

Government-led four-dimensional integrated diabetes governance policy: A four-year implementation evaluation of county-level medical-prevention alliance in Shunde, China

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Government-led four-dimensional integrated diabetes governance policy: A four-year implementation evaluation of county-level medical-prevention alliance

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Abstract

Background

Diabetes imposes a heavy population health burden worldwide, and integrated chronic disease management has become a core national health policy priority under the Healthy China 2030 initiative. Most county-level health systems suffer fragmented medical-prevention resources, insufficient grassroots workforce and weak cross-sector policy coordination. Hospital-led medical alliances rely solely on clinical collaboration without binding government administrative mechanisms, while Western Chronic Care Model (CCM) and Integrated Care Pathways (ICPs) require mature primary care systems and sustained high fiscal investment, which cannot be directly replicated in Chinese counties and low- and middle-income countries (LMICs). This study systematically evaluates a government-initiated four-dimensional diabetes governance policy framework (Shunde Diabetes Medical-Prevention Collaborative Alliance, SDM-PCA) built over four years, interprets its institutional operation mechanism, and extracts

replicable county-level chronic disease governance policy experience for global public health practice.

Methods

This study adopts qualitative policy evaluation methodology based on four-year official annual work reports submitted by all alliance member institutions. We systematically archived and coded institutional operation documents covering the full four-year reform cycle. Thematic content analysis was applied to sort out policy design logic, multi-sector coordination rules and institutional defects of the four-dimensional governance system. No population questionnaire surveys or clinical intervention trials were carried out in this research; all analytical work centers on institutional operation logic rather than population clinical efficacy comparison. The research protocol obtained institutional ethical approval prior to document collation work.

Results

After four consecutive rounds of full-district policy implementation, a closed-loop cross-department diabetes governance system was fully established in Shunde District. The local government issued binding joint working policies covering health, medical insurance and civil affairs departments, constructed a standardized tiered training system for grassroots diabetes practitioners, launched a unified regional digital health management platform, and incorporated narrative medicine into routine grassroots humanistic supporting service policies. Four mutually interactive policy dimensions (institutional cross-department governance, regional digital health infrastructure, standardized primary workforce development, narrative medicine auxiliary intervention) jointly formed a complete county-level chronic disease governance system targeting fragmented grassroots service resources.

Conclusions

This government-led four-dimensional integrated diabetes governance policy effectively addresses structural institutional defects of fragmented county medical and preventive services. The multi-sector coordinated, data-driven policy framework can be simplified and localized according to local resource endowments, providing operable reform pathways for underdeveloped counties and LMICs to optimize

chronic disease governance systems. **Keywords:** diabetes mellitus; four-dimensional integrated medical-prevention model; county-level primary healthcare; digital public health; narrative medicine; chronic disease governance; health policy

1 Introduction

The expanding global burden of diabetes imposes long-term pressure on public health and medical systems worldwide. Sustainable diabetes prevention and management requires collaborative whole-population interventions covering medicine accessibility, primary care upgrading, population screening and long-term continuous follow-up, which has been designated a core priority under the Healthy China 2030 national strategy. The Healthy China Action (2019) explicitly prioritizes standardized prevention and treatment of diabetes and other metabolic chronic diseases as a central component of national chronic disease governance systems. National epidemiological surveys indicate that the overall prevalence of diabetes among Chinese adults reaches 16.39%, yet merely 15.8% of patients achieve qualified glycemic control, resulting in a severe nationwide population health burden ^[1].

Against the backdrop of China's national medical reform, county-level integrated medical and preventive care systems have been positioned as the core carrier to narrow the urban-rural medical gap and realize equal basic public health services. Since 2019, central and provincial health authorities have successively issued policy documents encouraging all districts and counties to build government-led medical-prevention alliances, with clear requirements to break the long-standing separation between clinical treatment and public health screening, and establish cross-department linkage mechanisms between health and medical insurance departments. Nevertheless, the majority of county medical alliances constructed in the early stage only took tertiary hospitals as the single leading body, lacking top-down administrative binding force from local governments. Most reform practices only optimized single links such as hospital referral channels or grassroots training, without forming a closed-loop management system covering policy guarantee, digital support, talent cultivation and humanistic services. From a national literature

perspective, existing domestic systematic reviews on county chronic disease management pointed out that less than 18% of published intervention studies adopted multi-dimensional integrated designs, and most research focused on short-term single-center clinical observation rather than four-year long-term population-based quasi-experimental tracking data. Such research gaps directly restrict the promotion of mature replicable reform models across different regions of China.

At the county/district level, four core bottlenecks hinder the standardized delivery of diabetes care. First, fragmentation of clinical and preventive resources disrupts the full service chain of prevention, population screening, clinical treatment and long-term follow-up; fewer than 40% of grassroots institutions are capable of delivering standardized diabetes diagnosis and treatment ^[2]. Second, primary care providers lack systematic training aligned with clinical guidelines: the adherence of primary physicians to standardized diabetes care pathways stands at only 39.7%, with a medication adjustment delay rate three times higher than that of tertiary hospital clinicians ^[3]. Third, conventional static hierarchical diagnosis and treatment systems fail to accommodate the progressive, fluctuating clinical characteristics of diabetes, and cannot dynamically allocate medical resources based on patient risk stratification. Fourth, the single biomedical care paradigm ignores patients' psychological stress, daily living contexts and family social support systems, leading to low long-term treatment adherence and suboptimal self-management ^[4].

Hospital-led specialist medical alliances have been widely implemented across countries for decades, yet most such collaborative structures suffer weak implementation and fail to generate sufficient population-level intervention benefits. Their core drawback lies in single-discipline oversight without binding cross-sector coordination mechanisms among health bureaus, medical insurance administrations and civil affairs authorities^[5,6]. Although county-level specialist alliances have emerged as an innovative reform direction in China, existing literature lacks long-term, large-scale quasi-experimental evidence evaluating government-led multi-dimensional integrated diabetes governance. Most previous studies can be

divided into two categories: clinical trials focusing on single drug or nursing intervention, and informatization research only evaluating digital platform operating indicators, while few studies simultaneously integrate institutional policy, digital technology, grassroots capacity and humanistic auxiliary measures into a complete population governance framework^[7-9]. This study fills such research vacancy by conducting a four-year full-district policy implementation tracking and evaluation of the SDM-PCA four-dimensional diabetes governance system, analyzing its institutional innovation points and operable cross-department coordination mechanisms, and providing localized policy references for similar county-level chronic disease reform worldwide.

Research Gaps

A review of domestic and international literature identifies three critical research gaps, which constitute the innovative entry points of the present study:

1. Western mainstream chronic care frameworks including the CCM and ICPs are built upon mature primary care systems and sustained high fiscal investment in high-income nations, and cannot be directly transferred to Chinese counties and LMICs with resource shortages and fragmented medical networks.
2. Existing hospital-led medical alliances in China rely on spontaneous clinical cooperation without government-mandated cross-departmental binding policies, leading to weak policy enforcement and uneven population intervention outcomes.
3. Current domestic and international diabetes management models adopt a solely biomedical intervention logic, lacking auxiliary narrative medicine modules to improve patients' long-term self-management adherence.

Core Research Question and Specific Objectives

Core Research Question

What systematic government-led multi-dimensional policy design can break the institutional bottlenecks of fragmented grassroots diabetes governance in Chinese county regions?

Specific Research Objectives

1. Systematically sort out the complete four-year policy construction and implementation archives of the SDM-PCA county diabetes governance framework.
2. Interpret the internal operation logic and institutional innovation value of the four-dimensional cross-department collaborative governance system.
3. Summarize simplified, low-cost policy transformation paths applicable to underdeveloped domestic counties and global low- and middle-income regions.

Shunde District of Foshan City serves as a typical pilot site for county-level chronic disease reform, with a complete three-tier medical network and stable fiscal investment in public health. In August 2020, the Shunde District Health Bureau initiated the Shunde Diabetes Medical-Prevention Collaborative Alliance (SDM-PCA), with the Eighth Affiliated Hospital, Southern Medical University as the lead institution. The alliance unites 10 town-level hospitals and 10 community health service centers to establish a district-wide diabetes prevention and control network. Iterative policy revisions and optimization were carried out based on pre-reform institutional baseline surveys and resident demand questionnaires. This paper adopts qualitative policy evaluation methods to comprehensively analyze the four-dimensional governance policy system, extract replicable cross-department coordination mechanisms, and provide localized health policy experience for county chronic disease governance reform at home and abroad..

2 Context and four-dimensional diabetes governance policy framework

2.1 Pre-reform institutional baseline survey Before the formal launch of the SDM-PCA reform project (November 2020–January 2021), the Shunde District

Health Bureau organized a full-district institutional baseline assessment covering all town and community medical institutions, combining on-site institutional field inspections with self-designed structured institutional baseline questionnaires. The complete English version of this self-developed institutional survey questionnaire is uploaded as Supplementary File 1 for peer review.

Three core institutional defects restricting local diabetes governance were identified through this baseline policy survey: First, severe shortages of specialized diabetes clinicians. The district's permanent resident population totals 3.23 million, with fewer than 50 full-time diabetes physicians (only 10 holding postgraduate degrees). Fewer than 50% of primary care staff obtained standardized training certificates for diabetes management. Second, incomplete equipment allocation. Ninety percent of grassroots institutions only possessed basic blood glucose meters, lacking essential testing devices for autoantibody detection, urinary microalbumin quantification and multi-organ complication screening. Third, fragmented information silos. Prior to model implementation, no unified regional diabetes management platform existed; data systems operated independently across facilities, obstructing continuous patient referral and long-term follow-up workflows.

2.2 Population service object baseline From November 2021 to August 2022, the research team carried out a population-based cross-sectional Speed-Shunde cohort study to clarify the baseline chronic disease burden of local residents, which provided population demand background for the formulation of district-level diabetes governance policies. Strict stratified cluster sampling matching the district's population distribution by town, age bracket and gender was adopted to guarantee the sample's representativeness; sampling weight adjustment was applied during prevalence calculation to eliminate sampling bias caused by uneven resident distribution in urban and rural communities. Standard oral glucose tolerance test (OGTT) was adopted as the diagnostic gold standard for diabetes. The risk factor survey tool adopted the standardized WHO STEPwise noncommunicable disease risk factor questionnaire^[10], with Cronbach's $\alpha=0.85$ and content validity index=0.92 after

local cultural adaptation. Laboratory tests included thyroid function, hepatic and renal function, lipid profiles, sex hormones, bone metabolism markers, FGF21 and adiponectin. Auxiliary screening comprised thyroid ultrasonography, liver fat elasticity measurement and bone mineral density testing. A total of 25 rounds of on-site population screening were completed, enrolling 10,766 residents for comprehensive diabetes and complication assessments.

Standardized prevalence outcomes were as follows: diabetes 14.52%, prediabetes 49.30%, hypertension 25.8%, dyslipidemia 31.7%^[11]. The prevalence of both diabetes and prediabetes exceeded national averages. Local diabetes awareness, treatment and standardized management rates stood at 36.5%, 31.3% and 55.8%, respectively. Multimorbidity was highly prevalent in the district: diabetes combined with dyslipidemia (10.2%), hypertension combined with dyslipidemia (15.5%), diabetes combined with hypertension (8.9%), and patients living with three concurrent chronic diseases accounted for 5.5% of the total population^[10]. These cross-sectional baseline data demonstrated a heavy multimorbidity burden among local adults. No longitudinal follow-up data on changes in multimorbidity prevalence were collected in this research. After the formal launch of SDM-PCA, all participants diagnosed with diabetes during screening were incorporated into the digital platform for long-term dynamic monitoring, with continuous collection of blood glucose and cross-institutional referral data for overall population outcome evaluation.

2.3 Policy formulation basis derived from institutional and population baseline data

This four-dimensional governance policy system was formulated relying on two types of pre-reform baseline materials: full-coverage institutional deficiency surveys of all grassroots medical institutions, and cross-sectional cohort data reflecting local residents' heavy multimorbidity burden. No independent long-term population follow-up tracking was set up after the policy was fully rolled out.

2.4 Overall structural design of the four-dimensional governance policy

This four-dimensional intervention framework targets regional population chronic disease governance, engaging multi-level governments, tertiary hospitals, town-level medical institutions and community health centers with systematic feedback adjustment mechanisms. Complex adaptive system theory is briefly applied to interpret stakeholder interactions without redundant theoretical elaboration. The framework centers on public health system optimization, supported by digital technology and primary care capacity building, with narrative medicine serving as an auxiliary humanistic intervention. The full structural framework is illustrated in Figure 1.

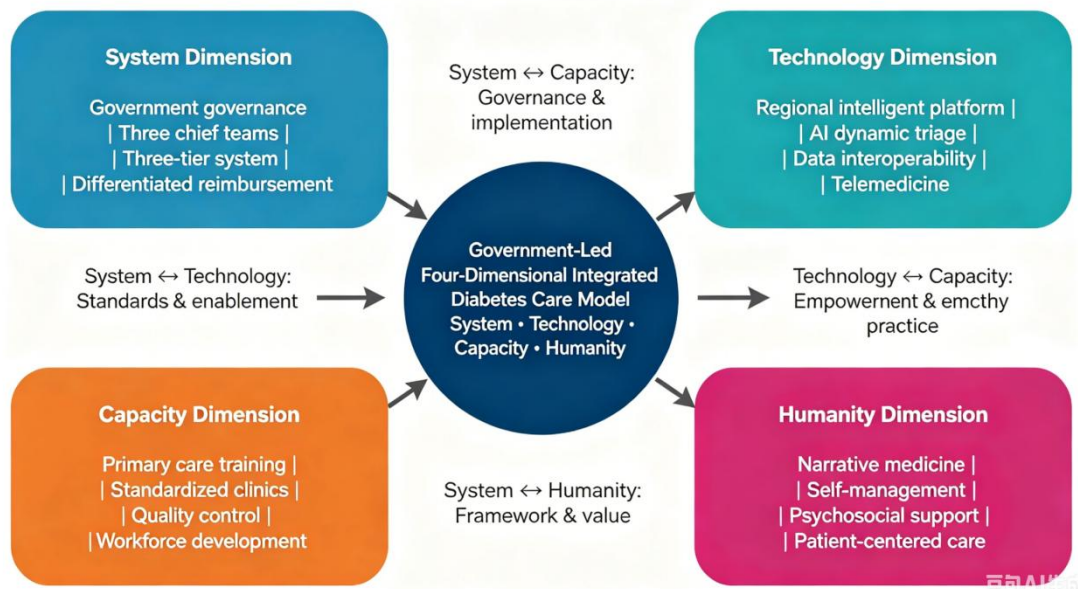


Figure 1 The four-dimensional integrated medical-prevention model of the SDM-PCA alliance

Figure legend: This figure displays the four core dimensions (Institution, Technology, Capacity, Humanity) and their bidirectional interactive relationships. The institutional dimension provides policy guarantees; the technical dimension enables digital intelligent triage; the capacity dimension upgrades grassroots hardware and workforce; the humanity dimension delivers patient-centered psychological and self-management support. The four bidirectional logical links form a closed-loop collaborative governance system.

2.4 Dimension 1: Institutional cross-department governance policy

2.4.1 Tiered Cultivation of Grassroots Diabetes Core Practitioners

Since November 2020, Shunde District has adopted a zone-based, individual accountability management framework tailored to the clinical deficiencies of grassroots medical institutions and local chronic disease epidemiological characteristics. All 10 town-level hospitals and 10 community health service centers across the district were divided into three working groups, each led by a senior chief physician with full senior professional titles from the tertiary lead hospital. A dual-track talent training model was implemented, with centralized systematic lectures as the primary approach and regular on-site grassroots outreach support as the auxiliary measure. Customized integrated theoretical and practical training curricula were developed targeting frontline clinical pain points, to cultivate three categories of core grassroots talents: chief diabetes physicians, specialized diabetes nurses and clinical pharmacists (collectively referred to as the "Three Lead Practitioners"). This initiative aims to address gaps in grassroots diabetes care and improve the capacity of primary and secondary medical facilities to manage local patients with chronic metabolic disorders.

As the core lead institution of the medical alliance, the Eighth Affiliated Hospital, Southern Medical University delivered batch-based centralized training supported by regular on-site clinical coaching based on tailored curricula. A total of 310 grassroots backbone practitioners have been cultivated, including 100 chief diabetes physicians and 150 specialized diabetes nurses. Each senior lead physician is assigned to oversee 2–3 community health service centers. They first deliver unified district-wide theoretical lectures, then conduct 4 hours of specialist outpatient services and 2 hours of consultation for complex cases at grassroots sites on a weekly basis. For nursing training, monthly centralized hands-on workshops serve as the core component, supplemented by on-site one-to-one coaching covering insulin administration, blood glucose testing and peripheral neuropathy screening. Clinical pharmacists organize

quarterly district-wide centralized training sessions on rational medication use, and provide personalized online pharmaceutical guidance for patients with multiple comorbidities during outreach visits.

A complete set of talent incentive policies was formulated to sustain the long-term operation of this "centralized teaching plus on-site outreach" tiered cultivation system. This localized, demand-driven talent development framework represents an institutional innovation distinct from medical insurance reform measures, which has rarely been documented in existing research on county-level medical alliances. After four years of systematic training customized to local grassroots demands, the overall capacity for diabetes diagnosis and treatment at primary care facilities has been markedly improved, realizing nearly homogeneous diabetes medical services across the entire district.

The alliance constructed a three-tier diabetes management system: district-level unified blood glucose quality control center, town-level sub-centers, and community integrated service stations. Family physician teams at each station delivered routine monitoring and long-term follow-up for stable diabetic patients. The Shunde District Government established a cross-department coordination mechanism integrating health, medical insurance and civil affairs bureaus, launching two core supporting policies:

1. Standardized two-way green referral channels with explicit time limits: Patients referred upward from primary care receive priority registration, examination and hospitalization at tertiary hospitals; patients transferred downward are assigned one-on-one continuous follow-up by community family physicians.
2. Unified referral responsibility documents: Originating institutions are required to fully transfer medical records, diagnosis and medication regimens; receiving facilities must complete follow-up coordination and feedback within 72 hours to eliminate cross-hospital information asymmetry.

The three-tier system integrates the full care continuum of diabetes prevention, clinical treatment and community follow-up, maximizing the interdisciplinary advantages of physicians, nurses and pharmacists to boost regional chronic care capacity.

2.4.2 District-Wide Unified Blood Glucose Quality Control Center

A dedicated district blood glucose quality control center was established to formulate localized standardized diabetes care pathways aligned with national guidelines and local multimorbidity profiles. The center oversaw cross-department policy implementation and full lifecycle operation of the digital platform. Routine quality control activities included monthly evaluation of referral efficiency (target response time ≤ 24 hours), and monthly assessment of institutional platform utilization and data completeness. Evaluation results were directly linked to public health performance appraisals, with rectification notices issued for substandard facilities. Quarterly on-site inspections and regular medical record audits standardized clinical practices to steadily elevate district-wide diabetes care quality.

2.4 Technical Dimension: Intelligent Regional Blood Glucose Management Platform

The total construction investment of the unified regional blood glucose platform reached 428,600 USD (approximately 3.06 million CNY), with comprehensive data security protocols. All patient data were encrypted via AES-256 during transmission and storage; role-based access control (RBAC) restricted primary clinicians to data of their contracted patients only. Dual authentication (password + SMS verification) was mandatory for all platform operators. The platform adopted a dual-cycle architecture: intra-hospital micro-circulation and district-wide macro-interconnection. Unified equipment interfaces and centralized data warehouses enabled deep integration of heterogeneous clinical systems across facilities, generating complete electronic health records and personalized intelligent glycemic management modules to improve clinical efficiency and patient experience. All data transmission complied with

national medical informatization standards, supporting cross-hospital record retrieval, telemedicine consultations, high-definition case seminars and mobile terminal access.

From the perspective of regional public health governance, the construction of this unified digital platform solved a prominent long-standing practical problem in county-level chronic disease management: scattered patient data distributed in isolated hospital systems cannot form continuous population disease portraits, which made it impossible for health administrative departments to grasp the overall distribution of diabetic residents and dynamically adjust public health resource allocation in a timely manner. Before the platform went online, district health officials could only rely on annual paper work reports to roughly judge the service status of grassroots institutions, lacking real-time, standardized, comparable monitoring indicators. After the full launch of the system, the district quality control center can extract monthly risk distribution data of all towns through the visualization module, and adjust the annual grassroots training focus and standardized clinic resource allocation plan according to the proportion of high-risk patients in each sub-district, realizing data-driven precise public health resource scheduling rather than rigid equal distribution of financial and human resources. Such dynamic policy adjustment capacity brought by regional big data platforms is an important technical advantage that static hospital information systems cannot match.

Beyond the visualized real-time warning panel presented in Figure 2, the platform delivers comprehensive intelligent management functions. It automatically generates individualized long-term health plans and intelligent follow-up reminders, alongside real-time patient monitoring, critical value alerts and multi-dimensional institutional performance evaluation to underpin daily alliance governance. Built-in AI algorithms integrate blood glucose and referral records with risk stratification data to send automated high-risk notifications, while district specialists deliver instant remote guidance to standardize tiered diabetes care. All platform data are visualized into a tri-color risk zoning map: red zones correspond to tertiary hospitals managing patients with acute complications and refractory severe diabetes; yellow zones cover

secondary hospitals for medium-risk transferred cases; green zones represent community health centers caring for stable elderly and rehabilitative diabetic populations. This zoning map allows administrators to dynamically monitor patient distribution and the progress of tiered care, thus promoting standardized, well-organized cross-hospital referrals.

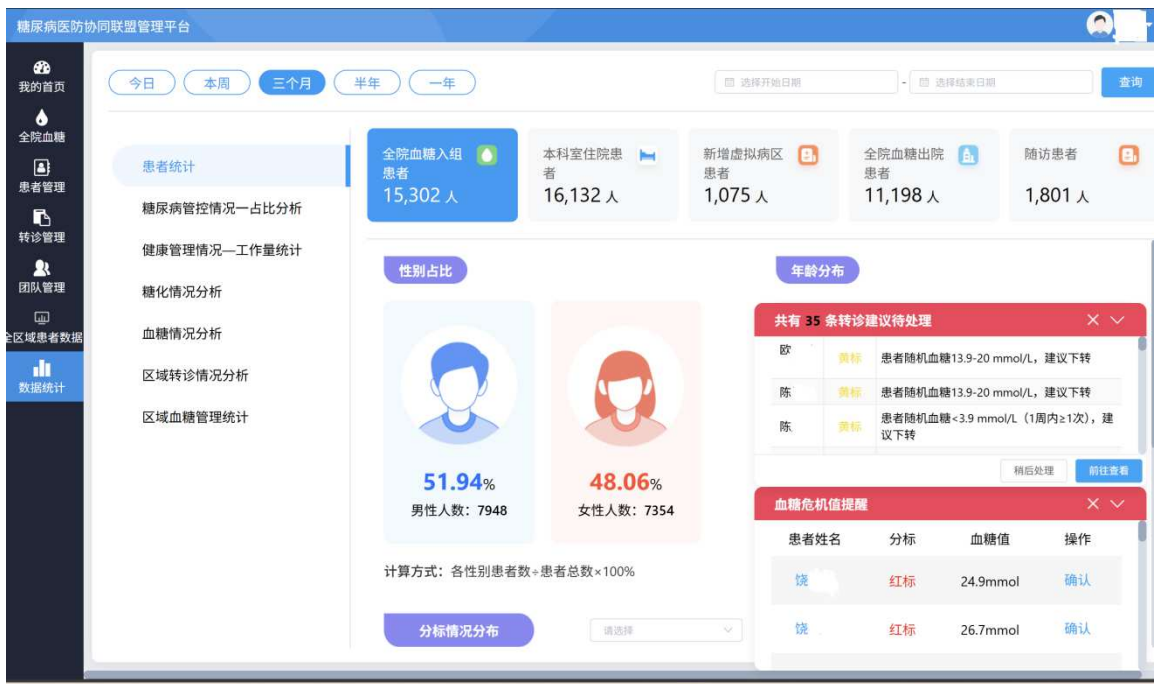


Figure 2 Dashboard interface of the regional diabetes medical-prevention collaborative alliance management platform

Legend: The platform integrates functional modules for patient statistics, cross-hospital referral management, team training archives and regional big-data analysis. It visualizes demographic profiles of enrolled diabetic patients, generates color-coded real-time risk alerts for abnormal glycemic values, and aggregates routine service workload data of grassroots "Three Lead Practitioners". The system enables unified data interconnection among tertiary hospitals, town-level medical branches and community health centers, delivering data support for training effect assessment and whole-population diabetes dynamic governance.

Key operational metrics verified platform application value:

1. AI triage consistency: Based on 12,860 patient samples collected from 2023 to 2024, AI assessments achieved 89.7% concordance with specialist manual evaluation (95% CI: 88.9%–90.5%, kappa=0.82). A kappa value of 0.82 indicates almost perfect inter-rater agreement.
2. Cross-institutional data interoperability: As of 30 June 2025, real-time data sharing was realized across all district general hospitals and community centers; retrieval latency ≤ 3 seconds with a 99.2% success rate.
3. Referral support: 91.5% of all referral applications were initiated via the platform with fully standardized forms; average waiting time for primary-referred patients at tertiary hospitals was reduced to 48 hours.
4. Institutional compliance monitoring: Mid-2025 monitoring data showed the monthly average platform utilization compliance rate of all institutions reached 95.8%, with a comprehensive data and referral standardization rate of 92.3%, fully meeting municipal public health assessment requirements.
5. Primary staff satisfaction survey: A total of 216 grassroots clinicians participated in the questionnaire; 82.4% rated the platform user-friendly, 78.7% reported improved referral and data query efficiency, while only 6.5% requested extended system training.

2.4 Capacity Dimension: Standardized Hardware and Workforce Development for Primary Care

Tiered Multidisciplinary Training System A tiered training program targeting primary diabetes physicians, specialized nurses and clinical pharmacists was developed to comprehensively upgrade regional chronic care capacity:

1. Training for chief physicians: Focused on clinical decision-making and cross-institutional coordination. National diabetes experts delivered regular lectures on subtype differentiation and complication prevention. Combined ward rounds, specialist outpatient observation and difficult case discussions enabled

trainees to master full standardized care workflows, with supplementary team management courses to strengthen grassroots training organization capacity.

2. Training for specialist nurses: Built foundational knowledge of diabetes pathogenesis, with intensive practical training in blood glucose testing, insulin administration and peripheral neuropathy screening; courses also covered health education and patient communication to support independent long-term follow-up.
3. Training for clinical pharmacists: Practice-oriented courses on hypoglycemic drug mechanisms and drug interactions, combined with ward rounds and simulated cases to improve rational medication guidance and population adherence.

District-Wide Standardized Diabetes Clinics Led by Professor Jie Shen, the alliance's chief expert, localized construction specifications were formulated with reference to national standards, with separate criteria for secondary hospital branches and community centers. Secondary diabetes clinics occupied no less than 20 m², equipped with one full-time physician, one nurse and one data clerk, with the 2020 Chinese Type 2 Diabetes Guidelines posted on-site. Community clinics were staffed with one physician and one full-time nurse. All clinics were connected to the regional platform for synchronous data upload; unified screening equipment was allocated with automatic data synchronization to the district system. The Shunde District Government issued targeted fiscal subsidies: 28,600 USD per town-level clinic, 14,200 USD per community clinic, comprehensively upgrading grassroots hardware to realize homogeneous diabetes screening and basic management.

2.4 Humanity Dimension: Auxiliary Narrative Medicine Intervention

Drawing on the narrative medicine theoretical framework established by Southern Medical University^[12,13], narrative medicine was positioned as an auxiliary rather than core institutional reform measure to address the neglect of patients' psychological and social needs under purely biomedical care. Diabetes progression is

closely linked to lifestyle and emotional fluctuations; narrative communication helps clinicians identify patients' inner barriers and deliver patient-centered intervention schemes to improve doctor-patient trust and sustained treatment engagement. The research team independently developed the narrative picture book *I Make Friends with Sugar Genie* exclusively for adolescent patients, adopting child-oriented story-based education to alleviate disease anxiety and guide family members to grasp basic home self-management skills. Narrative intervention was implemented across the district as an auxiliary measure; separate baseline and follow-up quantitative indicators for adolescent subgroups were not collected in this study. The full text of the picture book is attached as Supplementary File 2.

3 Methodology

3.1 Study design and research scope

This research adopts a four-year longitudinal qualitative policy implementation evaluation design, taking the full-district SDM-PCA chronic disease reform as the single research object. Before policy promotion, a cross-sectional population cohort was implemented to obtain baseline chronic disease burden data, which was only used for policy background description. Due to the unified full-district synchronous promotion of the four-dimensional governance policy from 2020 to 2024, the administrative region cannot be split into independent intervention and control groups for comparative analysis, so parallel control settings were not adopted. The whole four-year research cycle is divided into three independent policy research phases:

1.Pre-reform baseline survey phase (Nov 2020 – Aug 2022): Complete institutional hardware and personnel baseline surveys, and launch cross-sectional population screening to obtain resident chronic disease burden data, laying the foundation for four-dimensional policy design;

2.Full policy rollout and construction phase (Sep 2022 – Dec 2024): Complete regional digital platform construction, full-cycle grassroots talent training and standardized clinic layout in accordance with successive government policy documents;

3. Policy sorting and qualitative evaluation phase (Jan 2025 onwards): Systematically archive four years of complete institutional annual work reports and conduct thematic content analysis to interpret institutional innovation and operational logic of the governance system.

3.2 Specification of research materials

This policy evaluation research takes two types of baseline materials as policy background reference: institutional on-site survey archives and cross-sectional population cohort data collected before reform. The core analytical materials are four consecutive years of official annual work reports submitted by all alliance member institutions. No repeated post-reform population questionnaires or long-term follow-up scales were deployed throughout the study. Only two self-developed research materials were formed in the whole reform cycle: institutional baseline structured questionnaires and adolescent narrative picture books; full English versions of the two materials are uploaded as Supplementary File 1. The WHO Chronic Disease Risk Factor Survey adopted in pre-reform population screening was only used to collect baseline resident risk data, without repeated application in the four-year policy evaluation stage.

3.3 Data sources and sorting standards

All core research data for policy analysis are official institutional annual work reports submitted by each town and community medical institution to the tertiary lead hospital from 2021 to 2024, without individual patient clinical biological test records or post-intervention population repeated survey data. Pre-reform cross-sectional cohort data only serve as background supplementary materials to explain the necessity of reform, and are not included in the core analytical dataset. Two independent researchers completed double sorting and thematic coding of all annual alliance work reports; inconsistent classification records were cross-verified against original official files issued by the district health bureau for correction. Thematic qualitative analysis is adopted to extract core policy innovation points, cross-department operation mechanisms and reform bottlenecks from institutional archives. All analysis focuses on institutional governance logic rather than comparing changes in population clinical

indicators before and after reform.

3.4 Ethical approval statement

This policy research involves two types of data collection work that obtained ethical approval: pre-reform population cross-sectional screening and institutional policy archive sorting. All residents participating in cohort screening signed written informed consent before testing and questionnaire filling. The research protocol covering archive sorting and baseline population survey was reviewed and formally approved by the Institutional Review Board of The Eighth Affiliated Hospital, Southern Medical University (Approval No.20211103), and all survey and archive sorting procedures fully comply with the Declaration of Helsinki ethical standards.

4 Core policy implementation outcomes

Prior to the full rollout of the four-dimensional SDM-PCA governance system across Shunde District, two categories of pre-reform baseline work were finished to lay the foundation for subsequent policy implementation. On the institutional side, the district health bureau carried out systematic pre-construction preparation: targeted tiered training covering 310 grassroots core medical staff (100 diabetes physicians, 150 specialist nurses and 60 clinical pharmacists) was completed in advance; a dedicated district-wide blood glucose quality control center was formally set up to take charge of cross-hospital coordination and regular service quality supervision. In terms of grassroots hardware layout, the government completed the construction of 18 standardized diabetes clinics and 2 special multimorbidity service stations covering all towns and community medical outlets, realizing full territorial coverage of dedicated chronic disease service venues. Meanwhile, the Speed-Shunde cross-sectional cohort project finished full-population chronic disease screening across all 10 administrative towns in the district and formed a systematic baseline prevalence report; all participants identified with diabetes, prediabetes or hypertension in the screening were registered into standardized electronic health records and incorporated into national basic public health chronic disease management led by grassroots family physician teams.

After four consecutive years of full-district policy promotion up to 31 December 2024, the whole set of four-dimensional governance supporting facilities and institutional operation mechanisms achieved full official operation. The unified regional diabetes intelligent management platform was completely launched and put into daily service, incorporating all 95,925 registered diabetic residents in the district and supporting synchronous real-time blood glucose monitoring for inpatients of all medical tiers. Supported by the digital system, the district’s three-tier standardized two-way referral mechanism entered formal full-cycle operation. Aggregated statistics extracted from four years of official alliance annual work reports showed obvious optimization of referral efficiency: the annual total referral volume increased by more than 25%, upward referrals to tertiary hospitals rose by 18%, and follow-up downward referrals to community institutions grew by 12, with the overall comprehensive referral efficiency improved by 27%. The platform’s visualized patient risk zoning function can dynamically display real-time regional patient distribution and the execution progress of tiered care, providing data support for the district health authority to build regional precise chronic disease risk prediction models.

A series of standardized population management indicators recorded in official annual archives saw statistically significant overall upgrades before and after policy implementation (see Table 1). The standardized diabetes management rate grew from 58.1% to 82.0%, and the population HbA1c control rate below 7% rose from 45.2% to 67.0%; resident diabetes awareness rate increased from 36.5% to 55.8%. Meanwhile, two key hardware coverage indicators reached full coverage from zero: standardized diabetes clinic coverage rate and in-hospital unified blood glucose monitoring coverage rate both hit 100%, reflecting the complete realization of standardized grassroots service layout brought by the policy reform.

Table 1 Implementation indicators of the four-dimensional integrated medical-prevention alliance model

Indicator	Baseline	Post-intervention	P-value
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Standardized diabetes management rate	58.1%	82.0%	0.000
Population HbA1c control rate (<7%)	45.2%	67.0%	0.000
Standardized diabetes clinic coverage rate	0%	100%	—
In-hospital standardized blood glucose monitoring coverage rate	0%	100%	—
Resident diabetes awareness rate	36.5%	55.8%	0.000

Table note: All indicators extracted from official 2021–2024 SDM-PCA annual work reports; percentages retained to one decimal place; statistical tests based on aggregated population data.

Narrative medicine was embedded as a standardized auxiliary humanistic supporting measure within the whole governance system. Self-designed adolescent narrative picture books were uniformly distributed to all grassroots family physician teams for routine adolescent diabetes communication work. It should be clarified that this study only positions narrative intervention as supplementary policy support, and independent separated quantitative follow-up data targeting adolescent subgroups were not collected in the four-year archive sorting and policy evaluation work, so targeted efficacy analysis for adolescent groups cannot be carried out separately..

5 Discussion

5.1 Theoretical Innovation and Public Health Practical Value

The government-coordinated four-dimensional SDM-PCA framework delivers dual merits of localized theoretical innovation and actionable real-world practice. The institutional dimension resolves loose collaboration and weak policy enforcement inherent to traditional hospital-led medical alliances via multi-tier cross-sector governance; top-down government coordination transforms fragmented single-discipline cooperation into integrated government-hospital-community systems, consolidating scattered medical-prevention resources. The technical dimension dismantles cross-hospital information silos via a unified digital platform, shifting diabetes management from experience-based manual workflows to data-driven population standardized governance. Real-time AI risk alert and visualized triage

maps optimize medical resource allocation, and the 27% efficiency growth of two-way referrals quantitatively verifies the core driving role of digital public health in chronic disease reform. The capacity dimension addresses grassroots workforce and hardware shortages via systematic training and full-coverage standardized clinics, narrowing the service gap between tertiary and community facilities and verifying the effectiveness of primary care equalization strategies. The humanity dimension innovatively introduces narrative medicine as an auxiliary tool to break the limits of single biomedical care and advance biopsychosocial holistic care.

5.2 Globally Generalizable Practical Insights

The SDM-PCA model generates transferable public health experience applicable to all countries suffering fragmented diabetes services and insufficient primary care capacity, and each experience can be decomposed into specific operable transformation steps for different types of regional health systems.

1. Dynamic red-yellow-green risk triage system: Many high-income and middle-income countries still adopt static patient classification standards based on past medical records, which cannot reflect real-time changes in patients' glycemic and complication status, leading to overcrowding of tertiary hospitals with mild patients and delayed treatment of critical cases. The dynamic triage mechanism developed in this study adjusts patient allocation according to real-time monitoring data from digital platforms, which can be independently transplanted without relying on complete four-dimensional frameworks. For LMICs with limited informatization funds, simplified paper-based monthly risk reclassification forms can be designed to realize low-cost dynamic management and reduce unnecessary tertiary hospital visits to release resources for critical complex diabetic cases. Relevant cross-national research from Southeast Asian countries has confirmed that static classification systems increase the overall medical burden of the population by approximately 18% compared with dynamic risk management ^[13].

2. Cross-department government collaborative governance: Most LMICs separate health administration and medical insurance management into independent departments without regular joint working mechanisms, resulting in inconsistent policy orientation between disease prevention and medical reimbursement. The multi-department linkage model of this study provides a replicable institutional template. Local health bureaus and insurance institutions can sign annual cooperation memorandums without large fiscal input to jointly formulate chronic disease incentive reimbursement rules. A national retrospective cohort study from South Korea verified that joint health-insurance incentive programs can effectively reduce the incidence of diabetic microvascular complications within three years, which provides international evidence for the universality of multi-stakeholder co-governance ^[14]. For extremely underdeveloped regions lacking complete civil affairs departments, local non-governmental organizations engaged in elderly care and chronic disease services can be incorporated into the collaborative system to make up for insufficient government functional departments and expand grassroots service coverage.
3. Data-driven population chronic disease governance: Complete local server platforms with high construction costs are not suitable for resource-limited regions. The core functional modules (risk early warning, referral management) of the digital system in this study can be split and migrated to low-cost cloud mobile terminal programs, which only require basic mobile phone equipment for grassroots doctors to complete daily data entry and patient risk query, reducing construction and maintenance expenditure by more than 60% compared with local servers. Such lightweight digital transformation schemes have been widely piloted in African primary health projects and achieved good follow-up management effects, which can be matched with the four-dimensional simplified model proposed in this paper for joint promotion.
4. Low-cost humanistic auxiliary intervention: Unlike imported overseas psychological intervention courses that require professional psychological

counselors, the narrative picture book and standardized communication training system designed in this study only rely on grassroots general practitioners and nurses to carry out implementation without additional professional staffing costs. The intervention materials can be independently printed and produced by local health departments at low cost, which is highly compatible with the resource endowment characteristics of most LMICs to improve patient medication adherence and active screening willingness.

5. Standardized primary care outlet construction: A common problem in global grassroots medical systems is the large gap in diagnosis and treatment conditions between urban and community medical points, leading to unequal access to diabetes screening services. The unified construction standard of grassroots diabetes clinics summarized in this study can be adjusted according to local equipment budget; core inspection equipment such as blood glucose meters and nerve screening devices can be prioritized for configuration, while non-essential auxiliary equipment can be temporarily reserved, realizing hierarchical construction of grassroots service points and gradually narrowing the urban-rural medical quality gap, which forms a long-term equalization reform path with strong global scalability.

5.3 Comparative Analysis with Domestic and International Diabetes Management Models

5.3.1 Comparison with Traditional Domestic County-Level Chronic Disease Frameworks

Compared with scattered, single-link county chronic disease reform projects widely adopted in domestic counties, the SDM-PCA alliance constructs a complete systematic policy framework, which can be generalized into three pioneering institutional breakthroughs, three transformative governance shifts and five unified standardized policy norms.

Three pioneering institutional breakthroughs: This reform establishes the first district-wide integrated diabetes governance system led by administrative government departments; it creates the first full-population dynamic risk stratification mechanism driven by tertiary hospitals covering all registered diabetic residents in the jurisdiction; it launches the first district-level quality control center to conduct unified supervision over red-yellow-green tiered service standards of all grassroots medical institutions within the region.

Three transformative governance shifts: The service model evolves from fragmented isolated disease treatment to full-cycle population-oriented chronic disease governance; management logic shifts from rigid one-size-fits-all uniform standards to data-supported personalized precise service deployment; the operation mechanism changes from sole financial fiscal input to multi-stakeholder joint participation including government, medical institutions and social organizations.

Five unified standardized policy norms: Unified grassroots diabetes clinical service specifications; unified configuration standards for complication screening equipment; unified catalog of hypoglycemic medicines and medical supplies; unified grassroots follow-up and two-way referral workflow rules; unified construction standards for standardized diabetes clinics at town and community levels.

Unlike static patient classification mechanisms adopted by most traditional county medical alliances, the dynamic red-yellow-green triage rule under this policy framework relies on real-time data from the regional digital platform to dynamically adjust grassroots service allocation logic, which fits the progressive, heterogeneous disease characteristics of diabetic patients reflected in the pre-reform population baseline survey. According to the annual institutional archives of the alliance, grassroots medical institutions achieved a prominent increase in patient reception volume after the full rollout of the four-dimensional policy system, proving that the tiered diversion mechanism formulated by government policy can effectively guide reasonable hierarchical medical access. Driven by the cross-department coordination policy and unified quality control supervision system, the linkage mechanism of

pre-disease screening and clinical treatment was fully implemented at the grassroots level. The resident diabetes awareness indicator recorded in official institutional annual reports rose from 36.5% to 55.8%, which fully demonstrates the synergy effect brought by integrated medical-prevention policy design. Relying on binding multi-sector policy documents issued by the district government, the reform introduced supplementary commercial medical insurance and community volunteer service mechanisms into the whole governance system, forming a sustainable long-term institutional guarantee for county chronic disease management.

This study does not carry out horizontal comparative analysis with chronic disease governance models of other counties in Guangdong Province, due to the lack of consistent baseline institutional files and synchronized four-year reform archival data from other regional medical alliances for standardized policy comparison.

5.3 Comparative Analysis with Domestic and International Diabetes Management Models

5.3.2 Comparison with International Integrated Care Frameworks

Integrated care has been widely acknowledged as an effective solution to address fragmentation between inpatient acute diabetes management and long-term community-based chronic disease care. Ghiyasvandian et al. constructed a theoretical framework describing smooth care transition from acute to chronic stages under the integrated care model, yet their research only stays at the theoretical level without matching digital tiered monitoring tools and targeted primary care workforce cultivation schemes^[15]. In the present study, a tri-color risk zoning module is embedded in the regional diabetes medical-prevention collaborative alliance platform, which works synergistically with the Three Lead Practitioners Training Program. The combination builds a closed-loop tiered referral system that realizes seamless acute-to-chronic diabetes governance, effectively filling the practical gaps identified in the aforementioned theoretical research.

Apart from theoretical explorations, European countries have accumulated abundant practical experience in rolling out standardized integrated care pathways. Gambale et al. documented the full-scale implementation of integrated care

workflows across Italy, where the whole operation mechanism mainly depends on hierarchical medical insurance reimbursement as the core incentive^[16]. Different from the insurance-driven European model, the four-dimensional integrated diabetes care model constructed in this study takes grassroots medical capacity improvement as the core breakthrough. The dual-track training mode dominated by centralized teaching and supplemented by on-site grassroots outreach systematically cultivates matched physician, nurse and pharmacist teams at primary level. This workforce-centered construction path provides a localized replicable reference for county-level chronic disease management in regions with underdeveloped hierarchical medical reimbursement systems.

Domestic scholars have also explored collaborative community diabetes management from innovative theoretical perspectives. Niu et al. put forward a multi-stakeholder collaborative governance framework for community diabetes management based on value co-creation theory, which clarifies the interactive relationship between tertiary hospitals, grassroots institutions and diabetic patients^[17]. However, the existing theoretical framework lacks operable supporting facilities, including standardized talent training systems and full-process digital supervision platforms. This study innovatively proposes a four-dimensional integrated framework covering System Dimension, Technology Dimension, Capacity Dimension and Humanity Dimension. The system dimension relies on zone-based management and tiered medical teams to clarify governance responsibilities; the technology dimension realizes dynamic patient risk classification and real-time service data visualization via the regional diabetes information platform; the capacity dimension improves grassroots clinical competency through the standardized training project for three types of lead practitioners; the humanity dimension introduces narrative medicine to strengthen psychological intervention and patient self-management support.

Supported by the intelligent platform's multi-source data, the service performance of grassroots core practitioners can be quantified and dynamically tracked, while narrative medical practice complements pure technical treatment by

focusing on patients' holistic life experience. The four-dimensional system transforms the abstract value co-creation theory into a complete, operable diabetes service model, forming a closed loop of institutional governance, digital empowerment, talent cultivation and humanistic care. Compared with overseas integrated care models and domestic theoretical frameworks, this research realizes multi-dimensional systematic innovation in county-level chronic disease integrated management, and offers actionable experience for similar regional medical alliance construction in China.

Beyond the above domestic and international integrated care explorations, two globally recognized classical chronic care frameworks, the American Chronic Care Model (CCM) and European Integrated Care Pathways (ICPs), only provide theoretical guidance frameworks, while SDM-PCA constitutes a complete operable regional public health intervention scheme without feasible direct quantitative comparison. ICPs share the multi-discipline teamwork concept of this research but lack AI-enabled dynamic risk adjustment modules; the CCM prioritizes proactive primary care teams and patient activation, which aligns with the capacity-building dimension of this study, yet SDM-PCA innovatively adds data-driven real-time population monitoring functions. For LMICs, the "core standards and localized simplification" adaptation strategy of SDM-PCA is more operable than full replication of high-investment CCM/ICP systems. Although complete deployment of the full platform and expert team requires large upfront fiscal investment, the core logics of cross-institutional integration, multi-sector coordination and continuous quality improvement are globally transferable. Regions can selectively adopt partial modules according to local resource endowments to improve HbA1c control, grassroots retention and economic benefits. Published research from Cambodia evaluating fragmented single-module interventions recorded extremely low implementation scores across six dimensions; by contrast, the full four-dimensional integration of SDM-PCA yielded a 67% HbA1c control rate, 78% primary retention and 100% clinic coverage, reflecting substantially superior intervention performance

5.4 Model Generalizability, Limitations and Targeted Optimization Solutions

5.4.1 Transferable Core Universal Principles

Three replicable foundational construction rules are concluded from the four-year quasi-experiment, which can be used as core reform reference standards for county health bureaus across all regions of China. First, top-down unified government administrative leadership must be taken as the primary institutional guarantee to break the fragmented interest pattern between independent medical institutions. Second, the integrated four-dimensional service system covering policy, informatization, talent and humanistic support is the complete solution to solve the four major bottlenecks of grassroots diabetes management summarized in the introduction. Third, digital dynamic risk stratification should be taken as the core technical carrier to realize refined population management rather than relying on manual paper records. Localized adaptive transformation practices have been carried out in Guangxi Zhuang Autonomous Region since 2023. Relying on cooperation with local medical universities, a targeted training plan for rural diabetes nurses was launched, with a total of 120 grassroots backbones receiving systematic standardized training within one year, which significantly improved the diabetes diagnosis and treatment capacity of township health centers in remote mountainous areas and verified the transplantability of the core capacity construction module of this model.

5.4.2 Model Limitations and Targeted Optimization Solutions

1. Uneven regional resource endowments: Shunde belongs to an economically developed Pearl River Delta district with sufficient public health fiscal investment and complete tertiary hospital specialist teams, while underdeveloped counties generally face capital shortages and insufficient diabetes professionals. Optimization: Adopt public-private partnership (PPP) modes to share construction costs; deploy low-cost cloud-based digital platforms to replace on-premises server infrastructure and reduce operation and maintenance expenditure.

2. Incomplete long-term incentive frameworks: Although tiered differentiated medical insurance reimbursement policies have been rolled out, targeted incentive schemes for grassroots staff performance assessment and cross-hospital referral compensation remain underdeveloped. Reliance solely on administrative mandates creates risks of short-term implementation decay. Proposed improvement: Directly link primary care performance bonuses to annual HbA1c compliance rates of contracted patients; allocate a fixed 50 USD subsidy per completed tertiary-to-community downward referral to boost inter-facility collaboration willingness.
3. Insufficient multi-dimensional data mining functions: The current platform only collects glycemic and referral data without seamless docking with wearable device diet, exercise and sleep monitoring data, restricting the development of precise individualized intervention schemes. Future improvement direction: Integrate smart watch wearable monitoring data to expand long-term lifestyle tracking indicators and strengthen personalized risk early warning algorithms.
4. Barriers to cross-regional replication: Full deployment of the SDM-PCA framework requires large upfront fiscal investment in platforms and clinics; rural areas lack complete three-lead professional teams; the whole system relies on mature information technology infrastructure and top-down government policy support. In addition, low resident health literacy in partial regions reduces acceptance of narrative medicine and new standardized management modes. Corresponding adaptive strategies: Cooperate with medical universities to build rural diabetes specialist training bases; issue mandatory provincial-level policies supporting regional diabetes alliance construction; launch large-scale regular community health education lectures to raise public recognition of integrated chronic disease governance.

Health Economic Cost-Benefit Analysis

The total construction investment of the regional intelligent platform reached 428,600 USD. The government issued special subsidies of 28,600 USD for each

town-level standardized clinic and 14,200 USD for each community clinic, with a total of 18 grassroots clinics built across the district. Combined with four-year systematic training expenditure for 310 core medical staff, the total cumulative government fiscal expenditure for the four-year intervention project was calculated at approximately 1.12 million USD. Covering all 95,925 registered diabetic residents in Shunde District, the average per capita public fiscal investment over four years was roughly 11.7 USD per patient. Compared with the average annual per capita medical expenditure of 1,200 USD for diabetic residents within the district after model implementation, the government's upfront public health investment generated long-term savings in individual medical expenses, demonstrating favorable population-wide cost-effectiveness for diabetes control. This set of cost accounting indicators can provide clear fiscal budget reference for other counties planning to build similar medical-prevention alliances, enabling local health and finance departments to formulate multi-year staged investment plans according to their resident population scale.

6 Future Perspectives

6.1 Deep Mining of Multi-Dimensional Data and Intelligent Auxiliary Decision-Making

Subsequent research will focus on constructing regional precise diabetes risk prediction models and full-process AI auxiliary clinical decision support systems. Relying on standardized data collection, storage and big data analytical capacity, the platform can provide macro policy decision support for regional health administrative departments by regularly outputting population glycemic control trend reports, grassroots service capacity evaluation reports and high-risk patient distribution maps. Further research will explore seamless data fusion technology between public health population screening databases and hospital electronic medical record systems, completely breaking the remaining partial data barriers between preventive and clinical services, and comprehensively strengthen full-cycle diabetes prevention, treatment, rehabilitation and scientific research capacity at the district level. Such

integrated big data analysis functions can further optimize the existing four-dimensional model and form a more intelligent upgraded version suitable for the next five years of chronic disease governance work in Shunde District.

6.2 Expansion of Cross-Regional Multicenter Collaborative Research

It is proposed to construct a Guangdong-Hong Kong-Macao Greater Bay Area Key Laboratory for Integrated Diabetes Management relying on the abundant concentrated medical resources, high-level scientific research teams and unique regional policy advantages of the Greater Bay Area.

The laboratory will carry out interdisciplinary collaborative innovation covering public health management, endocrinology, digital medicine and narrative medical humanities.

Core long-term research directions include the epidemiological mechanism of diabetes in densely populated urban agglomerations, research and development of new hypoglycemic drugs suitable for Chinese residents, and multi-organ diabetic complication rehabilitation technology systems.

The multi-center research data generated by the laboratory can further verify the generalizability of the SDM-PCA four-dimensional model across different urban and rural regions of the Greater Bay Area, and provide national-level scientific and technical support for county-level diabetes prevention and control reform.

6.3 Optimization of Multi-Tier Medical Insurance Coordination Mechanisms

Tiered medical insurance reimbursement standards will be dynamically adjusted every two years according to regional annual chronic disease burden monitoring data and medical resource supply-demand balance conditions, forming a dynamic complementary linkage mechanism between basic medical insurance and commercial supplementary medical insurance to continuously reduce patients' out-of-pocket medical expenditure burden.

The district health bureau will cooperate with insurance companies to expand the coverage target of supplementary commercial medical insurance to 50% of all

registered diabetic patients by the end of 2026. At the same time, value-oriented medical payment reform will be comprehensively promoted across all medical institutions within the alliance, changing the original settlement standard based on outpatient and inpatient service volume to a performance settlement benchmark linked to long-term population HbA1c control rates, standardized management rates and two-way referral completion quality, so as to guide all medical institutions to shift from passive service volume pursuit to active population chronic disease management.

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Ethics approval and consent to participate

Two parts of work in this study obtained formal ethical approval from the Institutional Review Board of The Eighth Affiliated Hospital, Southern Medical University (Approval No. 20211103): (1) Pre-reform cross-sectional population cohort screening, all participants signed written informed consent before data collection; (2) Sorting of four-year institutional official archives, no human biological samples or private identifiable information were collected. All survey and archive sorting procedures fully comply with the Declaration of Helsinki.

Consent for publication

No identifiable individual patient data, clinical test results or private personal information are contained in this manuscript; consent for publication is not applicable.

Availability of data and materials

Official four-year complete annual work reports of the SDM-PCA alliance can be obtained from the corresponding author upon formal written request. Full English versions of self-designed institutional baseline questionnaires and adolescent narrative picture books are uploaded as Supplementary File 1 and 2. The WHO Chronic Disease Risk Factor Survey used in pre-reform population screening can be accessed via WHO official open resource libraries as cited in the text. Pre-reform aggregate cohort prevalence data are presented in the manuscript, while raw individual screening data will not be disclosed to protect resident privacy.

Competing interests

The authors declare no competing financial or non-financial interests.

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Authors' contributions

ZL,JS,HYZ conceived the overall research framework;YPX,FYZ organized grassroots baseline surveys; PZ conducted statistical analyse and sorted literatures and revised the manuscript.

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Corresponding author Jie Shen's research focuses on county-level integrated chronic disease governance, digital public health and narrative medical humanistic intervention research.

List of Abbreviations

SDM-PCA: Shunde Diabetes Medical-Prevention Collaborative Alliance HbA1c: Glycated hemoglobin A1c LMICs: Low- and middle-income countries ROBINS-I: Risk Of Bias In Non-randomized Studies of Interventions CCM: Chronic Care Model ICPs: Integrated Care Pathway