriptions than do doctors without incentives; this confirms that agency problems play an important role in drug prescriptions. However, the agency problems are largely constrained when a patient has no insurance. Overall, this study shows that the interaction between insurance coverage and agency problems has significant impacts on medical expenditures. Accordingly, it is doctors' self financial interest rather than their concerns for patients' wellbeing that motivates more expensive prescriptions to insured patients.

This study makes three major contributions to the literature on health insurance and agency problems. First, this study provides the clearest picture to date about the causal effects of a patient's insurance coverage on the decision-making of doctors, especially when doctors' own earnings are under stake. Most empirical work on the effects of health insurance either has focused the effects via patients or has studied the combined effects from both patients and doctors (Card, Dobkin and Maestas, 2008; Anderson, Dobkin and Gross, 2009; Wagstaff et al., 2009; Zweifel and Manning, 2000; Rice and Matsuoka, 2004; Gemmill et al., 2008; Lundin, 2000). Mort et al (1996) and McKinlay, Potter and Feldman (1996) investigate how insurance affects doctor decisions, but in their studies, doctors were aware that their decisions were under study. This paper uses controlled hospital visits and randomized insurance status to demonstrate that doctors react strongly to patient's insurance coverage.

Second, this analysis adds new empirical evidence on prescriptions to the agency health literature. McGruire (2000) reviews empirical evidence on agency problems in the health care market, and most studies focus on health care services. As the prescription of drug is more transparent than the prescription of service and therefore is less subject to information asymmetry, it is important to know whether and how agency problems exist in drug prescribing behaviors. In addition to Iizuka (2007) and Dalen, Sorisio and Strom (2010), this study deepens the understanding of drug prescribing behaviors, and shows doctors respond to the randomly presented financial incentives by prescribing more drugs.

Third, this work is the first study to separate the two explanations for increasing drug expenditures under insurance coverage – doctors' self interest versus their consideration for patients, and it demonstrates that insurance coverage can exacerbate doctors' agency problems. Kessel (1958), Feldstein (1970) and Sun et al. (2009) interpret the larger expenditures associated with insurance coverage by referring to the interaction between insurance and agency problems, but they can not provide solid evidence. Iizuka (2007) is an exception that looks at a patient's insurance and a doctor's markup at the same time. This paper uses controlled hospital visits and written prescriptions (as filled prescriptions are subject to patients' decisions) to exclude explanations due to differences across patients. And the randomized insurance and incentive status provide a rigorous identification for illustrating the interaction effects between insurance and incentive on doctors.

The next section describes insurance and doctors' incentives in China. Section 3 presents the experimental design and predictions tested. Section 4 describes the data, and Section 5 presents the main results. Section 6 conducts robustness checks. Section 7 summarizes the paper and draws conclusions.

2. Institutional Background

The Chinese government can not fully subsidize public hospitals, so it allows hospitals to profit from selling drugs, which is called the policy of "compensating hospitals through drug sales". In Beijing, the wholesale prices for drugs are set by the government. Public hospitals (except community-level hospitals) are allowed to charge a retail price for a drug that is 15% above the government-set wholesale price.[1] Every hospital has its own pharmacy. Around 70% of drugs across the country are dispensed through hospital pharmacies.[2] Revenues from drugs account for about half the total revenues for hospitals.[3]

The majority of doctors are affiliated with public hospitals. Although private clinics have emerged in recent years, public hospitals are the dominant medical service provider in China. Doctors work in the outpatient service or the inpatient service in hospitals, and they get salary, bonus, and other benefits from hospitals. How hospitals share profits with doctors may vary across hospitals, but it is widely believed that doctors do share profits.[4] Several online cases suggest that doctors usually have to fulfill a targeted workload first and then get an additional bonus in proportion to work exceeding the target. Only drugs or services sold at their own hospitals can be linked to doctors' bonuses. If patients choose to buy the prescribed drugs elsewhere, doctors cannot share the profit from selling drugs at places other than their hospitals. This feature is important for the design of the experiment. It is possible that drug companies

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1 During the experiment period, the wholesale prices at military-affiliated hospitals and other hospitals were decided by different government agencies, so the wholesale prices are not uniform, but those prices are very close. No violations of the rules for drug pricing appeared during the experiment.

2 Source: http://finance.ifeng.com/news/special/xylgg/20100419/2070067.shtml (in Chinese)

3 Source: http://health.sohu.com/20090318/n262859031.shtml (in Chinese)

4 The share of profits between a hospital and its doctors is said to be a secret rule in hospitals. Source: http://health.newssc.org/system/2009/02/05/011540387.shtml (in Chinese)

would bribe doctors for prescribing their drugs, but this possibility is ignored in this study given the lack of information.[5]

The top-rated hospitals are called Level-3A hospitals, which tend to be concentrated in large cities, such as Beijing. Patients from other areas may visit a doctor at a top-rated hospital in Beijing for treatments or for second opinions. When patients have difficulty in getting to hospitals, and if medical problems can be adequately described by test results, doctors are usually willing to give medical suggestions without seeing the patient in person. This practice is common in top-rated hospitals.[6] Doctors have a fixed phrase for this practice – "patient is not present, family member consults on patient's behalf". Under this circumstance, it is also reasonable for the patient to either buy prescribed drugs near his home or at the Beijing hospital.

The particular type of insurance chosen for this study is the commonly called "public-expenditure" insurance. The favorable feature of the public-expenditure insurance is that hospitals do not verify the insurance status if a patient states that she has public-expenditure insurance. With public-expenditure insurance, patients pay all the medical fees to hospitals as if they did not have any insurance, and then file for reimbursement with the necessary receipts at their affiliated organizations. This feature facilitates the manipulation of insurance status.

Employees of government agencies and government-affiliated non-profit organizations tend to have public-expenditure insurance. Copayment rates vary as they are decided independently by each employer. As patients with public-expenditure insurance pay full medical fees to hospitals, doctors facing public-expenditure insurance do not know the exact copayment rate. The typical copayment rate for employees in urban areas is around 30%, and it is commonly believed that government agencies and government-affiliated organizations tend to offer better benefits, so the copayment rate for public-expenditure insurance is usually expected to be below 30%.

Different insurances in Beijing vary largely in terms of deductibles, copayment rates, and drugs covered by insurance. For the purpose of this study – to compare patients with insurance and patients without insurance, the public-expenditure insurance shares three important features

[5] Occasionally, drug companies are exposed secretly bribing doctors for prescribing their drugs. For example, in May 2010, a drug company was exposed for paying 20% of revenue (6.5 out of 32.2 yuan per unit) to doctors who prescribed the drug. Source: http://www.chinanews.com.cn/jk/jk-aqjs/news/2010/05-30/2312025.shtml

[6] In a list of suggestions on how patients should communicate with doctors, written by a doctor in a Level 3A hospital, the first suggestion is to tell doctors clearly who is the patient as people sometimes see doctors on behalf of others. Source: http://www.yafda.gov.cn/article_view.asp?id=2515&type=6&parentID=6

with other insurances: first, insured patients pay a lower out-of-pocket price for drugs on average than uninsured patients pay; second, for many drugs, the copayment rates are the same for the brand-name drugs and their generic equivalent; and third, the regulations on prescriptions are largely similar.

Hospitals are required to clearly label prices for drugs and health care services, and they are prohibited from charging different prices according to insurance status. Hospitals have discretion over which drugs – brand-name or generic – to carry in their pharmacies, as long as they do not price drugs above the allowed level.

3. Experiment Design and Predictions Tested

The experiment used undercover hospital visits to detect variations in how doctors prescribe. The experiment employed a 2-by-2 intervention design:

(1) The patient was presented to have public-expenditure insurance ("insured") or not to have any insurance ("uninsured");

(2) Before the prescription was written, the doctor was informed either of the patient's intention to buy medicine from the doctor's hospital, so that the doctor has an "incentive" to prescribe extensively, or of the patient's intention to buy elsewhere ("no incentive").

	Incentive	No incentive
Insured	A	C
Uninsured	B	D

Thus, there were four possible situations, as the chart shows: A. insured-incentive; B. uninsured-incentive; C. insured-no-incentive; D. uninsured-no-incentive. Insurance and incentive status was randomly assigned to doctors.

Hypothetical Patients

Two hypothetical patients were constructed for the experiment (see Appendix A), and the same hypothetical patients were used for hospital visits across all the interventions. Diabetes, hypertension and abnormal triglyceride were chosen because these problems are among the most common illnesses for the elderly and they are relatively easy to describe with numbers.

Patient 1 was described as a 66 year-old male who recently received medical test results showing high blood pressure, high blood sugar, and elevated triglyceride, and was not yet taking any medication. The problem with triglycerides was included to test for over-prescribing. If a patient were to look at the lab results for blood lipids, he might reasonably conclude that he needed medication for triglycerides. However, according to medical guidelines, the patient should not be prescribed drugs for triglyceride, given his level of triglyceride and the possible side effects of the drugs.[7] Therefore, the prescription of triglyceride drugs indicated over-treatment or inappropriate treatment.

Patient 2 was described as a 65-year-old male with hypertension, already taking the brand-name drug Nifedipine, a control-released tablet for hypertension, but with his blood pressure still abnormal.

The experimenters posed them as family members who visited doctors. They were prepared with answers for the most likely questions that doctors might ask concerning other health problems, such as histories of family illness, smoking, drinking, height, weight, etc. The prepared answers excluded all other risk factors. The experimenters presented the patients' test results directly to the doctors, but they would only give other information if asked by doctors, because knowing the relevance of other information might suggest that the experimenters or the patients were much more knowledgeable than is typical.

Patients were described as living far from where the hospitals were located. If a patient lived nearby, a doctor might suggest that the patient visit the hospital himself. More importantly, in the no-incentive interventions, doctors might get angry if the patient refused to buy drugs at their hospitals, but they would understand if the patient lived far away.

This study was designed to evaluate the effects of health insurance for the social average patient (rather than, say, for a poor patient). Two indicators were provided to doctors to show that the patient was not poor. First, the drug that was currently being taken by Patient 2 for hypertension is a relatively expensive brand-name drug. The brand-name Nifedipine tablet costs about 163 yuan (around 24 dollars) per month,[8] which is 67% higher than the 98 yuan for the generic equivalent.[9] Among drugs for hypertension, the brand-name Nifedipine is one of the

[7] For the guideline in the U.S., see http://www.nhlbi.nih.gov/guidelines/cholesterol/atglance.htm.
[8] The exchange rate was \$1 U.S. ≈ 6.8 CNY during the experimental period, the summer of 2010.
[9] A study compares brand-name nifedipine with the generic one, and finds that the two are statistically similar in terms of clinical efficacy and adverse reactions.

most costly. In addition, the monthly expenditure for the brand-name Nifedipine costs more than 10% of the average income of an urban resident.[10] Given the availability of a much cheaper generic equivalent, a patient who pays for the brand-name Nifedipine tablet all out of his own pocket is likely to have decent economic status. Second, if doctors asked about the economic status of an uninsured patient, the doctor was told that the patient had "middle income." In China, "middle income" means that the patient is neither very poor nor very rich.

Experimenters and Hospital Visit Procedure

Hospital visits were conducted by two trained experimenters: the author, a 32-year-old Chinese female, and a 56-year-old Chinese female assistant. Before visiting hospitals, the experimenters participated in mock doctor visits and compared experiences in order to ensure consistent presentations. The use of the hypothetical patients made it easy to consistently present patients across different interventions, and reduced the influences of experimenters to the minimal.

Upon arriving at a hospital, the experimenter first went to the registration window, paid the visit fees, and provided information on the patient's name, gender, age and other demographics. Whether the patient had public-expenditure insurance was declared at the registration window. The registration staff either used a computer system to send the demographic and insurance information to the doctor, or printed that information on a registration ticket for the patient or family member to present to the doctor.

When an experimenter saw a doctor, she introduced herself by saying, "I am coming to see you on behalf of my {the relative} who lives in my hometown. He wants a doctor in a top-rated hospital to look at his case." Then the experimenter described the health problems according to the standard script. The experimenter always brought a reference sheet – a piece of paper with medical test results indicating health problems. The experimenter was required to describe the health problems with the assistance of the reference sheet, but was not allowed to directly read the reference sheet. Then the experimenter said either "{the relative} asked me to buy the medicines here for him" for the incentive interventions, or "{the relative} wants to get a prescription and buy drugs at his local store" for the no-incentive interventions. In the end, the experimenter exited the doctor's office with printed or hand-written prescriptions.

Source: http://www.100paper.com/100paper/yiyaoxue/yaoxue/20070623/24750.html

[10] The average annual income per capita among urban residents is 15781 yuan in 2008, so the current drug expenditure of the brand nifedipine tablet is 12% of the average income (163*12/15781≈12%).

Samples of Hospitals and Doctors

All the Level-3A hospitals with separate departments for endocrinology and cardiology in the urban districts of Beijing were included as the sample.[11] Patient 1 was presented to the department of endocrinology, and Patient 2 was presented to the department of cardiology. Each hospital-department received four visits with one visit under each intervention.

The interventions were randomly assigned to doctors within hospitals. All the doctors visited were specialists in the sense that they focus on either endocrinology or cardiology. In Chinese hospitals, there are two types of visits – regular visits and expert visits. Compared to regular visits, expert visits are associated with higher visit fees and doctors with higher titles. As hospitals do not post doctors' names and work shifts for regular visits, and as schedules for expert visits are sometimes inaccurate, it was not possible to randomize by assigning interventions to an ex ante list of doctors, as is commonly done in other field experiments. However, doctors are assigned by either the computer system or staff in regular visits, so a patient has very limited ability to choose a doctor during regular visits. Given that doctors are exogenously decided, a random sequence of the four interventions to a hospital generates a random assignment of interventions to doctors. In the experiment, the sequences for Patient 1 were generated first, and the sequences for Patient 2 were matched to those for Patient 1 by switching the insurance status.

In a few hospitals, there are only one or two doctors available for regular visits. To fulfill the four visits per hospital-patient, the experimenters supplemented with expert visits when necessary. Technically a patient can choose which doctor to visit for expert visits, but the experimenters did not make such a selection. The experimenters always took the next available expert visit if an expert visit was needed. When more than one expert visit was available on the same day, one of them was chosen randomly.

It was difficult to prevent two experimenters from visiting the same doctor during regular visits, because experimenters usually do not know whether a particular doctor has been visited by another experimenter. To limit the possible memory effect, the experimenters left at least a one-week gap between any two regular visits to the same hospital. The doctors consulted while the experiment was under design said that doctors are more likely to remember a patient's face

[11] This is to exclude Level-3A specialized hospitals which only have departments for particular health problems.

than a patient's health problems. In the experiment, experimenters were asked to avoid visiting the same doctor twice. If there was a high chance that an experimenter would see a doctor she had visited before, the visit was scheduled to another date.

Predictions tested

Following the literature that incorporates a disutility of acting against the best interest of the patient (Evans, 1974; McGuire and Pauly, 1991; Gruber and Owings, 1996), a doctor's utility can be specified as some combination of her own income, her consideration for a patient's financial situation as well as her professional concerns capturing the disutility for deviating from the optimal prescription. In both incentive and no-incentive interventions, the doctor may consider the tradeoff between drug efficacy and patients' other consumptions for patients, and prescribe more drugs or more expensive drugs to insured patients who pay lower out-of-pocket prices. In the incentive interventions, as the doctor's own income is in proportion to the expenditure of prescribed drugs, she wants to increase the drug expenditure up to a patient's ability to pay.[12] Let A, B, C, D in the previous chart be the drug expenditure under the corresponding intervention. The 2-by-2 experiment design allows testing five predictions.

(1) Insurance effect under incentive: A > B. A doctor with incentives writes more expensive prescriptions to insured patients than to uninsured patient for two possible reasons – her consideration on the tradeoff between patients' health and other consumptions or her intention to increase the expenditure up to a patient's budget limit.

(2) Insurance effect under no incentive: C > D. A doctor without incentives prescribes more expensive drugs to insured patients due to her consideration on the tradeoff. This is a test for the considerate doctor hypothesis.

(3) Agency problems with insurance: A > C. If a patient has insurance, a doctor with incentives prescribes more expensive drugs than does a doctor without incentives due to the motivation for profit.

(4) Agency problems with no insurance: B ≥ D or B < D. If a patient has no insurance, whether the incentive increases drug expenditures depends on the magnitude that the

[12] Some insured patients may have very low copayment rate. In that case, a doctor's professional concern may limit the prescription.

patient's budget is expected to be and the prescription expenditure when the doctor has no financial incentive.

(5) Interaction effect: A-B > C-D. Insurance coverage exacerbates the effect of incentive due to a doctor's intention for increasing the expenditure up to a patient's budget limit. Alternatively, it is due to the different degree of agency problems between predictions (3) and (4). This is a test for the differential agency problem hypothesis.

4. Data

I visited all Level-3A hospitals with separate departments for endocrinology and cardiology in the urban districts of Beijing between June and August of 2010. Five hospitals were eventually excluded from the sample because they either do not separate the "public-expenditure" insurance from no insurance or do not provide prescriptions unless patients pay for drugs there. [13] Although most doctors were willing to give prescriptions in the absence of the actual patient, some doctors were not. I excluded two hospitals whose doctors in the endocrinology department refused to prescribe without seeing the patient.[14] For Patient 2, one more hospital was dropped due to refusals from doctors in cardiology to prescribe without seeing the patient. Therefore, the final sample includes 25 hospitals for Patient 1 and 24 hospitals for Patient 2. Among the visits to the hospital-departments included in the sample, the experimenters encountered five additional refusals for Patient 1 and four refusals for Patient 2. The successful visits represented 95.4% of the intended visits, without counting refusals in hospitals which were dropped from the analysis; otherwise the success rate was 88% for Patient 1 and higher for Patient 2.[15] The success rate is comparable to the 91% consent rate in the videotape study by McKinlay et al. (1996), and is much better than the 64% consent rate in the survey by Mort et al. (1996) and 53-61% in the study with standardized patients by Kravitz et al. (2005). There was no correlation between

[13] Two hospitals label patients with "public expenditure" insurance if a patient does not have any insurance, and I believe doctors there tend to think patients actually have insurance. In one visit to those hospitals, when I was leaving, I forgot to take the registration ticket, and the doctor said "don't forget it; you need this for reimbursement" although I presented a patient without insurance.

[14] As patient 1 was expected to convey more interesting results, a hospital was excluded from the sample if the doctors in the endocrinology department refused to give prescriptions during the first two visits, although doctors in the cardiology department in the same hospital were willing to prescribe. If two refusals occurred, no additional visits were attempted.

[15] Only two visits were conducted for hospitals which were dropped from the analysis. To calculate the success rate, I assume four refusals in each dropped hospital, which gives a success rate of 88% for Patient 1 (4*2 hospitals + 5 additional refusals divided by 4*27 hospitals). For Patient 2, the first visit was successful in the hospitals which were dropped due to refusals to Patient 1.

refusals and intervention types. (See Appendix table 1 for the list of refusals.) When a refusal occurred, a second visit was attempted; in no case was a third try needed.

Visit characteristics include variables on who conducted the visit, whether the visit was an expert visit, and the doctor's gender and age. The doctor's age was estimated based on the experimenter's best guess. If a doctor seemed to be closer to 40 years old rather than 35 or 45 years old, her age is recorded as 40. Descriptive statistics are presented in Table 1. As there is a random matching between intervention types and doctor visits, Table 2 shows that the visit characteristics across intervention groups are largely balanced with data combining the two patients, and none of the F tests is statistically significant. The visit characteristics are also balanced for each individual patient (results not presented).

The raw drug expenditure is the overall amount of payment associated with a prescription. Experimenters requested a prescription of drugs for a month. Depending on the number of drugs per package and doctor's preference, drugs are usually prescribed for 28 days, 30 days or 35 days.[16] In the no-incentive interventions, the prescription is only to give patients information on what drugs to use and how to use them, and it is difficult to know whether doctors intend to prescribe for 28 days or 35 days. Therefore, the raw total expenditure is not calculated for the no-incentive interventions.

Drugs prescribed for Patient 1 can be separated into three mutually exclusive categories: drugs for triglycerides, drugs for diabetes and hypertension, and supplementary drugs. Drugs for Patient 2 include drugs for hypertension and supplementary drugs. Supplementary drugs are aspirin in most cases, except that vitamin B1 was included in one visit. The brand-name aspirin costs about 15 yuan (3% of average raw drug expenditure) and has a small effect on drug expenditure. There is not a clear medical justification whether to prescribe aspirin for the two hypothetical cases.[17] So I do not consider aspirin in the analysis.

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[16] In several visits for Patient 2, because the health problem was very simple, doctors reacted quickly and printed out the prescription with drugs for half a month or without drugs currently takenen before a research assistant had a chance to make the request. In these cases, I added necessary drugs and calculated the total drug expenditure with the modified parts based on 28 days or 30 days (not beyond 30 days).

[17] Aspirin is recommended for male hypertension patients above 50 years old if they do not have relevant contraindications for using aspirin, a condition which both Patient 1 and 2 satisfy, and if they are able to reduce their blood pressure below 150. Doctors who prescribe may expect the blood pressure to fall below 150, while those who do not prescribe may wait to prescribe until the blood pressure actually fall below 150. One doctor explicitly said "this time I don't prescribe aspirin, and he needs it when his blood pressure gets back to the normal level."

Patient 1 has an abnormal triglyceride level, but the level is well below the level requiring drug therapy according to the medical guidelines. Therefore, whether doctors prescribe drugs for triglycerides can serve as an indicator for over-prescription. On average, 43% of doctors in this study prescribed drugs for triglycerides, and there seems to be evidence for over-treatment.

Both diabetes and hypertension require long-term drug therapy, and prescribing drugs for a longer period does not indicate a waste. Therefore, I calculate monthly drug expenditure for diabetes and hypertension on a 30-day basis. The number of drugs and the unit of drugs capture the intensity of prescribing, although admittedly neither is a perfect measure.[18] The number of drugs is a simple count of how many drug names are prescribed.[19] To construct the unit of drugs, a table of "unit dosage" for each drug is compiled, based on the most commonly prescribed quantity or the representative dosage of the brand-name drug (see Appendix table 2). The differences between the number and the unit of drugs can be illustrated by an example. Say, a typical usage of Matformin is 500mg each time and 3 times a day (500mg*3), and a doctor prescribes 250mg*3, then Matformin is counted as 1 in terms of the number of drugs, but 0.5 in terms of the unit of drugs. The share of brand-name drugs is the number of brand-name drugs divided by the number of all drugs. A drug is classified as a brand-name drug if (i) it is clearly labeled as brand-name drug in the prescription; or (ii) its price is much closer to the price of the corresponding brand-name drugs than to the generic equivalent; or (iii) it is a Chinese patent medicine.[20]

In the no-incentive interventions, several doctors wrote down multiple treatment plans and let patients choose. Under these circumstances, doctors usually suggested that the first one is the best but all the plans work well. So the first plan is used to construct data.

5. Results

This section tests the five predictions listed in section 3. Table 3 presents the averages of various outcome variables under each intervention. Results in Table 4 to 8 are from the linear regression model for the purpose of simple interpretations, but all the results survive the tests of alternative

[18] The variables on drug intensity require a certain aggregation of effects of various drugs, but the precise measure of effects of drugs on blood sugar and blood pressure is complicated and not available.

[19] For Patient 2, two doctors suggested double the amount of the brand nifedipine tablet; it is counted as two drugs under this circumstance.

[20] The monthly expenditures for Chinese patent drugs are comparable to or higher than those of brand-name western drugs except for one Chinese patent drug.

model specifications, which include taking logarithms for expenditure related variables, using a logit model for the binary variable on whether drugs are prescribed for triglycerides, applying a Poisson model for the number of drugs, and taking a Tobit model for the share of brand drugs whose values range between 0 and 1.[21]

5.1 Effects of health insurance when doctors have financial incentives

The specification in Equation (2) is used to test Prediction 1.

$$Y_{hi} = \alpha_0 + \alpha_1 Insurance_{hi} + X_{hi} + hospital_{hi} + e_{hi} \quad (2)$$

The variable Y_{hi} indicates an outcome variable for hospital *h* and visit *i*. The key predictor $Insurance_{hi}$ equals 1 if a patient has insurance and 0 otherwise. The control variables X_{hi} include the four variables for visit characteristics. The analysis is restricted to observations under the two incentive interventions. Table 4 presents the estimated coefficients for the key predictor with each coefficient corresponding to a separate regression. The outcome variables are listed on the left. The first two columns present the results combining Patient 1 and Patient 2 together except for the variable on a prescription for triglycerides. All the standard errors are clustered at the hospital level. The first column controls for hospital fixed effects only, [22] and the second column controls for both hospital fixed effects and visit characteristics. The sample size is 50 for prescription on triglycerides and 98 for all other outcome variables. The results for Patient 1 and Patient 2 separately are in column 3 to 6.

Referring to Table 3, patients pay 522 yuan in total if they have insurance and 365 yuan otherwise. The 157-yuan difference represents 43% of the amount an uninsured patient pays. Alternatively, if drug expenditures are compared within each hospital, Patient 1 pays for a higher expenditure in 19 out of 25 hospitals if she is insured; the corresponding number for Patient 2 is 20 out of 24.

Drugs for triglycerides should not be recommended for Patient 1. Doctors who did not prescribe tended to say "the level is not very high" or "when the level of blood sugar is reduced, the blood lipid will go down automatically." Overall, 64 versus 40 percent of doctors prescribe

[21] If the model is featured by the maximum likelihood estimation, the hospital fixed effects are dropped out of the specification. For the number of drugs, I also try the negative binomial model, but the concavity assumption is not satisfied for several specifications.

[22] Since the intervention is fully balanced within hospitals, the model with only hospital fixed effects gives the same results as the model without fixed effects when the standard errors are clustered at the hospital level.

drugs for triglyceride under each insurance status respectively, and the 24-percentage difference is weakly significant (t=1.95, p=0.064 in the full model).

For the health problems which require drug therapy – hypertension and diabetes for Patient 1 and hypertension for Patient 2 – the insured pay 126 yuan more in terms of the monthly drug expenditure, about 42% more than the amount that the uninsured pay. Higher monthly drug expenditures could be driven by two factors: (1) doctors use more intense drug therapy, and (2) doctors prescribe more expensive drugs rather than cheaper drugs. Table 4 provides evidence for both channels. On average, doctors prescribed 0.26 more kinds of drugs or 0.44 more units of drugs to the insured.

There is a wide range of drugs suitable for the two patient cases. To manipulate the price level, doctors can choose different brand-name drugs or they can choose between brand-name drugs and their generic equivalence. But it is difficult to capture the intention for manipulating prices by choosing different brand-name drugs since those drugs also vary largely in other dimensions. This study explores the share of brand-name drugs. Doctors did not prescribe 100% of brand-name drugs even for the insured, which may be explained by doctor's habits or doctors' concern for the out-of-pocket payment, as drugs are not totally free to the insured. Table 4 shows that doctors prescribed 15 percent more brand-name drugs to the insured. One issue to note is that generic drugs are always much cheaper than the brand-name equivalent, but some generic drugs may have similar price levels as brand-name drugs of other types. Therefore the share of brand-name drugs is only a partial indicator for price manipulation.

The comparison between the insured-incentive intervention and the uninsured-incentive intervention confirms Prediction 1 – a patient's insurance status has strong effects on doctors' prescription decisions when a doctor is incentivized. As postulated earlier, doctors' concern for patient welfare can motivate differential prescriptions across insurance statuses; the following subsection explores this effect.

5.2 Effects of health insurance when doctors have no incentives

When doctors know that patients will not buy drugs from their hospitals, they have no financial incentive to prescribe more than what they think is optimal for the patient's health. Prediction 2 suggests that doctors might prescribe less expensive drugs to the uninsured if they care about the patient's out-of-pocket expenditure. I use a similar empirical strategy as in Equation (2) but restrict the analysis to the sample under the no-incentive interventions.

During the visits, several doctors showed explicit concerns about the insurance status, although patients will not buy drugs at their hospitals. They said the patient did not have health insurance, so they prescribed inexpensive but effective drugs for the patient, which suggests those doctors were empathetic toward uninsured patients. However, the comparison between means does not provide strong support for the empathy effect. Table 5 presents the results for the comparison between the insured-no-incentive intervention and the uninsured-no-incentive intervention. When doctors do not expect profits from prescriptions, none of the outcomes is statistically different across insurance statuses. Doctors are not more likely to prescribe drugs for triglycerides, which is not surprising given that those drugs are not needed. The 17-yuan difference represents 5.5% of the drug expenditure of the uninsured, but the differences are far from being statistically significant.

That doctors prescribe drugs for triglycerides even without a financial incentive may reflect the general over-medication problem, which is common in many Asian countries, such as India (Das-Hummer, 2007). As experimenters explicitly described triglycerides as a concern, doctors might have tried to avoid frustrating the experimenters by suggesting drugs for triglycerides. In addition, habit and competence also may explain the results. However, the overall tendency for over-treatment does not threaten the validity of the analysis, as the conclusions focus on the comparison across interventions so that the common over-treatment tendency cancels out.

When patients do not buy drugs at doctors' hospitals, doctors might leave some decisions for patients to make later, such as the brands of drugs, which may explain why there are no significant differences in drug expenditures and shares of brand-name drugs. However, the same explanation cannot account for the null results on drugs for triglyceride and the intensity of drugs.

Admittedly, due to the small number of observations, the standard errors for estimated insurance effect are large. A simple calculation shows that the hypothesis can be rejected only if doctors without incentive respond to insurance status by increasing prescriptions by 14% difference or more.[23] The 5.5% difference in drug expenditure is comparable to the 7.5%

[23] The minimum detectable effect $MDE = (t_{1-\kappa} + t_{\alpha}) * \sigma / \sqrt{p*(1-p)*N}$. The term σ is the standard deviation in drug expenditure if everyone is uninsured and doctors are under no incentive; N is the sample size; p is percent of

difference in recommendations for medical tests found in Mort et al. (1996). Nevertheless, the difference across insurance statuses when doctors have no incentive is too small to account for the difference under incentives. The interdependent preference among doctors cannot explain the insurance effect under incentives.

5.3 Effects of incentives if a patient has health insurance

Equation (3) is used to test the effects of incentive where $Incentive_{hi}$ equals 1 if in the incentive intervention and 0 otherwise. This subsection focuses on insured patients.

$$Y_{hi} = \alpha_0 + \alpha_1 Incentive_{hi} + X_{hi} + hospital_{hi} + e_{hi} \qquad (3)$$

Results in Table 6 confirm Prediction 3. Doctors with incentives are much more likely to prescribe drugs for triglycerides than are doctors without incentives if the patient is insured. Incentivized doctors write 100-yuan (31%) more expensive prescriptions for diabetes and hypertension. Evidence also shows that doctors with incentives use drugs more intensively for both patients. However, the share of brand-name drugs is 83% under incentive and 81% under no incentive, and incentivized doctors are roughly equally likely to prescribe brand-name drugs as are doctors without incentives.

5.4 Effects of incentives if a patient has no insurance

Table 7 presents results on the effects of incentives when a patient does not have insurance coverage. According to Prediction 4, the net effect of incentive on an uninsured patient is not clear, which depends on the expected budget constraint of a patient. When Patient 1 has no insurance, doctors with incentives are not more likely to prescribe drugs for triglycerides. The negative difference is unexpected; as it is not statistically significant, it is treated as random errors. The drug expenditures and intensities of drugs are more or less similar. The differences in the share of brand-name drugs show that doctors with incentive prescribe less brand-name drugs, which have two alternative explanations. First, it may suggest that patients' budgets are expected to be smaller than the amount required for the treatments. Second, in the no incentive case, the names of brands, as comparing to the scientific names of drugs or generic drug names, might be

treatment; $t_{1-\kappa}$ is the t statistics on power and t_α is on significance level. Even if I ignore the requirement on power, MDE = 43, which is around 14% of the average drug expenditure in the uninsured-no-incentive intervention.

more convenient for doctors to communicate with patients, and the prescriptions of brand-name drugs does not necessarily indicates that doctors want to prescribe brand-name drugs.

5.5 Interaction effect of insurance and incentive

The interaction effect of insurance and incentive can be calculated by subtracting coefficients in Table 5 from those in Table 4 or subtracting coefficients in Table 7 from those in Table 6. Alternatively, the interaction effect can be expressed as β_1 in Equation (4).

$$Y_{hi} = \beta_0 + \beta_1 Insurance_{hi} * Incentive_{hi} + \beta_2 Insurance_{hi} + \beta_3 Incentive_{hi} + X_{hi} + Hospital_{hi} + e_{hi} \quad (4)$$

Table 8 presents the estimated interaction effects. Prediction 5 suggests that the interaction between insurance and incentive could have strong effects on drug expenditure if incentivized doctors take advantage of the enlarged ability to pay under insurance coverage. The results on all outcome variables support Prediction 5. Doctors are much more likely to prescribe drugs for triglycerides when insurance and incentive are both present. The interaction effect accounts for a 105-yuan difference in the monthly drug expenditure for diabetes and hypertension, and it is about 80% of the expenditure difference across insurance status when doctors have incentives. Referring to average outcomes by intervention types in Table 3, the interaction effects on drugs for triglycerides, drug expenditure and drug intensity for diabetes and hypertension are driven by the fact that prescriptions in the insurance-incentive intervention deviate from those in the other three interventions. However, the interaction effect on drug brand is caused by doctors who prescribe a lower percentage of brand drugs in the uninsured-incentive intervention.

5.6 Effects of other variables

Table 9 presents estimated coefficients of all variables from Equation (4). Several facts are worth noting. First, experimenters do not have an effect on the outcomes, which suggests that the two experimenters did a successful job in conforming doctor visits. Second, none of the control variables has a significant effect on the prescription of drugs for triglycerides, and this indicates over-treatment is not correlated to any particular characteristics of doctors. Third, doctors holding expert visits tend to write more expensive prescriptions, while older doctors tend to prescribe fewer brand-name drugs.

6. Robustness

6.1 Doctors with multiple visits

During the doctor visits, experimenters were required to avoid visiting the same doctor twice, but the same doctors could be visited by different experimenters more than once.[24] Two concerns might arise: first, although there was at least one-week gap between any two visits to the same doctor, doctors might remember earlier visits and become suspicious during later visits; second, doctors visited more than once might have different characteristics from others and drive the results in particular. To address these concerns, the sample is separated into doctors visited only once and doctors with multiple visits. Table 10 shows the results according to Equation (4) with the sub-sample of doctors who are only visited once. Only the coefficients on the interaction term are presented, since the individual effects of insurance and incentive are not important even in the full sample. The first column copies the results for the full sample from Table 8, and the second column presents the results for the one-visit sub-sample. Given that around 40% of the visits are dropped from the analysis, the significance levels of tests are expected to decrease. The purpose of this exercise is to compare the magnitude of the point estimates. The estimated effects on prescription for triglycerides and monthly drug expenditure are roughly the same between the full sample and the sub-sample. There are no statistically significant differences between the coefficients across samples. Overall, the interaction effects of insurance and incentive are not driven by doctors with multiple visits.

On the other hand, the sub-sample of doctors with multiple visits can be used for the within-doctor comparison. The pair-wise comparison between the insured-incentive setting and any of the other three settings shows the following results: (1) in terms of monthly drug expenditure, 15 out of 22 comparisons support the main findings while 4 comparisons go against them, and 3 comparisons par; (2) in terms of drugs for triglycerides, 3 out of 11 comparisons support the main results and none of the comparisons go against them.

6.2 Contaminated cases

There are some contaminated cases, in which the actual insurance status or incentive status deviates from the intended ones. In one case intended for the insured-incentive intervention, the

[24] Two doctors ended up with three visits because experimenters did not recognize the doctors during the second visits. The doctors did not appear to recognize the experimenter either.

insurance status was mislabeled at the beginning, and the experimenter corrected the insurance status before she finished the prescription.[25] In four cases under no-incentive interventions in which the experimenters said they did not intend to purchase drugs at the doctor's hospital, doctors tried to persuade the experimenters to buy drugs there. They were persuading as they were prescribing, so their prescriptions might have been affected by their expectations about purchases. On the other hand, in two cases under uninsured-incentive interventions, doctors suggested that patients purchase drugs locally rather than in their hospitals. Except for the case with mislabeled insurance status, other contaminations are doctor-driven, so all the contaminated cases are kept under their intended intervention types for the main analysis. (See Appendix table 3 for a list of contaminated cases.) For the robustness check, the third column of Table 10 presents the estimations of the interaction effects by dropping hospitals with contaminated cases, and the results are close to those in the full sample.

6.3 Availability of drugs in other regions

Under no incentive, doctors prescribe drugs for patients to purchase in other regions, so the prescriptions might be affected by doctors' expectations on whether certain drugs are available in other regions. A particular concern is whether the possibly limited availability of drugs restricts the prescription of drugs under the insured-no-incentive intervention, which is important for the estimation of agency problems and the interaction effects. However, this concern does not appear to impose any strong threat to the analysis. First, for triglycerides, since the focus is on whether doctors prescribe drugs or not, the concern about availability requires doctors to expect there are no drugs for triglycerides in a certain region, which is very unlikely. Second, the shares of brand-name drugs for diabetes and hypertension are very similar across incentive statuses, which suggest there is no concern along the brand-generic dimension. Third, in terms of varieties of drugs for diabetes and hypertension, except for two Chinese patent drugs, all other drugs prescribed in the experiment are listed in the National Catalog of Basic Drugs under Insurance Coverage (2005). As provinces tend to add more drugs to provincial catalogs and rarely remove drugs, there is no reason to expect those drugs are not available in other regions. The fourth column in Table 10 presents the estimation of interaction effects by dropping the two hospital-

[25] The visit representative did so by requesting a second copy of the prescription for reimbursement purposes. Although doctors are required to print out two copies of prescriptions for all patients, some hospitals only print out one copy for those uninsured, because only those insured need a second copy for the purpose of reimbursement.

departments which prescribed the two drugs not included in the national catalog, and the results are similar to those in the full sample.

7. Conclusions

This study uses a randomized field experiment to demonstrate that doctors prescribe more expensive drugs to insured patients. The experiment was also designed to distinguish between the differential agency problem hypothesis, where doctors act in their self financial interest, and the considerate doctor explanation, where the doctor prescribe taking into account the tradeoff between the efficacy of drugs and patients' ability to pay. The controlled experiment not only solves the usual endogenous problems associated with the insurance and incentive status, but also avoids the confounding effect in observational studies where insured patients possibly request more drugs.

The results show that the doctor is more likely to prescribe inappropriate drugs or more expensive drugs to patients with insurance than to patients without insurance if a doctor expects to receive a proportion of prescribed drug expenditures. The prescriptions to insured patients cost more than 43% of those to uninsured patients on average. However, if the doctor does not have this financial incentive, the prescriptions are similar for insured and uninsured patients. Thus, the increases in drug expenditures are due to an agency problem, where doctors increase their earnings by exploiting the information asymmetry and taking advantage of the greater purchasing power of insured patients, and not to the caring doctor hypothesis. In practice, as a large proportion of patients buy drugs at the hospital where they see a doctor, this study suggests a substantial amount of increases in health expenditures under insurance coverage are in inefficient use due to doctors.

The Beijing hospitals and doctors in the experiment are among the best in China, and they are not a nationally representative sample. And the public expenditure insurance is relatively more generous than many other types of health insurance. Needless to say, the quantitative estimates are highly specific to the particular group of doctors, and the type of insurance. However, the structures of doctors' financial incentives are similar across the country, and different types of insurance share several important characteristics. Therefore, at a broad level, this study illustrates the importance of the interaction between insurance and incentive.

The analysis suggests that although insured patients receive more drugs or more expensive drugs, they may not be receiving better health treatments. It draws cautions in interpreting the welfare consequences of increased health expenditures under insurance coverage in China. It highlights the importance of coordinating an expansion of health insurance and a reform of doctors' incentive structure. In China, as well as in many other developing countries, there are market failures along various dimensions. These market failures interact – the lack of health insurance limits the extent of agency problems while expanding insurance coverage can exacerbate agency problems. This experiment illustrates, dealing with one failure while ignoring the other may actually generate substantial inefficiency.

APPENDIX A: DESCRIPTION OF HYPOTHETICAL PATIENTS

Patient 1: male, 66 years old.

Basic description of health problems is:

He is recently tested with problems.

Fasting blood sugar is 7.5 mmol/L and 2-hour postprandial blood sugar is 11.5 mmol/L.

Fasting c-peptide is 2.1 ng/ml and 2-hour postprandial c-peptide is 10.2 ng/ml.26

Hemoglobin A1C level is 7.8%.

Blood pressure is 160/90.

Triglyceride is 2.3 mmol/L (equivalent to 199 mg/dL). Cholesterin is normal.

Hearst rate is 80.

He does not feel sick.

If asked by doctors, prepared answers include:

Liver function and kidney function are normal.

Height is 175cm and weight is 70kg.

He does not smoke and he drinks little.

He does not eat too much food.

[26] The test of C-peptide is not standardized, and different labs have different normal range for fasting C-peptide. From the internet, we see more three standards: (1) 1.49-3.41 ng/ml; (2) 1.1-4.4 ng/ml; (3) 3.77-4.23 ng/ml. Overall, the constructed C-peptide indicates that the patient is of Type II diabetes, which is obvious even without the C-peptide test given that the patient is already 66 years old. Some doctors ask about the reference range; if so, the answer is from zero point something to three points something. Some doctors may think the C-peptide level is below the normal.

He does not have family history.

Patient 2: male, 65 years old.

Basic description of health problems is:

He has hypertension.

He is taking the brand-name NIFEDIPINE control-released table one tablet per day.

Blood pressure is 155/80.

Heart rate is 75.

He does not feel faint.

If asked by doctors, prepared answers include:

Liver function and kidney function are normal.

Highest blood pressure can reach 170.

He has hypertension for three years.

He has taken Bai Xin Tong for several months.

He does not smoke and he drinks little.

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TABLES

Table 1. Summary statistics

Variables	Obs	Mean	Std.	Min	Max
For Patient 1					
Visited by researcher (0/1)	100	0.48	0.50	0	1
Expert visit (0/1)	100	0.33	0.47	0	1
Male doctor (0/1)	100	0.34	0.48	0	1
Doctor age (years)	100	43.00	8.29	30	65
Raw drug expenditure (yuan)	50	534.06	252.76	115.12	1394.86
Prescription for triglycerides (0/1)	100	0.43	0.50	0	1
Monthly expenditure D&H (yuan)	100	374.57	151.04	109.38	762.52
Number of drugs D&H	100	2.39	0.65	1	4
Unit of drugs D&H	100	2.37	0.78	1	5
Share of branded drugs D&H (0~1)	100	0.72	0.32	0	1
For Patient 2					
Visited by researcher (0/1)	96	0.49	0.50	0	1
Expert visit (0/1)	96	0.28	0.45	0	1
Male doctor (0/1)	96	0.42	0.50	0	1
Doctor age (years)	96	44.95	7.56	30	60
Raw drug expenditure (yuan)	48	349.43	143.38	122.63	794.28
Monthly expenditure D&H (yuan)	96	301.45	116.00	102.92	761.84
Number of drugs D&H	96	2.13	0.42	2	5
Unit of drugs D&H	96	2.08	0.47	1.5	4
Share of branded drugs D&H (0~1)	96	0.83	0.26	0	1

Notes: "D&H" represents "for diabetes and hypertension only".

Table 2. Visits characteristics by intervention types

Variables	Insurance Incentive	No Insurance Incentive	Insurance No Incentive	No Insurance No Incentive	F-test	P value
For both patients						
Visited by researcher (0/1)	0.49	0.51	0.51	0.43	0.64	0.59
s.e.	(0.07)	(0.07)	(0.07)	(0.07)		
Expert visit (0/1)	0.29	0.27	0.31	0.37	0.80	0.51
s.e.	(0.07)	(0.06)	(0.07)	(0.07)		
Male doctor (0/1)	0.37	0.33	0.41	0.41	0.53	0.66
s.e.	(0.07)	(0.07)	(0.07)	(0.07)		
Doctor’s age (years)	43.57	43.67	44.08	44.49	0.14	0.95
s.e.	(1.17)	(1.19)	(1.15)	(1.08)		
Observations	49	49	49	49		

Table 3. Outcomes by intention types

Dependent variables	Insurance Incentive	No Insurance Incentive	Insurance No Incentive	No Insurance No Incentive
For both patients				
Raw drug expenditure (yuan)	522.11	365.14	-	-
s.e.	(35.80)	(23.63)	-	-
Prescription for triglycerides (0/1)	0.64	0.40	0.28	0.40
s.e.	(0.10)	(0.10)	(0.09)	(0.10)
Monthly drug expenditure D&H (yuan)	424.78	298.71	324.50	307.03
s.e.	(23.54)	(15.84)	(18.95)	(15.44)
Number of drugs D&H	2.47	2.20	2.18	2.18
s.e.	(0.10)	(0.08)	(0.07)	(0.06)
Unit of drugs D&H	2.53	2.09	2.16	2.12
s.e.	(0.11)	(0.08)	(0.09)	(0.07)
Share of branded drugs D&H (0~1)	0.83	0.68	0.81	0.80
s.e.	(0.04)	(0.05)	(0.03)	(0.04)
Obs. for triglycerides	25	25	-	-
Obs. for other variables	49	49	49	49

Notes: "D&H" represents "for diabetes and hypertension only".

Table 4. Effects of insurance when doctors have financial incentives

	Both patients		Patient 1		Patient 2	
Dependent variables	(1)	(2)	(3)	(4)	(5)	(6)
Raw drug expenditure (yuan)	156.97***	155.49***	202.77***	202.13***	109.26***	99.07***
	(36.35)	(37.67)	(59.01)	(64.56)	(34.81)	(27.38)
Prescription for triglycerides (0/1)	0.24*	0.26*	0.24*	0.26*		
	(0.13)	(0.14)	(0.13)	(0.14)		
Monthly drug expenditure D&H (yuan)	126.07***	125.53***	146.62***	140.80***	104.67***	92.93***
	(25.48)	(25.46)	(31.63)	(31.30)	(33.07)	(24.58)
Number of drugs D&H	0.27**	0.27**	0.32**	0.29**	0.21	0.18
	(0.12)	(0.12)	(0.13)	(0.10)	(0.17)	(0.12)
Unit of drugs D&H	0.44***	0.45***	0.57***	0.58***	0.31*	0.25**
	(0.12)	(0.11)	(0.14)	(0.14)	(0.17)	(0.10)
Share of branded drugs D&H (0~1)	0.15**	0.14**	0.12	0.10	0.18***	0.17***
	(0.05)	(0.05)	(0.10)	(0.09)	(0.06)	(0.05)
Control for:						
Hospital fixed effects	Y	Y	Y	Y	Y	Y
Visit characteristics	N	Y	N	Y	N	Y
Obs for triglycerides	50	50	50	50	-	-
Obs for other variables	98	98	50	50	48	48

Notes: "D&H" represents "for diabetes and hypertension only". The dependent variables are listed on the left, and coefficients are from separate regressions. Standard errors, clustered at the hospital level, are in parentheses. * denotes significance at the 10% level, ** at the 5% level, and *** at the 1% level.

Table 5. Effects of insurance when doctors have NO incentives

	Both patients		Patient 1		Patient 2	
Dependent variables	(1)	(2)	(3)	(4)	(5)	(6)
Prescription for triglycerides (0/1)	-0.12	-0.07	-0.12	-0.07		
	(0.11)	(0.09)	(0.11)	(0.09)		
Monthly drug expenditure D&H (yuan)	17.47	16.67	13.70	13.79	21.40	20.21
	(23.00)	(23.38)	(34.54)	(35.82)	(23.09)	(20.06)
Number of drugs D&H	0.00	-0.01	-0.04	-0.04	0.04	0.03
	(0.08)	(0.09)	(0.16)	(0.14)	(0.04)	(0.03)
Unit of drugs D&H	0.04	0.02	-0.09	-0.08	0.18*	0.15
	(0.11)	(0.10)	(0.22)	(0.20)	(0.09)	(0.09)
Share of branded drugs D&H (0~1)	0.01	0.01	0.04	0.03	-0.02	-0.03
	(0.04)	(0.04)	(0.07)	(0.07)	(0.06)	(0.06)
Control for:						
Hospital fixed effects	Y	Y	Y	Y	Y	Y
Visit characteristics	N	Y	N	Y	N	Y
Obs for triglycerides	50	50	50	50	-	-
Obs for other variables	98	98	50	50	48	48

Notes: "D&H" represents "for diabetes and hypertension only". The dependent variables are listed on the left, and coefficients are from separate regressions. Standard errors, clustered at the hospital level, are in parentheses. * denotes significance at the 10% level, ** at the 5% level, and *** at the 1% level.

Table 6. Effects of incentives when a patient has health insurance

	Both patients		Patient 1		Patient 2	
Dependent variables	(1)	(2)	(3)	(4)	(5)	(6)
Prescription for triglycerides (0/1)	0.36***	0.35***	0.36***	0.35***		
	(0.11)	(0.10)	(0.11)	(0.10)		
Monthly drug expenditure D&H (yuan)	100.28***	101.22***	104.69**	105.16**	95.68***	110.52***
	(31.65)	(30.93)	(47.58)	(49.43)	(30.97)	(29.33)
Number of drugs D&H	0.29**	0.29**	0.28	0.27*	0.29*	0.29**
	(0.11)	(0.11)	(0.17)	(0.15)	(0.14)	(0.12)
Unit of drugs D&H	0.37***	0.38***	0.47**	0.47**	0.26*	0.30**
	(0.13)	(0.13)	(0.21)	(0.22)	(0.15)	(0.14)
Share of branded drugs D&H (0~1)	0.02	0.02	-0.07	-0.07	0.12*	0.14**
	(0.05)	(0.04)	(0.09)	(0.08)	(0.06)	(0.06)
Control for:						
Hospital fixed effects	Y	Y	Y	Y	Y	Y
Visit characteristics	N	Y	N	Y	N	Y
Obs for triglycerides	50	50	50	50	-	-
Obs for other variables	98	98	50	50	48	48

Notes: "D&H" represents "for diabetes and hypertension only". The dependent variables are listed on the left, and coefficients are from separate regressions. Standard errors, clustered at the hospital level, are in parentheses. * denotes significance at the 10% level, ** at the 5% level, and *** at the 1% level.

Table 7. Effects of incentives when a patient has NO insurance

	Both patients		Patient 1		Patient 2	
Dependent variables	(1)	(2)	(3)	(4)	(5)	(6)
Prescription for triglycerides (0/1)	0.00	-0.01	0.00	-0.01		
	(0.13)	(0.13)	(0.13)	(0.13)		
Monthly drug expenditure D&H (yuan)	-8.32	-5.09	-28.22	-14.96	12.42	16.38
	(21.19)	(19.38)	(34.97)	(33.26)	(22.30)	(23.83)
Number of drugs D&H	0.02	0.02	-0.08	-0.02	0.13*	0.13*
	(0.09)	(0.09)	(0.15)	(0.16)	(0.07)	(0.06)
Unit of drugs D&H	-0.03	-0.04	-0.19	-0.13	0.14	0.12
	(0.09)	(0.10)	(0.18)	(0.20)	(0.10)	(0.12)
Share of branded drugs D&H (0~1)	-0.12*	-0.11*	-0.16*	-0.14*	-0.08	-0.05
	(0.06)	(0.06)	(0.09)	(0.08)	(0.10)	(0.07)
Control for:						
Hospital fixed effects	Y	Y	Y	Y	Y	Y
Visit characteristics	N	Y	N	Y	N	Y
Obs for triglycerides	50	50	50	50	-	-
Obs for other variables	98	98	50	50	48	48

Notes: "D&H" represents "for diabetes and hypertension only". The dependent variables are listed on the left, and coefficients are from separate regressions. Standard errors, clustered at the hospital level, are in parentheses. * denotes significance at the 10% level, ** at the 5% level, and *** at the 1% level.

Table 8. The interaction effects of insurance and incentive

	Both patients		Patient 1		Patient 2	
Dependent variables	(1)	(2)	(3)	(4)	(5)	(6)
Prescription for triglycerides (0/1)	0.36**	0.34**	0.36**	0.34**		
	(0.14)	(0.14)	(0.14)	(0.14)		
Monthly drug expenditure D&H (yuan)	108.60***	103.71**	132.92**	128.49**	83.27**	72.68*
	(37.57)	(38.37)	(56.56)	(56.73)	(38.38)	(37.00)
Number of drugs D&H	0.27**	0.26**	0.36*	0.36**	0.17	0.14
	(0.13)	(0.13)	(0.18)	(0.17)	(0.17)	(0.15)
Unit of drugs D&H	0.40**	0.39**	0.67**	0.64**	0.13	0.11
	(0.16)	(0.16)	(0.27)	(0.28)	(0.18)	(0.16)
Share of branded drugs D&H (0~1)	0.14*	0.13*	0.08	0.07	0.20*	0.18*
	(0.07)	(0.07)	(0.13)	(0.12)	(0.11)	(0.09)
Control for:						
Hospital fixed effects	Y	Y	Y	Y	Y	Y
Visit characteristics	N	Y	N	Y	N	Y
Obs for triglycerides	100	100	100	100	-	-
Obs for other variables	196	196	100	100	96	96

Notes: "D&H" represents "for diabetes and hypertension only". The dependent variables are listed on the left, and coefficients are from separate regressions. Standard errors, clustered at the hospital level, are in parentheses. * denotes significance at the 10% level, ** at the 5% level, and *** at the 1% level.

Table 9. Effects of all variables on prescriptions

	Dependent variables:				
Independent variables	Prescription for Triglycerides	Monthly Expenditure	Number of Drugs	Unit of Drugs	Share of Brand drugs
Insurance*Incentive	0.34**	103.71**	0.26**	0.39**	0.13*
	(0.14)	(38.37)	(0.13)	(0.16)	(0.07)
Insurance	-0.10	21.07	0.01	0.05	0.02
	(0.10)	(24.33)	(0.09)	(0.11)	(0.04)
Incentive	0.02	-3.49	0.03	-0.02	-0.11*
	(0.13)	(21.86)	(0.09)	(0.10)	(0.06)
Visited by researcher	-0.11	-16.17	0.05	-0.00	-0.02
	(0.08)	(20.32)	(0.09)	(0.10)	(0.05)
Expert visit	0.09	44.82**	0.12	0.10	0.13*
	(0.13)	(21.40)	(0.11)	(0.13)	(0.06)
Male doctor	0.07	-1.67	-0.04	-0.03	0.07
	(0.17)	(25.74)	(0.12)	(0.15)	(0.05)
Doctor's age	0.00	-1.14	0.00	0.01	-0.01**
	(0.01)	(1.66)	(0.01)	(0.01)	(0.00)
Hospital fixed effects	Y	Y	Y	Y	Y
Observations	100	196	196	196	196

Notes: Standard errors, clustered at the hospital level, are in parentheses. * denotes significance at the 10% level, ** at the 5% level, and *** at the 1% level.

Table 10. Interaction effects of insurance and incentive in different samples

Dependent variables	Full sample	One-visit sample	No-contamination sample	National-catalog sample
Prescription for triglycerides	0.34**	0.35	0.32**	0.40**
	(0.14)	(0.25)	(0.15)	(0.16)
Monthly drug expenditure D&H	103.71**	97.82*	94.37**	97.82**
	(38.37)	(56.12)	(38.03)	(40.70)
Number of drugs D&H	0.26**	0.44*	0.33**	0.22*
	(0.13)	(0.21)	(0.13)	(0.13)
Unit of drugs D&H	0.39**	0.45*	0.45**	0.35*
	(0.16)	(0.23)	(0.17)	(0.17)
Share of branded drugs D&H	0.13*	0.07	0.11	0.15**
	(0.07)	(0.09)	(0.07)	(0.06)
Control for:				
Hospital fixed effects	Y	Y	Y	Y
Visit characteristics	Y	Y	Y	Y
Obs for triglycerides	100	62	76	92
Obs for other variables	196	114	168	188

Notes: "D&H" represents "for diabetes and hypertension only". The dependent variables are listed on the left, and coefficients are from separate regressions. Standard errors, clustered at the hospital level, are in parentheses. * denotes significance at the 10% level, ** at the 5% level, and *** at the 1% level.

The following is "Not for Publication".

APPENDIX TABLES

Appendix table 1: List of doctor refusals

Patient No.	Intended Intervention[1]	Experimenter[2]	Male Doctor	Doctor Age
1	D	0	0	35
1	A	0	0	50
1	C	1	1	50
1	C	1	0	30
1	B	1	0	35
2	D	0	1	55
2	A	0	1	40
2	D	1	0	50
2	B	1	0	40

Notes:
1. A. Insured-incentive; B. uninsured-incentive;
 C. insured-no-incentive; D. uninsured-no-incentive.
2. 0 indicators the assistant, and 1 represents the researcher.

Appendix table 2: List of unit dosage

Drug names	Instructions (dose*times/day)	Unit
Drugs for diabetes:		
Glipizide	5mg*1	1
Gliquidone	30mg*3	1
Glimepiride	2mg*1	1
Gliclazide	30mg*1	1
Nateglinide	120mg*3	1
Repaglinide	1mg*3	1
Metformin	0.5g*3	1
Pioglitazone	15mg*1	1
Rosiglitazone	4mg*1	1
Acarbose	50mg*3	1
Calcium dobesilate	0.5g*3	1
Chinese Patent Drug 1	#8*3	1
Chinese Patent Drug 2	#1*3	1
Chinese Patent Drug 3	#4*3	1
Chinese Patent Drug 4	#6*3	1
Drugs for hypertension:		
Perindopril	4mg*1	1
Benazepril	10mg*1	1
Fosinopril	10mg*1	1
Enalapril	10mg*1	1
Ramipril	5mg*1	1
Valsartan	80mg*1	1
Irbesartan	150mg*1	1
Telmisartan	80mg*1	1
Losartan Potassium	50mg*1	1
Candesartan	4mg*1	1
Nifedipine	30mg*1	1
Lacidipine	4mg*1	1
Felodipine	5mg*1	1
(Lev)amlodipine	5mg*1	1
Bisoprolol	5mg*1	1
Metoprolol	47.5mg*1	1
Arotinolol	10mg*1	1
Carvedilol	12.5mg*1	1
Indapamide	1.5mg*1	1
Amiloride	25mg*1	1
Antisterone	20mg*1	1
Hydrochlorothiazide	25mg*1	1
Chinese Patent Drug 5	#2*2	1
Chinese Patent Drug 6	#3*3	1
Chinese Patent Drug 7	#3*3	1
Losartan Potassium and Hydrochlorothiazide	(50mg+12.5mg)*1	1.5
Irbesartan and Hydrochlorothiazide	(150mg+12.5mg)*1	1.5

Appendix table 3: List of contaminated cases

Patient No.	Intended Intervention[1]	Contaminated Intervention[1]	Experimenter[2]	Male Doctor	Doctor Age
1	D	B	1	1	40
1	C	A	1	0	40
1	D	B	0	0	50
1	D	B	0	1	55
1	B	D	1	0	55
1	A	B	1	0	35
2	B	D	0	0	50

Notes:
1. A. Insured-incentive; B. uninsured-incentive;
C. insured-no-incentive; D. uninsured-no-incentive.
2. 0 indicators the assistant, and 1 represents the researcher.