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Diabetes management in primary health care, China

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Third-party governance and artificial intelligence for diabetes management in primary health care, China

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Abstract

Problem Fragmented primary health care in China fails to tackle the growing burden of noncommunicable diseases. Despite substantial investment, fewer than half of patients with diabetes achieve glycaemic control.

Approach Tianjin's 2020–2023 reform established a public–private partnership model where WeDoctor managed community health centres under a capitation scheme. This strategy integrated: (i) monthly prepaid capitation covering all diabetes-related outpatient services; (ii) claims auditing and clinical decision support using artificial intelligence (AI); (iii) dedicated health managers for care coordination; and (iv) redesigned services incorporating complication screening and digital medication management. A pilot study including 494 945 patients with diabetes compared three care models from 2022 to 2023: WeDoctor–community health centre care, hospital care and usual care.

Local setting Tianjin city serves 15 million residents through 177 hospitals and 266 community health centres. Chronic disease management is fragmented: the Health Commission regulates care standards, while the Insurance Bureau controls funding.

Relevant changes Visits for diabetes at WeDoctor health centres increased 2.6% (0.7/26.6) but declined 10.6% (–3.8/35.7) for hospital-based care and 2.3% (–0.8/34.1)

for usual care. All groups reduced outpatient expenditure. The WeDoctor model generated a 37.62 million United States dollars (US\$) surplus, boosted health centre diabetes revenue by 65% (US\$ 154 577/237 805) and raised physician annual salaries by 30% (US\$ 5172/17 241). More than three quarters of patients expressed satisfaction with and trust in the WeDoctor model.

Lessons learnt Integrating capitation financing with third-party governance and AI support can strengthen primary health care, contain costs and enhance patient-centred care.

Introduction

Primary health care in low- and middle-income countries is under-resourced and fragmented, failing to effectively manage the rising burden of noncommunicable diseases. This fragmentation is acute in China, where rapid epidemiological transitions have outpaced health-system reforms. China faces a diabetes crisis: the prevalence is estimated at about 12.4% but only about a half of cases achieve glycaemic control.¹ Although primary care facilities are the first point of contact, they are underused, indicating a structural failure rather than lack of resources.

While China has increased investment from 2.8 billion United States dollars (US\$) in 2008 to US\$ 33.7 billion in 2019 and established the National Essential Public Health Service Programme,² the capacity of primary care networks to manage noncommunicable diseases has decreased. The main failure lies in the misalignment of financing and service delivery. The absence of a mandatory referral system allows patients unrestricted access to hospital outpatient care, which undermines the role of primary care. Furthermore, the government funds preventive services at primary care, while social health insurance funds curative services, creating perverse incentives that encourage service fragmentation and volume-driven care rather than good health outcomes.³

To guide patients to seek care at the primary level and restructure the health-care delivery system, policy-makers have implemented top-down interventions, including family doctor contracting, tiered medical treatment and different reimbursement rates. However, these policies have been largely ineffective.⁴ This failure reflects a disconnect between the macro-level policy vision of patient-centred integrated care and the micro-level institutional reality characterized by

fragmentation of preventive and curative financing and competition rather than cooperation between primary care facilities and hospitals.

Here, we describe a system-wide reform in Tianjin that piloted two innovations for diabetes care: a capitation payment model and a private third-party organizer. We analyse first-year outcomes (2022–2023) to inform future scaling up and optimization, drawing on policy reviews, semi-structured interviews with health-system administrators and frontline providers, and de-identified electronic health records.

Local setting

Tianjin city serves 15 million residents through 177 hospitals and 266 community health centres. The Health Commission regulates care standards, while the Insurance Bureau controls funding. Chronic disease management is fragmented: health centres receive US\$ 14 a year per capita for preventive management of chronic diseases (e.g. lifestyle counselling and diabetes and hypertension monitoring), excluding clinical treatment. In contrast, insurance separately reimburses curative services. Patients can choose providers, exacerbating care misalignment.

The government partners with WeDoctor, a private health management company. In Tianjin, WeDoctor maintains a multidisciplinary workforce of 300–400 personnel, including semi-professional health managers, liaison managers and a technical and administrative support team. Health managers hold a National Health Manager Certification and provide comprehensive health management for patients using artificial intelligence (AI)-enabled tools (Box 1).

Approach

To restructure primary health care, Tianjin's government partnered with WeDoctor in 2020 in a three-party agreement between the Health Commission, Insurance Bureau and WeDoctor. The Commission delegated control of diabetes management in community health centres to WeDoctor, including digital systems, service allocation and staffing. The Insurance Bureau introduced claims auditing by WeDoctor and capitation payment for enrolled outpatients with diabetes. Under this model, the Insurance Bureau set an annual expenditure ceiling for each patient's outpatient diabetes care (US\$ 1537 per enrollee, based on 2019 costs), capping

payments to the provider (WeDoctor) rather than to patient benefits. WeDoctor kept savings generated by improving care efficiency and reducing unnecessary usage within this budget. By December 2022, WeDoctor had signed agreements with all 266 health centres throughout Tianjin, built operational capacity and enrolled patients. The pilot of patients enrolled under WeDoctor launched in January 2023.

Capitation payment

Patients with diabetes voluntarily enrolled in the pilot which allowed choice between community health centres and hospitals. Patients who did not enrol continued to receive the pre-pilot usual care. The pilot offered benefits beyond the usual package including online consultations, full coverage for drug complications, reduced co-payments and higher reimbursement ceilings.

The Insurance Bureau funding (about US\$ 1537/person annually) covered all reimbursable services. Under the capitation budget, 30% of the generated surpluses were allocated to WeDoctor to recover investments (e.g. in health managers, artificial intelligence; AI; systems and equipment), and 70% went directly to the health centres. Hospitals kept 100% of their surpluses.

Third-party governance

During 2020–2024, WeDoctor raised about US\$ 88 million through parent company capital and external financing. Revenue came from capitation-based shared savings and value-added preventive services.

Improving management

WeDoctor launched an initiative to strengthen governance capabilities across the community health centres. The company established an integrated health information platform that centralized financial management systems for all contracted health centres, incorporating AI-powered modules designed to audit medical prescriptions. To optimize interdepartmental coordination, WeDoctor deployed 90 liaison managers to support the health centres. These managers implemented system training, conducted operational analytics and arranged monthly financial risk meetings to review fund use for each centre. When deficits occurred (i.e.

expenditure for enrolled patients exceeded the capitation budget), managers worked with local teams to develop corrective measures.

Redesigning services

WeDoctor redesigned diabetes care services by deploying more than 200 health managers, who were trained by WeDoctor (Box 1), WeDoctor also (i) equipped all health centres with ophthalmological and podiatric screening devices; (iii) implemented AI-generated patient health risk stratification to create personalized care plans; and (iv) integrated medication management with insurance processing via a commercial digital platform connected to pharmaceutical logistics for direct-to-patient medication delivery.

The WeDoctor system was integrated with health centres' electronic infrastructure through a mobile application, which formed an AI-powered health management platform developed by Zhejiang University's Ruiyi Artificial Intelligence Research Centre. Using patient data from three leading diabetes care hospital networks, the platform used an algorithm to deliver targeted features (Box 2).

The health managers undertook care coordination through WeDoctor's platform. Core responsibilities included biometric data collection (blood pressure readings and photograph-verified diet and exercise documentation), standardized screenings for diabetic complications, quarterly refinement of AI-generated health plans, and implementation of automated follow-up alerts with health education delivery via instant messaging and telephone and face-to-face consultation.

Relevant changes

From June to December 2022, 494 945 patients with diabetes enrolled in one of three models: 18.2% (90 064/494 945) in WeDoctor community health centres; 27.2% (134 461/494 945) in hospital-based care; and 54.6% (270 423/494 945) in usual care. By December 2023, overall retention was 86.2% (426 876/494 945). Attrition rates varied across groups: 17.1% (15 375/90 064) for WeDoctor health centres; 22.5% (30 285/134 461) for hospital-based care; and 11.2% (31 412/279 423) for usual care. Usual care had the lowest attrition rate, likely

reflecting differences in patient characteristics and payment incentives rather than a deficiency in the WeDoctor model. Additionally, WeDoctor's attrition rate was lower than for hospital-based care, indicating its relative effectiveness in patient retention under a managed budget.

In 2023, the We-Doctor model demonstrated financial viability. Against capitation funds of US\$ 152.04 million, expenditure was US\$ 114.42 million, generating a US\$ 37.62 million surplus shared between health centres and WeDoctor. Concurrently, all participating health centres saw a 65.0% (US\$ 154 577/237 805) revenue growth during 2022–2023 for diabetes care. Physicians' annual salaries rose by 30.0% (US\$ 5172/17 241) correlating with high reported levels of satisfaction with and trust in physicians' work (78.9%; 258/327) and competence (71.9%; 235/327).

The WeDoctor model shifted care to health centres, which increased their share of outpatient visits and diabetes-related costs, while hospitals saw a decline. Conversely, inpatient spending rose in all groups. As shown in Table 1, the WeDoctor health centre group had a 2.6% (0.7/26.6) increase in diabetes-related outpatient visits between 2022 and 2023, contrasting with declines of 10.6% (–3.8/35.7) and 2.3% (–0.8/34.1) in the hospital-based and usual care groups, respectively. This pattern was not seen in non-diabetes care, where all groups showed similar increases. The WeDoctor group captured 69.2% (1 650 359/2 384 912) of all outpatient visits in 2023, a 7.1 percentage point increase from 2022, exceeding the 2–3 percentage point gains in the other groups. Inpatient admissions rose substantially in all groups with no significant differences, likely due to the health-care financing structure which emphasizes inpatient reimbursement.

All groups saw outpatient expenditure reductions: –3.7% (–416.4/11 274.5) for WeDoctor health centres; –8.2% (–1452.9/17 682.8) for hospital-based care; and –2.0% (–366.9/18 566.0) for usual care. These reductions were driven by decreases in diabetes-related claims (indicating improved patient health outcomes and more efficient resource utilization).

Lessons learnt

Tianjin's chronic care pilot demonstrates that revitalizing primary care requires overcoming the dichotomy between vertical disease-specific programmes (often having accountability issues)

and horizontal system-strengthening efforts (often lacking disease-specific focus). Tianjin's innovative so-called diagonal governance mechanism resolved this disconnect by using a private third-party as an intermediary: it used diabetes management as a vertical entry point to drive accountability, while simultaneously building horizontal capacity (AI and health managers) to strengthen the primary care system. This approach showed that: (i) capitation sharing can align insurer, provider and patient interests; (ii) AI decision support can help upgrade primary care capacity; and (iii) administrative constraints can be resolved. Box 3 summarizes the main lessons learnt. A stakeholder analysis that identified interests, risks and mitigation strategies is available in the online repository.⁵

Tianjin's model represents a shift from conventional public-private partnerships, which act as a stopgap for acute resource deficits.^{6,7} The new model shows that using an existing community health centre network can drive systemic upgrading. Furthermore, private-sector governance and AI implementation can simultaneously improve care quality and integrate insurers with providers.

The model also shows that evidence-based principles from high-income countries (sustained financing, individualized care and decision support) can be translated into a public-private partnership framework in a middle-income country. Embedding private-sector efficiencies within a shared savings mechanism can improve population health and cost containment without additional public expenditure, thereby offering solutions that could be transferred to health systems worldwide.

After the initial success, Tianjin expanded the model in 2024 to cover 13 chronic conditions. Interest has spread to eight provinces, although scale-up faces structural barriers including payment misalignment, distrust of private partners, patient disenrollment, fiscal constraints and hospital resistance. Successful replication requires municipal commitment, capable private partners, primary care engagement, patient retention and adequate financing, underscoring the need for robust regulation to prevent profit-driven quality compromise.

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Competing interests:

TZ was affiliated with the Tianjin Health Insurance Bureau and Yipeng Guo is affiliated with the Tianjin Health Commission. Both institutions participated in the design and implementation of the reform evaluated in this study. No other authors declare competing interests.

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Box 1. Recruitment, training, and compensation structure of health managers, pilot on diabetes management in primary health care, China

Recruitment pipeline

The health manager workforce at WeDoctor Tianjin comprises two primary recruitment channels: approximately 40% are graduates from WeDoctor's proprietary Hainan Health Management College (annual intake: 300 students); remaining 60% are locally recruited within Tianjin's health care sector.

All personnel hold the National Health Manager Certification issued by institutions designated by the Chinese Ministry of Human Resources and Social Security, and 74% additionally possessing clinical qualifications, such as nursing licenses or physician credentials.

Training protocol

The training system includes: probationary phase (at least three sessions), minimum 8 hours for each session, and competency-based skill assessments; and periodic capacity-building training for continuous development.

Compensation model

Mean annual compensation for a health manager: ¥70 000.^a

Funding mechanism: Surplus of capitation allocated to WeDoctor.

Standard deployment: 1 full-time equivalent manager per primary health-care facility.

^a 1 United States dollar = ¥6.38.

Box 2. Functions provided by the WeDoctor's AI-enabled platform for diabetes management, Tianjin, China

The health-care management platform uses a general-purpose large language model, fine-tuned using human feedback to improve output quality, to generate diagnostic hypotheses from structured clinical data, such as chief complaints, medical history and vital signs, entered by general practitioners. The platform provides tiered recommendations:

- diagnostic guidance: differential diagnosis suggestions with probability weighting;
- investigative protocols: prioritized lists of required examinations, such as cardiac ultrasound and liver function panels; and
- referral triggers: automated identification of cases requiring specialist intervention based on algorithmic analysis of treatment response trajectories.

Standardized screening infrastructure

Operationalized across 89.5% (238/266) of community health centres, the WeDoctor deploys uniform retinal imaging equipment; AI-assisted image interpretation validated against radiologist benchmarks; and centralized verification workflow for abnormal findings through a central teleradiology verification team.

AI-enhanced prescription optimization

The AI system analyses the patient's data, identifies similar cases from its own database and recommends treatment options. These suggestions consider the medication history, adverse drug reactions, medication inventory, formulary availability and price. Treatment options are ranked by total cost for more possible cost-effective choices. Once a general practitioner submits a prescription, the AI reviews it based on clinical guidelines, hospital-level data and insurance policies. The review results are categorized into three outcomes: flagged for revision, forwarded to a pharmacist for further review or approved directly.

AI-enhanced risk-stratified patient follow-up system

The health-care management platform operates through a five-component framework.

- (i) data collection: health managers systematically input patient data at initial enrolment and each subsequent follow-up consultation (follow-up assessment with 76 indicators);
- (ii) automated risk classification: the system performs multiparametric evaluation using HbA1c levels (the main biomarker) and supplementary biomarkers to classify patients into three risk tiers;
- (iii) tiered management approach: the AI-enabled system classifies patients into three risk tiers with corresponding follow-up reminders: red (about 8%) with monthly reminders; yellow (24%) with reminders every 2 months; and green (68%) with quarterly reminders.
- (iv) personalized care delivery: the platform generates individualized plans incorporating evidence-based pharmacological regimens, tailored nutritional protocols, customized exercise prescriptions and lifestyle modification strategies.
- (v) clinical support features: health-care supervisors receive automated monitoring alerts and scheduled complication screening protocols.

AI: artificial intelligence; HbA1c: glycated haemoglobin.

Box 3. Summary of main lessons learnt

- The adoption of third-party governance and public–private partnerships significantly strengthened coordination between health workers and insurance systems, fostering more integrated and efficient service delivery.
- Expanding and enriching primary care capacity for chronic disease management increased the attractiveness and accessibility of public health services, effectively meeting community needs for integrated care.
- The combined implementation of capitation payments and prescription surveillance using artificial intelligence reduced inappropriate medication use, decreased unnecessary by passing of primary health care, and contained insurance expenditures, thus ensuring more sustainable resource allocation.

Table 1. Health-care use and medical expenditure, China, 2022–2023

Variable	WeDoctor community health centre group (n = 74 689)				Hospital-based provider group (n = 104 176)				Usual care group (n = 248 011)			
	2022	2023	Absolute difference (95% CI)	Relative difference, %	2022	2023	Absolute difference (95% CI)	Relative difference, %	2022	2023	Absolute difference (95% CI)	Relative difference, %
Care utilization												
Average annual outpatient visits per patient	59.1	63.1	4.0 (3.8 to 4.2)	6.8	72.7	72.4	-0.4 (-0.6 to -0.1)	-0.5	71.2	75.2	4.0 (3.8 to 4.2)	5.6
Diabetes-related visits	26.6	27.3	0.7 (0.6 to 0.8)	2.6	35.7	31.9	-3.8 (-3.9 to -3.7)	-10.6	34.1	33.3	-0.8 (-0.9 to -0.7)	-2.3
Non-diabetes-related visits	32.4	35.7	3.3 (3.1 to 3.5)	10.2	37.0	40.5	3.4 (3.3 to 3.6)	9.3	37.1	41.8	4.8 (4.6 to 4.9)	12.9
% of outpatient visits at community health centres	58.0	61.5	3.5 (3.1 to 3.9)	6.0	56.1	57.6	1.5 (1.2 to 1.8)	2.7	59.7	61.8	2.1 (1.8 to 2.4)	3.5

Diabetes-related visits	62.2	69.2	7.1 (6.6 to 7.5)	11.4	57.3	59.0	1.7 (1.3 to 2.1)	3.0	65.5	68.6	3.1 (2.7 to 3.5)	4.7
Non-diabetes-related visits	54.6	55.7	1.0 (0.6 to 1.5)	1.9	54.9	56.5	1.6 (1.2 to 1.9)	2.8	54.4	56.5	2.0 (1.8 to 2.3)	3.7
Average annual hospital admissions per patient	0.4	0.5	0.1 (0.1 to 0.1)	25.8	0.4	0.4	0.1 (0.1 to 0.1)	27.5	0.4	0.5	0.1 (0.1 to 0.1)	26.2
Medical expenditure												
Annual outpatient expenditure per patient, in ¥ ^a	11 274.5	10 858.0	-416.4 (-474.8 to -358.1)	-3.7	17 682.8	16 230.0	-1452.9 (-1511.3 to -1394.5)	-8.2	18 566.0	18 199.0	-366.9 (-428.7 to -305.2)	-2.0
Diabetes-related visits	6 134.1	5 339.9	-794.1 (-824.2 to -764.1)	-12.9	10 964.6	9 024.9	-1939.7 (-1975.6 to -1903.9)	-17.7	11 105.5	9 929.8	-1175.6 (-1210.2 to -1141.0)	-10.6
Non-diabetes-related visits	5 140.4	5 518.1	377.7 (327.5 to 427.9)	7.3	6 718.2	7 205.0	486.9 (441.1 to 532.6)	7.2	7 460.5	8 269.2	808.7 (760.5 to 856.8)	10.8

related visits													
Community health centre share of total health-care expenditure, %	48.3	50.5	2.1 (1.7 to 2.6)	4.4	47.2	46.7	-0.5 (-0.8 to -0.2)	-1.3	57.8	62.6	4.7 (4.4 to 5.1)	8.2	
Diabetes-related visits	54.3	60.2	5.8 (5.3 to 6.4)	10.7	48.1	45.3	-2.8 (-3.2 to -2.5)	-6.0	64.2	69.8	5.7 (5.3 to 6.1)	8.8	
Non-diabetes-related visits	41.1	41.0	-0.1 (-0.6 to 0.5)	-0.1	45.8	48.5	2.7 (2.2 to 3.2)	5.0	48.4	53.8	5.4 (4.9 to 6.0)	11.2	
Annual inpatient expenditure per patient, in ¥ ^a	5 931.2	7 345.7	1 414.5 (1 219.0 to 1 610.1)	23.8	6 145.6	7 923.8	1 778.2 (1 597.5 to 1 958.8)	28.9	7 317.3	8 234.2	916.9 (782.1 to 1 051.7)	12.5	

CI: confidence interval; ¥: yuan.

^a 1 United States dollar = ¥6.38.

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Note: Inconsistencies arise in some values due to rounding.