Impact of capitation on outpatient expenses among patients with diabetes mellitus in Tianjin, China: a natural experiment

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ABSTRACT

Objectives Capitation policy, a new medical insurance settlement method implemented on 1 January 2014 in Tianjin, China, aimed to control unreasonable increases in medical costs. The goal of the current study was to evaluate the impact of capitation on outpatient expenses among patients with diabetes mellitus and provide scientific evidence for health policy-makers.

Design A natural experiment.

Setting The medical insurance database of Tianjin from 1 January 2010 to 31 December 2014.

Participants In total, 35,529 records were included, comprising 9646 records in the pilot group (4907 records in 2014 and 4739 records in 2013) and 25,883 records in the control group (9814 records in 2014 and 16,069 records in 2013).

Main outcome measures The outcome variables included annual total outpatient expenses, drug expenses, examination expenses, treatment expenses and other expenses.

Results Capitation produced an increase in total outpatient expenses of ¥1993.76 (95% CI, ¥1643.74 to ¥2343.77) in the pilot group relative to the control group. There was also an increase in drug expenses of ¥1904.30 (95% CI, ¥1578.63 to ¥2229.96) after the implementation of capitation. An increase in examination expenses of ¥44.90 (95% CI, ¥19.11 to ¥70.68) was found in the pilot group versus the control group. Capitation also produced an increase in treatment expenses of ¥3.55 (95% CI, ¥1.01 to ¥6.09) and an increase in other expenses of ¥43.46 (95% CI, ¥26.81 to ¥60.11) in the pilot group versus the control group.

Conclusion Compared with those who participated in the ‘control’ policy, outpatient expenses of patients enrolled in capitation increased significantly. The increases were due to the actual needs of patients, changes in drug directories, and the autonomy and independence of hospitals. It is necessary for the government, policy-makers, hospitals, doctors, patients and supervisory agencies to improve the capitation policy.

INTRODUCTION

Diabetes mellitus (DM), a widespread chronic and non-communicable disease that is rapidly growing in prevalence, is becoming an increasingly serious global public health problem. The latest International Diabetes Federation (IDF) figures show that there were 425 million diabetic patients in the world in 2017, and this number is expected to reach 629 million by 2045. China has a total of 114.4 million patients with DM, the most in the world, and this number is expected to increase to 119.8 million by 2045. Meanwhile, medical expenses for the treatment of diabetes are rapidly increasing.

Research on the associations among capitation, health outcomes and medical costs is lacking in our study.
poor access to medical care’ has not been solved. Therefore, reducing the economic burden for patients with DM is a major challenge in the Chinese health system. Policy-makers are increasingly interested in reducing health-care costs and inefficiencies through innovative payment strategies. Payment reform is on the political agenda for China’s healthcare system. The two major payers in China, the Ministry of Human Resources and Social Security (MOHRRSS) and the National Health and Family Planning Commission (NHFPC), issued official documents on payment reform in 2011 and 2012 that identified the use of prospective payment methods, including capitation, as a priority for payment reform.

As the third largest city in China, Tianjin enjoys the same political status as a province. Tianjin is located on the eastern coast of China, where the prevalence of diabetes is the highest. Medical expenses for DM amounted to ¥3300 million, accounting for 80% of the medical expenses for all outpatient special diseases in Tianjin. A capitation policy was implemented as a possible method for controlling unreasonable increase in medical expenses in Tianjin. Capitation payments have also been adopted in Latin America, Thailand and Nigeria. This new medical insurance settlement method has been officially piloted since 1 January 2014 at the ST Hospital in the Tianjin Nankai district. Capitation policy refers to a practice, whereby medical insurance agencies (governmental agencies) pay for medical expenses that are reimbursed at a capitation standard to designated hospitals. Patients' out-of-pocket expenses are settled on the basis of total outpatient expenses and proportion of payment. The agencies do not consider the extent of medical service provided by doctors when they prepay insurance expenses. Agencies and institutions share in the financial risk. The policy enables doctors to provide long-term, ‘one-on-one’ guidance to patients and establish a long-term mechanism to promote trust in the healthcare system. Doctors guide patients in terms of dietary health and physical activity to prevent premature DM complications. Patients are prescribed not only hypoglycaemic drugs but also drugs for lowering blood pressure, lowering blood lipids and managing DM-related complications. They are scheduled to undergo a routine blood examination every month and glycated haemoglobin (HbA1c) tests every 3 months. In addition, patients can choose ‘three hospitals, one drugstore’, not just ST Hospital. Furthermore, they are offered referral services to tertiary hospitals based on the patient’s condition and complications. The policy also monitors the patient’s condition on a regular basis to prevent unreasonable increases in medical costs. The ‘outpatient special diseases’ medical insurance policy is still implemented in other hospitals for patients with DM. This policy was aimed at patients in a large population who require long-term treatment via hospitalisation and outpatient treatment and incur high medical expenses; 13 diseases and conditions covered in this policy in Tianjin include DM, pulmonary heart disease, cancer, mental disorders, kidney dialysis, antirejection therapy after renal transplantation, lupus erythematoses, hemiplegic paralysis, antirejection therapy after liver transplantation, haemophilia, epilepsy, aplastic anaemia and chronic thrombocytopenic purpura. The reimbursement ratio of urban employees who participated in the ‘outpatient special diseases’ policy ranged from 80% to 95% according to different categories of patients (employees, retirees and veteran workers), while that of urban residents ranged from 45% to 65% based on different hospital grades and different categories of patients (students, children and adult residents) in 2017 (online supplementary appendix 1). The remaining ratio was paid out of pocket by patients. These ratios were based on expenses exceeding the annual deductible, which is the amount paid out of pocket for covered expenses before reimbursement.

Few studies have assessed the impact of capitation policy on medical costs in Tianjin. The purpose of this article is to explore the association between capitation and the outpatient costs of diabetes, including annual total outpatient expenses, drug expenses, examination expenses, treatment expenses and other expenses related to DM, to provide scientific evidence for further improvement of the policy.

METHODS

Study design

ST Hospital, a secondary hospital in the Nankai district of Tianjin, was chosen as the subject of investigation. According to relevant policies, capitation has been implemented since 1 January 2014 in the hospital. The study was not controlled in the traditional sense of a randomised experiment. Participants were exposed to the policy naturally. Thus, the study design was defined as a natural experiment. In this natural experiment, patients with DM who participated in the reform at ST Hospital were in the pilot group, which was compared with a control group of people with DM sampled from the remaining hospitals using the ‘outpatient special diseases’ insurance policy. Although the policy was only piloted in a secondary hospital, patients could go to hospitals at different levels based on their condition according to the policy. Therefore, records for the control group were not selected from other secondary hospitals but from the remaining hospitals in Tianjin. Capitation fee standards were calculated based on the medical insurance reimbursement ratio of urban employees and urban residents and the average expenses in Tianjin for the previous 3 years:

\[
M_i = \left( \bar{X} \times (1 - \bar{t}) \right) - D_i - G_i \times S_i
\]

In Equation (1), ‘\(i\)’ represents different categories of patients (including employees, retirees, students, children, adult residents, elderly residents), ‘\(M\)’ represents capitation fee standards of different categories of patients, ‘\(\bar{X}\)’ represents annual cost per patient with DM in the last 3 years in Tianjin, ‘\(\bar{t}\)’ represents out-of-pocket proportion,
‘D’ represents annual deductible, ‘G’ represents additional payment and ‘S’ represents the reimbursement ratio of ‘outpatient special diseases’.

Data source
Data from 1 January 2010 to 31 December 2014 were collected from the medical insurance database of Tianjin. There were 1 850 395 outpatient records with DM. We excluded the records in which total outpatient expenses were equal to 0 and 1 845 022 records remained. We used data from 1 January 2010 to 31 December 2014 to capture trends in outpatient expenses. Data from this data range were used to evaluate the effects of capitation policy on outpatient expenses. There were 410 620 and 465 210 outpatient records with DM in 2013 and 2014, respectively. In 2014, 4910 records of outpatients who participated in capitation were assigned to the pilot group at ST Hospital. There were 460 300 outpatient records assigned to the control group. The records of total outpatient expenses equal to 0 were excluded. There were 1363 and 1144 records that dropped out in 2013 and 2014, respectively. There were 4907 records that remained in the pilot group and 459 159 records that remained in the control group in 2014 (figure 1). Specifically, a patient can have multiple records in the same year, as hospital grades are considered influential factors in medical costs. Each individual may have a maximum of three records and a minimum of one record every year. Our study was designed according to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Guidelines.

Outcome variables
Indicators that were employed to measure the financial impact of capitation included: annual total outpatient expenses, drug expenses, examination expenses, treatment expenses and other expenses. In sensitivity models, expenses were log-transformed because the distribution of the untransformed variables was heavily skewed.

Statistical analysis
Our exploratory analysis started by analysing the basic characteristics and outpatient expenses of patients based on statistical description. For univariate comparisons, X^2 tests were used to evaluate categorical variables, and t-tests were used for continuous variables. This study examined variations in total outpatient expenses, drug expenses examination expenses, and other expenses from 2011 to 2014 in hospitals with and without capitation by a line chart. Propensity score matching (PSM) was performed to create comparable intervention and control groups. This method allows observational studies to be designed in a manner similar to randomised experiments. Variables including sex, age, number of comorbidities, number of complications, type of medical insurance and hospital grade were used to generate the propensity score. Records from the pilot group and control group were paired 1:2 using nearest neighbour matching, with each record in the pilot group matched to two records in the control group. The PSM balance was evaluated.
by comparing standardised differences in the means of matching variables before and after PSM using a threshold of 0.1.11 The records from 2013 for both groups were traced back according to the outpatient number per patient. Ultimately, there were 9646 records in the pilot group (4907 records in 2014 and 4739 records in 2013) and 25883 records in the control group (9814 records in 2014 and 16069 records in 2013) (figure 1).

We estimated the impact of capitation reform on outpatient expenses among patients with DM through difference-in-difference (DID) analysis, which compares mean changes in an outcome in a pilot group before and after a policy change with the mean changes in a control group with no policy change.12 13 The method can overcome bias caused by preassessments/postassessments.14 DID analysis was conducted on the matched sample.

The impact of performing capitation is:

$$\text{DID} = (y_{\text{pilot},2014} - y_{\text{pilot},2013}) - (y_{\text{control},2014} - y_{\text{control},2013})$$

In Equation (2), ‘y’ is the outcome variable (annual health expenses). To control for the observable confounding factors, linear regression models were employed to analyse the impact of capitation policy on outpatient expenses among patients with DM.

$$y = \beta_0 + \beta_{1,\text{pilot}} + \beta_{2,\text{year}} + \beta_{3,\text{pilot} \times \text{year}} + \beta_4 X_i + \varepsilon$$

In Equation (3), ‘y’ indicates dependent variables (annual health expenses); ‘pilot’ and ‘year’ indicate independent variables; ‘pilot \times \text{year}’ indicates the interaction term; ‘X’ indicates control variables (including sex, age, number of comorbidities, number of complications, type of medical insurance and hospital grade); and ‘ε’ indicates the residual term. Although the policy was only piloted in a secondary hospital, patients could be treated at hospitals of different levels for their condition according to the policy. Therefore, hospital grade was incorporated into the model as a covariate.

$$y_{\text{pilot},2014} - y_{\text{pilot},2013} = \gamma_{1,1} - \gamma_{1,0} = \beta_2 + \beta_3$$

$$y_{\text{control},2014} - y_{\text{control},2013} = \gamma_{0,1} - \gamma_{1,0} = \beta_3$$

Therefore, $\beta_3$ is the estimate of DID (regression-adjusted DID), and the estimate of $\beta_3$ becomes more sophisticated when the control variables are included in Equation (3).15 Online supplementary appendix 3 explains the definition and assignment of categorical variables.

The variations in trends in median annual total outpatient expenses, drug expenses, examination expenses, treatment expenses and other expenses were similar in hospitals with and without capitation from 2010 to 2013 (figure 2), which is consistent with the DID hypothesis.15 Various models were used for the estimate. First, expenses as dependent variables were subsumed into the models directly. Second, log-transformed expenses as dependent variables were subsumed into DID models in a sensitivity analysis because the distribution of the untransformed variables was heavily skewed.7 Third, the control group was sampled from other secondary hospitals with a ratio of approximately 1:2 using PSM for another sensitivity analysis. Due to the existence of collinearity between the number of comorbidities and the number of complications, only the latter was subsumed into the regression models. A two-sided p value less than 0.05 was considered statistically significant. The data were analysed using SAS V9.3 software and RGui (R V.3.4.4, platform: x64 Windows OS).

**Patient and public involvement**

Patients were not involved in setting the research question or the outcome measures. No patients were involved in the study design and recruitment stages or in conducting the study. Additionally, the results of the research were not disseminated to study participants.

**RESULTS**

**Sociodemographic characteristics**

A total of 35529 records (18936 males, 53.30%) were included in the analysis to assess capitation. Table 1...
Table 1  Characteristics of patients with diabetes mellitus between the two groups in 2014 before PSM

| Variables                      | Pilot group (n=4907) | Control group (n=459159) | P value |
|-------------------------------|----------------------|--------------------------|---------|
| Sex, n (%)                    |                      |                          | <0.001  |
| Male                          | 2650 (54.00)         | 232450 (50.63)           |         |
| Female                        | 2257 (46.00)         | 226709 (49.37)           |         |
| Age (years), mean±SD          | 62.44±10.69          | 60.81±10.73              | <0.001  |
| Number of comorbidities, n (%)|                      |                          | <0.001  |
| 0                             | 1343 (27.37)         | 179413 (39.07)           |         |
| 1                             | 1473 (30.02)         | 135287 (29.46)           |         |
| ≥2                            | 2091 (42.61)         | 144459 (31.46)           |         |
| Number of complications, n (%)|                      |                          | <0.001  |
| 0                             | 1800 (36.68)         | 229503 (49.98)           |         |
| 1                             | 1020 (20.79)         | 126591 (27.57)           |         |
| ≥2                            | 2087 (42.53)         | 103065 (22.45)           |         |
| Types of medical insurance, n (%)|                     |                          | <0.001  |
| Urban employees               | 4725 (96.29)         | 388182 (84.54)           |         |
| Urban residents               | 182 (3.71)           | 70977 (15.46)            |         |
| Hospital grade*, n (%)        |                      |                          | <0.001  |
| Primary hospitals             | 1252 (25.51)         | 158363 (34.49)           |         |
| Secondary hospitals           | 2678 (54.58)         | 133279 (29.03)           |         |
| Tertiary hospitals            | 977 (19.91)          | 167517 (36.48)           |         |

*ST Hospital is a secondary hospital, but patients with diabetes mellitus participating in capitation also went to other grades of hospitals as appropriate.

PSM, propensity score matching.

Descriptive analysis of patients’ expenses

In 2013, total outpatient expenses for DM in Tianjin were ¥2829.16 million. Drugs accounted for the highest proportion of the costs (¥2592.67 million, 91.64%), followed by examinations (¥119.76 million, 4.23%) and treatment (¥26.17 million, 0.93%). The remaining categories had a total cost of ¥90.56 million (3.20%). In 2014, total outpatient expenses for DM were ¥3288.02 million. Drug expenses accounted for the highest proportion of outpatient expenses (¥3037.64 million, 92.39%), followed by examinations (¥117.05 million, 3.56%) and treatment (¥29.54 million, 0.90%). The remaining categories totalled ¥103.80 million (3.16%). The trends in mean annual expenses for outpatient records between the two groups from 2010 to 2014 are illustrated in figure 2. The variation in trends in mean annual total outpatient expenses, drug expenses, examination expenses, treatment expenses and other expenses between the two groups was similar from 2010 to 2013. However, from 2013 to 2014, the mean annual total outpatient expenses increased by ¥1358.66 in the pilot group but decreased by ¥484.37 in the control group. The mean annual drug expenses increased by ¥1361.49 from 2013 to 2014 in the pilot group compared with a decrease of ¥399.61 in the control group. The mean annual examination expenses decreased by ¥16.99 in the pilot group and decreased by ¥52.74 in the control group. The mean annual treatment expenses decreased by ¥3.71 from 2013 to 2014 in the pilot group compared with a decrease of ¥6.38 in the control group. Finally, the mean annual other expenses increased by ¥17.87 in the pilot group but decreased by ¥25.62 in the control group. In general, capitation influenced the trends significantly.

DID analysis

Table 3 presents the results of DID analysis. The increase in total outpatient expenses between the
preimplementation and postimplementation periods was ¥1843.03 greater in the pilot group than in the control group. The DID model demonstrated an increase in total outpatient expenses of ¥1993.76 (95% CI, ¥1643.74 to ¥2343.77) in the pilot group relative to the control group after adjusting for confounding factors including age, sex, number of complications, type of medical insurance and hospital grade. The increase in drug expenses between the preimplementation and postimplementation periods was ¥1761.10 greater in the pilot group than in the control group. The adjusted DID model showed an increase in drug expenses of ¥1904.30 (95% CI, ¥1578.63 to ¥2229.96) in the pilot group relative to the control group. The decrease in examination expenses between the preimplementation and postimplementation periods was ¥35.75 less in the pilot group than in the control group. The adjusted DID model showed an increase in examination expenses of ¥44.90 (95% CI, ¥19.11 to ¥70.68) in the pilot group relative to the control group. The decrease in treatment expenses between the preimplementation and postimplementation periods was ¥2.67 less in the pilot group than in the control group. The adjusted DID model showed an increase in treatment expenses of ¥3.55 (95% CI, ¥1.01 to ¥6.09) in the pilot group relative to the control group. The increase in other expenses between the preimplementation and postimplementation periods was ¥43.49 greater in the pilot group than in the control group. The adjusted DID model showed an increase in

Table 2  Comparison of characteristics between the two groups in 2014 after PSM

| Variables                          | Pilot group (n=4907) | Control group (n=9814) | P value | Standardised differences* |
|-----------------------------------|----------------------|------------------------|---------|---------------------------|
| Sex, n (%)                        |                      |                        |         |                           |
| Male                              | 2650 (54.00)         | 5322 (54.23)           | <0.767  | 0.005                     |
| Female                            | 2257 (46.00)         | 4492 (45.77)           |         | 0.005                     |
| Age (years), mean±SD              | 62.44±10.69          | 62.44±10.57            | 0.983   | 0.000                     |
| Number of comorbidities, n (%)    |                      |                        | 0.966   |                           |
| 0                                 | 1800 (36.68)         | 3605 (36.73)           |         | 0.001                     |
| 1                                 | 1020 (20.79)         | 2043 (20.82)           |         | 0.001                     |
| ≥2                                | 2087 (42.53)         | 4166 (42.45)           |         | 0.002                     |
| Number of complications, n (%)    |                      |                        | 0.964   |                           |
| 0                                 | 1343 (27.37)         | 2689 (27.40)           |         | 0.001                     |
| 1                                 | 1473 (30.02)         | 2964 (30.20)           |         | 0.004                     |
| ≥2                                | 2091 (42.61)         | 4161 (42.40)           |         | 0.004                     |
| Types of medical insurance, n (%) |                      |                        | 0.756   |                           |
| Urban employees                   | 4725 (96.29)         | 9460 (96.39)           |         | 0.005                     |
| Urban residents                   | 182 (3.71)           | 354 (3.61)             |         | 0.005                     |
| Grade of hospitals, n (%)         |                      |                        | 0.990   |                           |
| Primary hospitals                 | 1252 (25.51)         | 2498 (25.45)           |         | 0.001                     |
| Secondary hospitals               | 2678 (54.58)         | 5368 (54.70)           |         | 0.006                     |
| Tertiary hospitals                | 977 (19.91)          | 1948 (19.85)           |         | 0.002                     |

*For continuous variables, the standardised differences is defined as

\[
d = \frac{|\bar{X}_\text{pilot} - \bar{X}_\text{control}|}{\sqrt{\frac{S^2_{\text{pilot}} + S^2_{\text{control}}}{2}}}
\]

where \(\bar{X}_\text{pilot}\) and \(\bar{X}_\text{control}\) indicate the sample mean of the covariates in pilot and control groups, respectively, while \(S^2_{\text{pilot}}\) and \(S^2_{\text{control}}\) denote the sample variance. For categorical variables, the standardised differences is defined as

\[
d = \frac{|P_\text{pilot} - P_\text{control}|}{\sqrt{\frac{P_{\text{pilot}}(1-P_{\text{pilot}}) + P_{\text{control}}(1-P_{\text{control}})}{2}}}
\]

where \(P_{\text{pilot}}\) and \(P_{\text{control}}\) denote the prevalence of variables in the two groups.

PSM , propensity score matching.
other expenses of ¥43.46 (95% CI, ¥26.81 to ¥60.11) in the pilot group relative to the control group.

There were significant differences in the regression coefficients for interaction terms in the log-transformed DID models, which indicated significant increases in outpatient expenses between the two groups (table 4). Log-transformed DID estimates were consistent with the main model, suggesting that the analyses were not biased by skewed data.7

Another sensitivity analysis examining a control group composed of only patients at secondary hospitals was performed. Online supplementary appendix 5 presents results similar to the main model.

**DISCUSSION**

**Characteristics of medical insurance systems in China**

In China, the mode of payment for healthcare providers is mainly fee for service (FFS), but more areas have been piloting and implementing alternative payment methods,16 such as capitation and case-based payment. Those designing payment systems for healthcare in low- and middle-income countries are increasingly looking to capitation payments to avoid the cost inflation experienced with FFS payments.17 Previous studies showed that capitation was effective in controlling increasing costs.18-20 A study in Vietnam showed that capitation resulted in a more than 5% decrease in total recurrent expenditure.5 Capitation policy has been used in many health systems to control unreasonable increases in medical costs. The policy can reduce the utilisation of medical resources and increase preventive healthcare, but it can have a negative impact on patients’ health outcomes.21-23 Capitation may result in the provision of a suboptimal quality healthcare.24 25 There is evidence that the incentive for cost control may lead to a shortage of services or the elimination of high-cost patients.26

A medical insurance policy for ‘outpatient special diseases’ was mainly implemented for patients with DM in Tianjin. FFS is the main method of payment for these patients. The ‘outpatient special diseases’ policy was aimed at patients in a large population who require long-term treatment via both hospitalisation and outpatient treatment and incur a large amount of medical expenses; 13 diseases and conditions are covered in this policy. Medical services received by patients with DM are restricted by the three major directories of health insurance including the drug catalogue, the directory of diagnostic and therapeutic items, and the medical service facilities in hospitals that accepted the ‘outpatient special diseases’ policy. Before the co-ordinated payment is included, some of these treatments require patients to pay a certain proportion on their own, which may lead patients to accept those treatments selectively. However, for patients involved in the capitation policy, if medical services are provided actively by the hospital, ST Hospital does not charge additional fees regardless of whether they are in line with the three directories. Furthermore, if the hypoglycaemic drug cost of enrollees exceeds ¥10

### Table 3 Changes in total outpatient expenses, drug expenses, examination expenses, treatment expenses and other expenses in the pilot group relative to the control group

| Variables | Mean annual expenses (RMB, ¥) | Pilot group (n=9646) | Control group (n=25 883) | DID | β /regression-adjusted DID (95% CI) | P value* |
|-----------|-------------------------------|----------------------|--------------------------|-----|-----------------------------------|---------|
| Total outpatient expenses |                               |                      |                          |     |                                   |         |
| 2013      | 8357.31                       | 7575.99              | 1843.03                  | 1993.76 (1643.74 to 2343.77) | <0.001 |
| 2014      | 9715.97                       | 7091.62              | 1761.10                  | 1904.30 (1578.63 to 2229.96) | <0.001 |
| Drug expenses |                              |                      |                          |     |                                   |         |
| 2013      | 7542.94                       | 6945.78              | 1761.10                  | 1904.30 (1578.63 to 2229.96) | <0.001 |
| 2014      | 8904.43                       | 6546.17              | 35.75                    | 44.90 (19.11 to 70.68)      | <0.001 |
| Examination expenses |                             |                      |                          |     |                                   |         |
| 2013      | 518.89                        | 318.16               | 35.75                    | 44.90 (19.11 to 70.68)      | <0.001 |
| 2014      | 501.90                        | 265.42               |                         |                                |         |
| Treatment expenses |                             |                      |                          |     |                                   |         |
| 2013      | 72.10                         | 71.27                | 2.67                     | 3.55 (1.01 to 6.09)         | 0.006   |
| 2014      | 68.39                         | 64.89                |                         |                                |         |
| Other expenses |                             |                      |                          |     |                                   |         |
| 2013      | 223.38                        | 240.77               | 43.49                    | 43.46 (26.81 to 60.11)      | <0.001 |
| 2014      | 241.25                        | 215.15               |                         |                                |         |

Adjusted for confounding factors including age, sex, number of complications, types of medical insurance and hospital grade.

*Significant difference in β (regression-adjusted DID) from zero is reflected by the p values.
In this analysis, capitation was associated with a significant increase in expenses for people with DM, which was inconsistent with certain previous studies in the same field.\textsuperscript{5,17} Capitation was found to help medical staff build active cost control consciousness.\textsuperscript{16} There are four explanations for this phenomenon. First, the lack of autonomy and independence of public hospitals made them less responsive to economic incentives.\textsuperscript{27} Public hospitals are dependent on different government departments for the allocation of human, financial and physical resources in China. ST Hospital is a secondary public hospital. Medical staff and managers lack awareness of and autonomy in cost control at these hospitals, resulting in problems such as lack of effective cost constraint mechanisms, waste of medical resources and excessive consumption. Second, capitation policy refers to the practice, whereby medical insurance agencies (government agencies) pay for medical expenses reimbursed by a capitation standard to designated hospitals. Once the costs of patients with DM enrolled in capitation were within the standard range, the social security monitoring system did not continue extensive monitoring. The expenses of hospitals without the policy were irregularly supervised, which may encourage healthcare workers to focus on cost control. Third, in the first year of policy implementation, doctors paid more attention to building trusting relationships with patients with DM, but often neglected cost control. It is important for doctors to gain the trust of these patients because they sign up for long-term, ‘one-on-one’ guidance. Doctors need to establish long-term treatment programmes for patients’ conditions so that patients can obtain more information about their treatment. In this way, ‘fixed’ individualised diagnosis and treatment can be established that will ultimately benefit the patients’ health. Finally, drug expenses and examination expenses were significantly higher in the patients enrolled in capitation than in the ‘outpatient special diseases’ policy (table 3). Patients participating in capitation were prescribed not only hypoglycaemic drugs but also drugs for lowering blood pressure, lowering blood lipids and managing DM-related complications. Based on their condition, they were scheduled to undergo a routine blood examination every month and HbA1c level tests every 3 months. Therefore,
their drug expenses and examination expenses were higher. For patients, participating in the policy can help them regularly monitor their condition and make it more convenient for them. In subsequent research, a retrospective cohort study will be carried out to evaluate associations among policy, medical costs and health outcomes (such as HbA1c, number and severity of complications).

Policy suggestions
These results suggest that the supervision of medical services must be strengthened. Management systems should promptly implement dynamic supervision and network notifications for service quality, medical expenses and patient satisfaction. Next, a variety of payment methods should be considered within the capitation system. Although capitation is expected to control unreasonable increases in medical costs, it also has some limitations. Therefore, it is recommended that a variety of payment methods be combined to complement each other. Additionally, the results suggest that a competition mechanism should be established. Doctors with good medical cost control have high performance, but the patients' health indicators should be incorporated into the performance management system. Self-restraint and incentive mechanisms should be established in pilot hospitals.

Limitations
This study has several limitations. First, there is a lack of survey information available on the following topics: health-seeking behaviours, disease control, the severity of patient comorbidities and complications and patient satisfaction with DM treatment. Second, research on the associations among capitation, health outcomes and medical costs is lacking. Third, medicine use per patient in both groups was not specific; for example, we do not know how total costs are driven by drug costs. Furthermore, this analysis only covered the effect of the year after the implementation of the policy. The feasibility and scientific basis of the policy need to be analysed with additional years of data.

CONCLUSION
Compared with those who did not participate in the policy, annual total outpatient expenses, drug expenses and examination expenses per outpatient with DM enrolled in the capitation policy increased significantly. These increases were due to actual patient needs, changes in drug directories, and the autonomy and independence of hospitals. Further study is needed to assess longer-term associations among the policy, health outcomes and medical costs.

Contributors
YD, JC, XJ and JM conceived and designed the study. YD, JC, XJ, XS, YC and XD analysed the data. YD wrote the manuscript and is the guarantor. YD, JC, XJ, XS, YD, XD and JM edited the manuscript.

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None declared.

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