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# Does capitation payment influence healthcare service behavior in county medical community? Evidence from patients with diabetes in rural China

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## Abstract

**Objective** Amid efforts to develop primary healthcare, China has been working to establish an integrated care system through the county medical community model, incorporating capitation payment to improve chronic disease management. This study investigates the impact of capitation payment reform on diabetes-related healthcare service behaviors across different levels of healthcare facilities within the county medical community.

**Methods** We conducted interrupted time series analysis to evaluate the changes in healthcare service behavior before and after the implementation of the capitation model. Using F County, as the sample area, we collected outpatient reimbursement records of type 2 diabetes mellitus (T2DM) patients from six townships that initiated reform in April 2015. The dataset, covering January 2014 to December 2019, includes 49,326 records from primary healthcare facilities and 1,628 from county hospitals, with information on medical costs, service items, and other details.

**Results** Following the implementation of capitation, both the average medical costs per visit and proportion of examination and testing costs showed a deceleration in growth in primary healthcare facilities (-0.615, $p < 0.05$; -1.554, $p < 0.01$). The proportion of medication costs, the proportion of insulin or combination therapy and the average number of medications exhibited a significant downward trend prior to the reform, while all reversed to upward trends after reform. In county hospitals, the proportion of medication costs increased by 19.115% immediately post-reform, and both the level and slope of average number of medications significantly rose (2.041, $p < 0.01$; 0.244, $p < 0.01$). Although the proportion of examination and testing costs increased before the reform, both the instantaneous level and the trend declined afterward (-19.684, $p < 0.05$; -1.833, $p < 0.05$).

**Conclusions** In the sample area, the average medical costs for T2DM outpatients were effectively controlled after the capitation reform. Township health centers showed improved standardization in prescribing practices, while county hospitals focused more on comprehensive examinations and testing services. Medication prescription intensity increased across all facilities, contributing to enhanced chronic disease management.

**Keywords** Capitation, County medical community, Healthcare service behavior, Type 2 diabetes mellitus, Interrupted time series

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## Background

Not only low-income countries but also many other nations continue to strive for healthcare systems that provide high-quality, reliable, and affordable healthcare services and medications for all [1]. In 2009, China launched a reform aimed at delivering quality basic healthcare services. The reform achieved notable milestones, marked by a substantial increase in government investment in healthcare. The government has worked to enhance insurance coverage, achieving a stable enrollment rate of 95% after the achievement of universal health insurance in 2011 [2]. Concurrently, funding has been directed toward grassroots healthcare, strengthening the support of personnel, finances, resources, and information for primary healthcare services [3]. However, the system still reveals inefficiencies on the supply side, necessitating the establishment of a comprehensive framework for healthcare services system and a systematic, integrated operational mechanism that prioritizes people-centered care [4].

The people-centered integrated care model (hereinafter referred to as the "integrated care model") has been widely advocated both domestically and internationally, with pilot initiatives in China aligning with this approach. In 2015, the State Council issued the "Guiding Opinions on Promoting the Construction of a Tiered Health Care Delivery System," laying a solid foundation for integrated care [5]. The World Bank's report *Deepening Health Reform in China*(2016) also provided guidance for the development of integrated care in China [6]. Developing primary healthcare is the foremost task in building integrated care system, particularly in developing countries where primary healthcare remains relatively weak. A cost-effective integrated care model requires enhancing primary healthcare and shifting appropriate services from hospitals to primary or outpatient settings. Only by enhancing primary healthcare and transferring certain services from hospitals to grassroots or outpatient settings can a cost-effective integrated care model be realized [6]. Furthermore, given the increasing burden of chronic diseases, a cost-effective care model is necessary, requiring coordinated collaboration across different levels of providers for acute care and post-acute rehabilitation [7, 8]. Primary healthcare facilities not only serve as essential parts of integrated care system but also play a leading role in chronic disease management.

Currently, relevant practical experiences related to integrated care models are concentrated in more developed nations [9–11]. For instance, Clinical Commissioning Groups (CCGs) in the United Kingdom have been granted commissioning authority over primary healthcare and have adopted capitation as the core payment mechanism, promoting integrated care model that fosters collaboration among regional healthcare physicians [12, 13]. In Ontario, Canada, capitation-based blended payment scheme has facilitated the implementation of Family Health Teams (FHTs) [14]. In the United States, capitation has been introduced as part of efforts to address the misalignment between fee-for-service (FFS) incentives and the goals of coordination and prevention in the Patient-Centered Medical Home (PCMH) model [15]. China has attempted to establish localized integrated care networks, primarily composed of county or district hospitals and primary facilities, to provide continuous, high-quality healthcare services to residents within counties or regions together, thereby reducing the demand for cross-regional healthcare utilization. However, as previously mentioned, the inefficiency in service delivery stems largely from an inadequate incentive mechanism for physicians (e.g., previous FFS payment model, mark-ups on medication prices), which results in unreasonable healthcare service behavior that directly leads to decreased delivery efficiency [6]. Therefore, it is essential to devote efforts to designing a financial incentive mechanism that coordinates multiple stakeholder profiles and enhances the overall performance of integrated care system [6, 16]. Additionally, the limited outcomes of provider restructuring aimed at delivering integrated services for chronic disease patients are also believed to stem from a lack of adequate financial incentives [17]. Consequently, refining the medical insurance payment system for providers is a core strategy to address these issues. By designing payment methods that guide physician behavior toward policy objectives as anticipated, it is possible to achieve multiple goals of healthcare reform.

Guided by national policy, various regions are exploring the establishment of effective and efficient payment methods, implementing a variety of payment models such as capitation, case-based payment, and global budget [18]. Evidence suggests that implementing a prospective global budget within a network of healthcare facilities is a suitable incentive for integrated care system [19]. In a province in central China, a capitation payment reform was carried out within a county medical community. This reform determines the total budget for the region based on the collected insurance premiums and calculates the per capita payment standard. Each county medical community can receive its global budget based on per capita payment standard and population size, covering both outpatient and inpatient services. If there is a surplus in the total budget under the capitation system, it can be distributed among healthcare facilities within the region and used for staff compensation. Compared with other payment methods such as global budget, Diagnosis-Related Groups (DRG), and Diagnosis-Intervention

Packet (DIP), this system has the advantage of aligning incentives across providers across different levels through a shared-benefit mechanism.

This study focuses on the medical records of patients with type 2 diabetes mellitus (T2DM), which accounts for over 95% of all diabetes cases [20]. In 2021, the global prevalence of diabetes among adults aged 20 to 79 was 10.5%, affecting approximately 537 million individuals and resulting in global healthcare expenditures reaching $966 billion [21]. In China, the prevalence in 2021 was slightly higher at 10.6%, with related healthcare costs amounting to $165.3 billion [22]. Given the significant burden, there is an urgent need for cost-effective interventions to alleviate financial strain and improve patient outcomes [23]. Driven by the integrated care system and payment reform, the integration of prevention, treatment, and management services is expected to be jointly promoted on the supply side. By standardizing the clinical practices of primary healthcare providers, such reforms are anticipated to play an important role in improving the health outcomes of patients with chronic diseases such as diabetes.

We conducted an observational study using medical insurance claims data for patients with T2DM, applying an interrupted time series (ITS) analysis to compare changes in healthcare service behavior indicators before and after the implementation of the capitation payment model within county medical community.

## Methods

### Setting

This study was conducted in F County (pseudonym) located in central China with a population that ranged from 1.15 to 1.20 million between 2014 and 2019. The county, previously one of the key national poverty alleviation development counties, faced financial challenges that resulted in limited healthcare resources. Such limitations hindered residents' access to high-quality healthcare services, resulting in a county-wide healthcare utilization rate of less than 60%. Additionally, due to the financial pressure, the county struggled to mitigate the issue of "medicine as a primary revenue source," leading to persistently high medical costs and an unsustainable health insurance fund balance. In response to the limited healthcare resources and rising medical costs, and in line with the trend towards integrated care model, F County launched its first reform in April 2015 across six townships, establishing a county medical community and implementing capitation payment model. This initiative aimed at reinforcing the tiered healthcare delivery system, reallocating resources toward primary healthcare facilities, and enhancing their capability to provide quality and accessible services locally. Simultaneously, the reform of the medical insurance payment method played a financial incentive role by standardizing healthcare service behavior, promoting prevention and disease management, controlling the rapid growth of medical costs, and ensuring the sustainability of the medical insurance fund.

### Data and study population

Data were extracted from F County medical insurance claims database, including all records for T2DM patients (discharge diagnosis) from all healthcare facilities in six sample townships between 2014 and 2019. Records involving Type 1 diabetes mellitus and those with inconsistencies in cost structures or total costs were excluded. After data anonymization, an analytical dataset was established on SQL Server. Using the time interval between admission and discharge and reimbursement types, we identified outpatient and inpatient records, extracting 50,954 outpatient visits for the main analysis. Healthcare facilities were further classified into two tiers according to their service functions, and analyses were conducted separately for each tier, with village clinics and township health centers grouped into one tier, comprising 49,326 records, and county hospitals into another, comprising 1,628 records. Inpatient service volume over the same period was also included in the analysis. The dataset also included demographic information, such as gender, age, and poverty status, as well as admission and discharge dates, healthcare facilities, total costs, and specifics of each service, including service names, categories, costs, specifications, and other details.

### Outcome and data definition

We evaluated healthcare service behavior using several indicators: average medical costs per visit, proportion of medication costs, proportion of examination and testing costs, proportion of insulin or combination therapy, average number of medications per visit, and the ratio of outpatient to inpatient visits. The average medical costs per visit provides an overview of physician service behavior. Proportion of examination and testing costs (as a share of total medical costs per visit) reflects physician behavior in terms of screening, disease monitoring, and complication assessment. Proportion of medication costs (as a share of total medical costs per visit), proportion of insulin or combination therapy, and the average number of medications per visit are used to capture prescribing behavior. Specifically, the proportion of insulin or combination therapy refers to the proportion of prescriptions involving either insulin for blood glucose control or combined use of two classes of hypoglycemic agents, with detailed medication classifications and representative medications listed in Appendix Table 1. The average

number of medications per visit refers to the mean number of medication categories prescribed per visit. Since the needs of T2DM patients are typically met through outpatient services without the need for frequent hospitalization, the ratio of outpatient to inpatient visits was used to reflect the physician preferences in care delivery patterns.

### Statistical analyses

Evaluating the impact of health policy interventions is crucial in assessing their effectiveness. Given that many policies are implemented on a whole regional scale, random assignment is often not feasible, making pre- and post-policy comparisons a common approach [24]. Interrupted time series (ITS) analysis is a robust method in such contexts, particularly suited to evaluate the impact of significant events or policies at specific time points. In this study, ITS analysis was applied using six years of monthly observation data. By constructing segmented regression models, we estimated changes in both immediate post-reform levels and slope trends, providing insight into the effects of the capitation payment reform.

$$\text{PhysicianBehavior}_t = \beta_0 + \beta_1 \text{Time}_t + \beta_2 \text{Reform} + \beta_3 (\text{Time}_t \times \text{Reform}) + \epsilon_t \quad (1)$$

In Model (1), $PhysicianBehavior_t$ represents the monthly outcome variable over the period from January 2014 to December 2019. $Time_t$ is the time variable (January 2014 = 0, February 2014 = 1, …, April 2015 = 15, …). *Reform* is a dummy variable indicating the intervention (0 for pre-reform and 1 for post-reform). The interaction term "$Time_t$ * *Reform*" was coded as 0 before April 2015, and increased from 0 onward (i.e., 0, 1, 2…) after the reform. The parameters $\beta_0$ and $\beta_1$ estimate the baseline level and trend prior to the reform, while $\beta_2$ and $\beta_3$ estimate the changes in level and trend post-reform relative to the pre-reform period.

Given the time series nature of the data, we conducted Durbin-Watson tests to assess autocorrelation in the data analysis process. Where autocorrelation was detected, Newey-West standard errors were applied to adjust for it. We also examined scatter plots to ensure that no significant seasonal fluctuations were present in the data. All analyses in this study were conducted using Stata Statistical Software (Release 17; StataCorp, College Station, TX, USA). All $p$-values were two-sided, and statistical significance was set at $p < 0.05$.

## Results

### Descriptive statistics of outpatient visits

From 2014 to 2019, the number of outpatient visits in village clinics and township health centers increased annually, while the ratio of outpatient to inpatient visits gradually decreased. The proportion of female patients consistently exceeded that of male patients. Regarding age distribution, approximately 70% to 80% of T2DM patients were concentrated in the 45–59 and 60–74 age groups. From 2014 to 2017, the proportion of patients aged 60–74 was higher than that of those aged 45–59. However, starting from 2018, the proportion of visits aged 45–59 surpassed that of those aged 60–74. The average total medical costs per visit in village clinics and township health centers increased annually from 43.95 yuan in 2014 to 50.66 yuan in 2019. Medication costs consistently accounted for the majority of total costs, with an overall upward trend over time. Examination and testing costs rose from 8.32 yuan in 2014 to 18.97 yuan in 2018 followed by a slight decrease in 2019. The proportion of insulin or combination therapy prescriptions increased from 20.72% in 2014 to 26.79% in 2019. The average number of medications per visit decreased from 1.50 in 2014 to 1.35 in 2018 (Table 1).

The number of outpatient visits in county hospitals was significantly lower than that in village clinics and township health centers. In 2019, the proportion of female patients was 60.54%, markedly higher than the 39.46% recorded for male patients. Visits were primarily concentrated in the 45–59 and 60–74 age groups, with the proportion of visits aged 45–59 increasing annually, approaching 50% of total outpatient visits by 2019. Medical costs and medication costs per visit in county hospitals were higher than those in village clinics and township health centers, but both showed a significant downward trend, while the average cost for examinations and testing increased significantly. The proportion of insulin or combination therapy in county hospitals was higher than that in township health centers and village clinics, although it showed a fluctuating downward trend over the six years. The average number of medications per visit decreased annually from 3.02 in 2014 to 1.12 in 2019, even lower than that in village clinics and township health centers. The ratio of outpatient to inpatient visits in county hospitals remained relatively stable during this period (Table 1).

### Change in healthcare service behavior in primary healthcare facilities due to capitation payment reform

We employed an ITS analysis method to examine changes in healthcare service behavior indicators using T2DM outpatient records from village clinics and township health centers. The specific results are shown in Table 2 and Fig. 1.

**Table 1** Characteristics of outpatient visits with T2DM from 2014 to 2019

| | Village clinics and Township health centers | | | | | | County hospitals | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** |
| Gender, n (%) | | | | | | | | | | | | |
| Male | 1807 (33.92) | 2092 (34.08) | 2531 (37.78) | 3531 (37.90) | 4043 (38.24) | 4109 (36.46) | 43 (32.33) | 65 (34.95) | 110 (48.03) | 86 (46.49) | 86 (44.56) | 277 (39.46) |
| Female | 2906 (54.54) | 3608 (58.78) | 4014 (59.91) | 5783 (62.08) | 6529 (61.75) | 7135 (63.30) | 64 (48.12) | 86 (46.24) | 109 (47.60) | 98 (52.97) | 105 (54.40) | 425 (60.54) |
| Missing | 615 (11.54) | 438 (7.14) | 155 (2.31) | 2 (0.02) | 1 (0.01) | 27 (0.24) | 26 (19.55) | 35 (18.82) | 10 (4.37) | 1 (0.54) | 2 (1.04) | 0 (0.00) |
| Age group, n (%) | | | | | | | | | | | | |
| −17 | 10 (0.19) | 12 (0.20) | 8 (0.12) | 14 (0.15) | 14 (0.13) | 18 (0.16) | 0 (0.00) | 0 (0.00) | 0 (0.00) | 4 (2.16) | 0 (0.00) | 0 (0.00) |
| 18–44 | 548 (10.29) | 605 (9.86) | 696 (10.39) | 955 (10.25) | 879 (8.31) | 751 (6.66) | 15 (11.28) | 16 (8.60) | 35 (15.28) | 35 (18.92) | 39 (20.21) | 78 (11.11) |
| 45–59 | 1923 (36.09) | 2231 (36.35) | 2505 (37.39) | 3648 (39.16) | 4598 (43.49) | 5098 (45.23) | 52 (39.10) | 58 (31.18) | 88 (38.43) | 80 (43.24) | 88 (45.60) | 338 (48.15) |
| 60–74 | 1925 (36.13) | 2451 (39.93) | 2775 (41.42) | 3877 (41.62) | 3968 (37.53) | 4277 (37.95) | 39 (29.32) | 69 (37.10) | 91 (39.74) | 56 (30.27) | 55 (28.50) | 222 (31.62) |
| 75- | 306 (5.74) | 401 (6.53) | 561 (8.37) | 820 (8.80) | 1108 (10.48) | 1059 (9.40) | 1 (0.75) | 8 (4.30) | 5 (2.18) | 9 (4.86) | 9 (4.66) | 63 (8.97) |
| Missing | 616 (11.56) | 438 (7.14) | 155 (2.31) | 2 (0.02) | 6 (0.06) | 68 (0.60) | 26 (19.55) | 35 (18.82) | 10 (4.37) | 1 (0.54) | 2 (1.04) | 1 (0.14) |
| Poverty or not, n (%) | | | | | | | | | | | | |
| Yes | 1120 (21.02) | 1307 (21.29) | 1602 (23.91) | 2843 (30.52) | 2723 (25.75) | 2248 (19.94) | 24 (18.05) | 59 (31.72) | 57 (24.89) | 37 (20.00) | 38 (19.69) | 127 (18.09) |
| NO | 4208 (78.98) | 4831 (78.71) | 5098 (76.09) | 6473 (69.48) | 7850 (74.25) | 9023 (80.06) | 109 (81.95) | 127 (68.28) | 172 (75.11) | 148 (80.00) | 155 (80.31) | 575 (81.91) |
| Medical costs per visit, mean±(SD) | 43.95±27.55 | 49.36±34.34 | 48.02±34.12 | 55.63±45.62 | 59.08±52.43 | 50.66±53.05 | 113.45±93.39 | 98.01±75.64 | 107.43±76.75 | 107.95±83.10 | 92.54±56.63 | 86.7±82.73 |
| Medication costs per visit, mean±(SD) | 29.04±23.30 | 30.21±28.24 | 31.99±30.41 | 33.14±32.56 | 31.93±30.53 | 34.63±37.69 | 87.95±87.97 | 75.94±77.70 | 79.99±79.89 | 76.35±79.95 | 51.94±56.52 | 41.65±42.11 |
| Examination and testing costs per visit, mean±(SD) | 8.32±24.53 | 12.51±30.69 | 9.48±27.76 | 15.63±43.50 | 18.97±51.98 | 5.67±32.44 | 19.12±55.42 | 20.28±52.53 | 24.92±58.16 | 28.05±69.01 | 37.18±63.24 | 33.15±88.77 |
| Proportion of insulin or combination therapy (%) | 20.72 | 21.64 | 20.84 | 22.82 | 22.97 | 26.79 | 36.84 | 24.19 | 28.38 | 30.81 | 19.69 | 29.91 |
| Average number of medications per visit (Types) | 1.50±1.50 | 1.40±1.34 | 1.41±1.22 | 1.39±1.21 | 1.35±1.28 | 1.47±1.17 | 3.02±5.05 | 2.25±4.17 | 2.15±4.22 | 1.90±3.61 | 1.24±0.99 | 1.12±1.19 |
| Ratio of outpatient to inpatient visits | 4.87 | 4.47 | 4.07 | 3.36 | 1.86 | 1.24 | 0.11 | 0.12 | 0.13 | 0.07 | 0.05 | 0.11 |
| Overall, n | 5328 | 6138 | 6700 | 9316 | 10573 | 11271 | 133 | 186 | 229 | 185 | 193 | 702 |

*T2DM* type 2 diabetes mellitus, *SD* standard deviation

**Table 2** Estimated changes in level and trend of outpatient indicators in village clinics and township health centers

| | Baseline level $\beta_0$, (95%CI) | Baseline slope $\beta_1$, (95%CI) | Level change $\beta_2$, (95%CI) | Slope change $\beta_3$, (95%CI) |
|---|---|---|---|---|
| [a]Medical costs per visit (RMB) | 40.340*** (37.143 to 43.536) | 0.728*** (0.256 to 1.199) | −2.101 (−7.623 to 3.42) | −0.615** (−1.100 to −0.131) |
| [a]Proportion of medication costs (%) | 72.913*** (67.637 to 78.188) | −1.091*** (−1.515 to −0.667) | 5.524** (0.150 to 10.899) | 1.109*** (0.668 to 1.550) |
| [a]Proportion of examination and testing costs (%) | 9.875*** (3.271 to 16.479) | 1.418*** (0.910 to 1.925) | −4.909 (−11.200 to 1.382) | −1.554*** (−2.089 to −1.018) |
| Proportion of insulin or combination therapy (%) | 23.551*** (21.000 to 26.103) | −0.366** (−0.726 to −0.005) | 2.062 (−2.293 to 6.418) | 0.473** (0.108 to 0.838) |
| Average number of medications per visit (Types) | 1.660*** (1.502 to 1.818) | −0.026*** (−0.042 to −0.011) | 0.120* (−0.001 to 0.241) | 0.027*** (0.012 to 0.042) |
| [a]Ratio of outpatient to inpatient visits | 6.087*** (4.413 to 7.760) | −0.140 (−0.322 to 0.043) | 1.305* (−0.122 to 2.733) | 0.059 (−0.124 to 0.243) |

*CI* confidence interval

* $p<0.1$

** $p<0.05$

*** $p<0.01$

[a] Autocorrelation was performed

The model results indicate that prior to the reform, the average medical costs per visit showed a significant upward trend (0.728, 95% CI: 0.256 to 1.199, $p < 0.01$). After the reform, although there was no significant immediate level change (−2.101, 95% CI: −7.623 to 3.42), the rate of increase markedly slowed compared to the pre-reform period, with the post-reform slope declining to 0.113 yuan per month (95% CI: −1.100 to −0.131, $p < 0.05$, post-reform slope = $\beta_1+\beta_3$ = 0.728-0.615=0.113). This indicates a significant reduction in the growth of medical costs post-reform.

Before the reform, the proportion of medication costs was on a downward trend, decreasing by an average of 1.091% per month (−1.091%, 95% CI: −1.515 to −0.667, $p < 0.01$). In April 2015, there was an immediate increase in the proportion of medication costs by 5.524% (95% CI: 0.150 to 10.899, $p < 0.05$), which subsequently reversed to a slight upward trend, increasing by 0.018% per month (−1.091, 95% CI: 0.668 to 1.550, $p < 0.01$, $\beta_1+\beta_3 = -1.091 + 1.109 = 0.018$).

In contrast to the trend in proportion of medication costs, the proportion of examination and testing costs exhibited an upward trend before the reform (1.418, 95% CI: 0.910 to 1.925, $p < 0.01$). After the reform, the previous upward trend dissipated, with the proportion of examination and testing costs declining at a rate of 0.136% per month (−1.554, 95% CI: −2.089 to −1.018, $p < 0.01$, $\beta_1+\beta_3 = 1.418 - 1.554 = -0.136$).

Before the reform, the proportion of insulin or combination therapy showed a declining trend (−0.366, 95% CI: −0.726 to −0.005, $p < 0.05$). Although there was no significant level increase in April 2015, the slope increase associated with the implementation of capitation method reform at the rate of 0.107% per month (0.473, 95% CI: 0.108 to 0.838, $p < 0.05$, $\beta_1+\beta_3 = -0.366 + 0.473 = 0.107$).

Similar to the trend observed for insulin or combination therapy, the number of medications per visit decreased at a rate of 0.026 types per month before the reform (−0.026, 95% CI: −0.042 to −0.011, $p < 0.01$). After the reform, there was a modest but significant upward trend of 0.001 types per month (0.027, 95% CI: 0.012 to 0.042, $p < 0.01$, $\beta_1+\beta_3 = -0.026 + 0.027 = 0.001$).

The ratio of outpatient to inpatient visits also showed a declining trend both before and after the reform, with slopes of −0.140 (−0.140, 95% CI: −0.322 to 0.043) and −0.081 (0.059, 95% CI: −0.124 to 0.243, $\beta_1+\beta_3 = -0.140 + 0.059 = -0.081$) respectively, but neither was statistically significant.

### Change in healthcare service behavior in county hospitals due to capitation payment reform

Table 3 and Fig. 2 report the impact of capitation payment model on the behavior of county hospital physicians providing outpatient services for T2DM.

Before the reform, the average medical costs per visit showed a declining trend, decreasing by 3.652 yuan per month on average, but this was only statistically significant at the 0.1 level (−3.652, 95% CI: −7.736 to 0.431, $p < 0.1$). After the reform, there was an immediate increase in average medical costs of 34.307 yuan during the reform month (95% CI: −11.824 to 80.439). The declining trend slowed, resulting in an average monthly decrease of only 0.367 yuan (95% CI: −0.809 to 7.379, $\beta_1+\beta_3 = -3.652 + 3.285 = -0.367$). However, neither the changes in level nor slope after the reform were statistically significant.

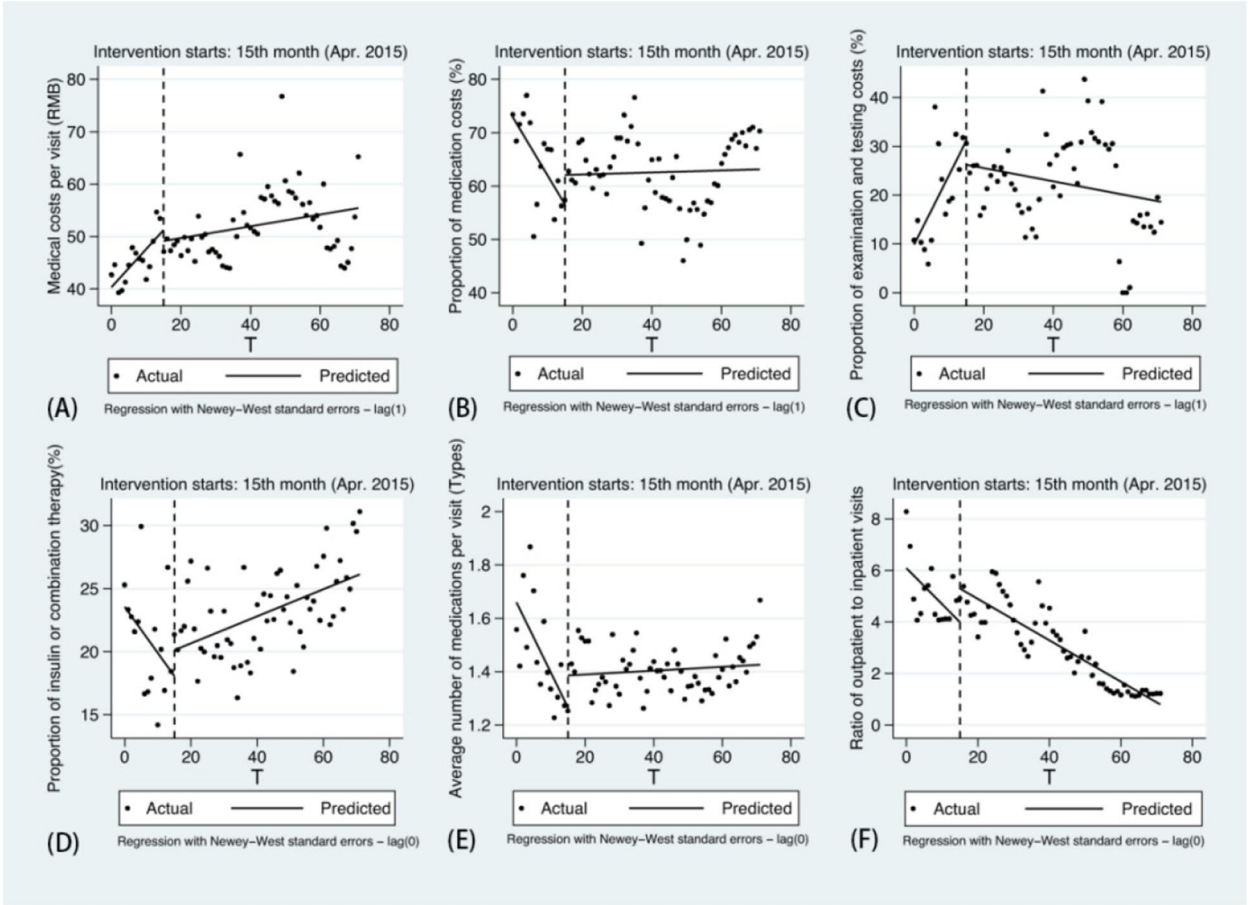


**Fig. 1** Interrupted time series analysis of healthcare service behavior in village clinics and township health centers, 2014-2019. Note: **A** Medical costs per visit (RMB), **B** Proportion of medication costs (%), **C** Proportion of examination and testing Proportion of examination and testing costs (%), **D** Proportion of insulin or combination therapy(%), **E** Average number of medications per visit (Types), **F** Ratio of outpatient to inpatient visits. Dots are the average or ratio of the observed monthly indicators, and solid line is the predicted value of the monthly indicators derived from the ordinary least squares regression with Newey-West standard errors. Baseline: from January 2014 to March 2015; Intervention stage: from April 2015 to December 2019. Across all models, rare monthly points fell outside the 95% prediction interval

Before the reform, the proportion of medication costs showed a declining trend (−1.355, 95% CI: −3.125 to 0.414). After the reform, the instantaneous level of medication costs increased by 19.115% (95% CI: 0.158 to 38.071, $p < 0.05$), but the change in trend was not significant (0.691, 95% CI: −1.09 to 2.472).

Before the reform, the proportion of examination and testing costs showed a significant upward trend, increasing by 2.212% per month on average (95% CI: 0.751 to 3.673, $p < 0.01$). After the reform, there was a substantial immediate decrease of 19.684% (95% CI: −37.16 to −2.208, $p < 0.05$), and compared to the pre-reform trend, the post-reform upward trend significantly slowed, showing a gentle upward trend with an average increase of only 0.379% per month (−1.833, 95% CI: −3.324 to −0.342, $p < 0.05$, $\beta_1+\beta_3 = 2.212 - 1.833 = 0.379$).

Before the reform, the proportion of insulin or combination therapy showed a declining trend, decreasing by 1.535% per month (−1.535%, 95% CI: −3.510 to 0.440). The instantaneous level change post-reform was −1.242% (−1.242%, 95% CI: −19.639 to 17.155), and the post-reform downward trend significantly slowed (1.506%, 95% CI: −0.478 to 3.490). Unfortunately, none of these were statistically significant.

An opposing trend in number of medications per visit was noted compared to that of insulin or combination therapy usage. Before the reform, ITS analysis found a downturn at a rate of 0.272 types per month (−0.272, 95% CI: −0.387 to −0.157, $p < 0.01$). In April 2015, there was an immediate increase of 2.041 types (2.041, 95% CI: 1.106 to 2.975, $p < 0.01$), and compared to the pre-reform trend, the post-reform downward trend slowed,

**Table 3** Estimated changes in level and trend of outpatient indicators in county hospitals

| | Baseline level $\beta_0$, (95%CI) | Baseline slope $\beta_1$, (95%CI) | Level change $\beta_2$, (95%CI) | Slope change $\beta_3$, (95%CI) |
|---|---|---|---|---|
| Medical cost per visit (RMB) | 128.458*** (102.318 to 154.598) | −3.652* (−7.736 to 0.431) | 34.307 (−11.824 to 80.439) | 3.285 (−0.809 to 7.379) |
| [a]Proportion of medication costs (%) | 84.927*** (70.985 to 98.869) | −1.355 (−3.125 to 0.414) | 19.115** (0.158 to 38.071) | 0.691 (−1.09 to 2.472) |
| [a]Proportion of examination and testing costs (%) | 4.358 (−6.054 to 14.77) | 2.212*** (0.751 to 3.673) | −19.684** (−37.16 to −2.208) | −1.833** (−3.324 to −0.342) |
| Proportion of insulin or combination therapy(%) | 50.602*** (33.113 to 68.090) | −1.535 (−3.510 to 0.440) | −1.242 (−19.639 to 17.155) | 1.506 (−0.478 to 3.490) |
| Average number of medications per visit (Types) | 4.551*** (3.239 to 5.863) | −0.272*** (−0.387 to −0.157) | 2.041*** (1.106 to 2.975) | 0.244*** (0.128 to 0.360) |
| Ratio of outpatient to inpatient visits | 0.138*** (0.081 to 0.195) | −0.003 (−0.009 to 0.003) | 0.040 (−0.010 to 0.089) | 0.002 (−0.004 to 0.008) |

*CI* confidence interval

* $p<0.1$

** $p<0.05$

*** $p<0.01$

[a] Autocorrelation was performed

only decreasing 0.028 types per month (95% CI: 0.128 to 0.360, $p < 0.01$, $\beta_1+\beta_3 = -0.272 + 0.244 = -0.028$).

The trend in the ratio of outpatient to inpatient visits remained stable, similar to the trends observed in primary healthcare facilities. Before the reform, there was a slight downward trend (−0.003, 95% CI: −0.009 to 0.003), while immediately after the reform, it increased by 0.040 (0.040, 95% CI: −0.010 to 0.089). The post-reform downward trend further slowed (0.002, 95% CI: −0.004 to 0.008). None of these were statistically significant.

## Discussion

### More rational allocation of healthcare services and clarification of service responsibilities across healthcare facilities

According to the "Technical Plan for Graded Diagnosis and Treatment of Diabetes," primary healthcare facilities provide essential services for T2DM patients, including initial diagnosis, treatment plan formulation, medication supply, health record establishment, routine check-ups, follow-ups, and health education [25, 26]. In cases of urgent onset, complex clinical classification, poor glycemic control, or severe complications, patients are referred to county hospitals when township health centers are unable to manage their conditions [27]. Previous analyses of the implementation effects of tiered healthcare delivery system have indicated a relatively weak impact on chronic diseases [28]. However, in the sample areas post-reform, the number of outpatient visits to primary healthcare facilities increased year by year, while outpatient visits to county hospitals remained consistently lower. This aligns with the regulations of the county medical community, which require township health centers to undertake responsibilities for over "50+N" types of diseases, including T2DM. As a result, patients primarily receive diagnosis, treatment, and management in village clinics and township health centers.

In Jinhua City, China, pilot programs have been conducted for inpatient payment based on Diagnosis-Related Groups (DRG) and outpatient payment combining capitation with the Ambulatory Patient Groups (APGs) method. Relevant studies indicate that after the reform of inpatient payment methods, hospitalization costs decreased while outpatient volumes increased. Following the reform of outpatient payment methods, the trend of increasing outpatient volumes was reversed [29, 30], and outpatient costs declined [31], suggesting a cost-shifting between outpatient and inpatient services. However, this study did not observe such a phenomenon. The ratio of outpatient to inpatient visits showed only a slight decline following the reform, which was not statistically significant. This indicates that the growth rate of outpatient visits slightly outpaced that of inpatient visits during the post-reform period. One possible explanation is that, in F County, outpatient and inpatient expenditures were merged under a unified per capita payment standard within the county medical community. The funding pool did not distinguish between outpatient and inpatient services, and any expenditure exceeding the total budget was not reimbursed. If all patients were admitted for inpatient treatment, the risk of expenditure exceeding would increase, thereby reducing the cost transfer between outpatient and inpatient services. In addition, our findings may also be related to another aspect of the policy design.

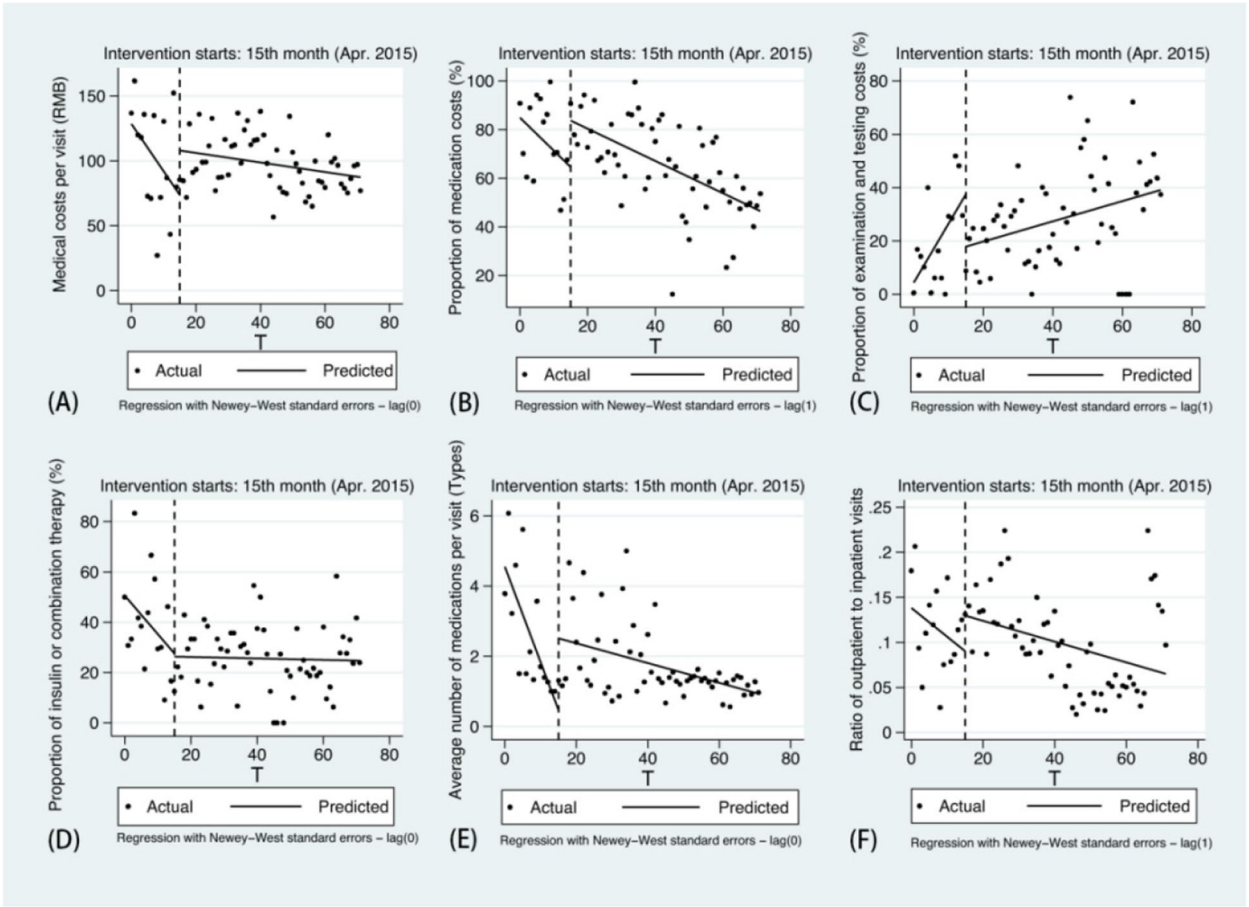


**Fig. 2** Interrupted time series analysis of healthcare service behavior in county hospitals, 2014-2019. Note: **A** Medical costs per visit (RMB), **B** Proportion of medication costs (%), **C** Proportion of examination and testing costs (%), **D** Proportion of insulin or combination therapy(%), **E** Average number of medications per visit (Types), **F** Ratio of outpatient to inpatient visits. Dots are the average or ratio of the observed monthly indicators, and solid line is the predicted value of the monthly indicators derived from the ordinary least squares regression with Newey-West standard errors. Baseline: from January 2014 to March 2015; Intervention stage: from April 2015 to December 2019. Across all models, rare monthly points fell outside the 95% prediction interval

In F County's integrated care system reform, in addition to the core capitation payment model, basic public health funding was also allocated to the medical communities on a per capita approach. County hospitals received funding based on both the quantity and quality of public health services delivered—measured by indicators such as hospitalization rates and patient satisfaction, which reflect both clinical service and public health performance. This well-designed mechanism incentivized primary healthcare providers to strengthen chronic disease management and reduce hospitalization needs caused by complications, thereby promoting a shift toward proactive health management.

The results regarding the cost structure reveal that medication costs constitute the largest share of total costs, closely aligning with findings from another rural study conducted in 2015 [29]. Analyzing the trend of changes in the cost structure reveals that after the reform, there was a slight increase in the proportion of medication costs in primary healthcare facilities, while examination and testing costs decreased; conversely, the trend in county hospitals was the opposite. This indicates a more pronounced trend in primary healthcare facilities toward prescribing medications for the management and control of common illnesses, while county hospitals primarily focus on specialized examinations, complication assessments, and treatment planning for critically ill patients with T2DM [20].

### Enhanced standardization of physicians' prescribing practices and control of medical cost growth

We conducted a focused analysis on physicians' medication practices for T2DM patients, as pharmacological treatment is essential alongside lifestyle management

[27]. Physicians typically tailor treatment plans based on disease severity and comorbidities, with periodic adjustments that directly influence patients' medication choices. The results indicate that, both in primary healthcare facilities and county hospitals, the average number of medications prescribed and the proportion of insulin or combination therapy are lower than those in economically developed regions (based on prior research findings that suggest a significantly higher insulin or combination therapy rates compared to our sample area) [32, 33]. This highlights the need for further improvement in medication standardization in rural China. However, the trends post-reform indicated a positive shift, with a notable increase in the proportion of insulin or combination therapy, and a slight rise in medication costs and average number of medications prescribed. This improvement may be attributed to enhanced service capability of primary healthcare physicians, leading to more standardized and stable prescribing practices. According to policy regulations, county hospitals are also required to provide technical support to primary healthcare facilities, enhancing their capacity to manage common diseases and guiding them in chronic disease management. Furthermore, the implementation of these policies is integrated into performance evaluations, linking to physicians' income, thereby incentivizing collaboration among all members to enhance practice capability. With improved practice capacity, physicians can offer more standardized prescriptions for blood glucose reduction based on disease management guidelines.

In primary healthcare facilities, although the medical costs per visit showed a significant upward trend before the reform, the rate of increase notably slowed post-reform. This may be attributed to the enhanced awareness of cost control among physicians under the capitation payment model. Compared to the former FFS model, the surplus of the medical insurance fund under capitation can be directly distributed to physicians, creating a financial incentive for them. Physicians may reduce unnecessary services, with savings redistributed as performance-based salaries. This incentivizes a shift in physicians' behavior from "earning revenue through increased services" to "gaining income through cost control" [34]. In county hospitals, the average medical costs per visit steadily declined, and the growth rate of examination and testing costs also experienced a decline, indicating that physicians may reduce excessive examination and testing services, contributing to more effective cost control [35].

The findings also suggest that under the incentive of capitation with retained surpluses, there has been no decline in service volume. On the contrary, the intensity of chronic disease management through medication prescriptions for T2DM patients increased, without significantly increasing costs. This aligns with similar research conducted in Ontario, Canada, which demonstrates that a team-based capitation model improved diabetes management [36]. Additionally, a study focusing on blended capitation model indicates that capitation contributes to higher-quality chronic disease care [37].

### Limitations

This study has several limitations. Firstly, as a retrospective study, it is susceptible to various confounding factors, such as physician-specific characteristics, practice environments [38], and the health status of T2DM patients [39], all of which may influence prescribing behaviors and service utilization. Future studies should consider collecting such information in the study design phase. Although we obtained a limited number of individual-level patient characteristics, these variables were excluded from the model due to substantial and uneven missing data. Future studies should incorporate these covariates into the analytical models where feasible. Secondly, we were unable to gather data on the quality of care or outcome indicators for T2DM patients, such as the incidence of complications, readmission rates, and patient glycated hemoglobin levels. Therefore, it is not possible to determine the impact of the policy on the quality of care, nor to assess the effectiveness of standardized prescribing practices in T2DM management. Future research could focus on these indicators to evaluate whether cost-control measures affect the effectiveness of T2DM care. Additionally, quality and outcome indicators could be integrated into the capitation payment model, with the implementation of performance-based incentives linked to patient health outcomes. Lastly, this study focuses on a single rural area in China and one specific disease, which constrains the generalizability of the findings [40]. In addition, due to the unavailability of a comparable control group, we were unable to employ a difference-in-differences strategy to identify policy effects, which may have affected the robustness of our findings to some extent.

## Conclusions

The results of this study indicate that the outpatient medical costs for T2DM patients in the sample area were effectively controlled following the implementation of capitation payment reform. Healthcare facilities across different levels provide services based on their designated functions. Physicians in township health centers demonstrated improved standardization in prescribing practices, while county hospitals offered more comprehensive examination and testing services for T2DM patients. Without accelerating the overall growth of medical costs, physicians increased the

intensity of medication use and strengthened chronic disease management.

This study provides empirical support for the effectiveness of capitation payment model, showing favorable performance in terms of financial sustainability, the division of responsibilities between different levels of healthcare facilities, and the standardization of care. Notably, the unified budgeting arrangement for outpatient and inpatient services appears to have effectively mitigated cost-shifting behaviors. However, the limited service capacity of primary healthcare facilities in this county underscores the importance of strengthening primary healthcare to improve the efficiency of regional service delivery. From a policy perspective, future reforms should promote the evolution of primary healthcare capitation payment models toward accountability for total cost of care and higher-quality, value-based payment model [41].

## Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12889-025-22979-8.

Supplementary Material 1

### Authors' contributions

JZ, YX and NZ conceived and designed the study. YS pre-processed and interpreted the data. JZ, JY and XL analyzed the data. JZ, YX and NZ wrote the manuscript. All authors reviewed the manuscript.

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### Data availability

As the database used in our research group is confidential and we have signed a non-disclosure agreement, we regret that we cannot publicly share the original data. However, the dataset analyzed in this study is available from the corresponding author on reasonable request.

## Declarations

### Ethics approval and consent to participate

We confirm that all procedures were conducted adherence to the Declaration of Helsinki. Informed consent was obtained from all participants and/or their legal guardians. This study was approved by the Medical Ethics Committee of Capital Medical University.

### Consent for publication

Not applicable.

### Competing interests

The authors declare no competing interests.

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## Publisher's Note



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