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RESEARCH ARTICLE

Title: SWOT Analysis of Community Elderly Health Examination Models and Health Smart Station Models in Shanghai (Optimized English Version)

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Abstract: With the accelerating global aging process, innovative community health service models have become a key issue in improving the health management of the elderly. Based on the "Notice on Further Improving Health Management Services for the Elderly in Shanghai" (2024) issued by the Shanghai Municipal Health Commission, this study systematically compares the strengths and weaknesses of traditional health examination models and health smart station (health kiosk) models, incorporating policy context and empirical data. Applying the SWOT （Strength， Weakness，Opportunity，Threat） analysis framework, the research finds that traditional models have significant advantages in policy implementation and resource integration but face limitations such as service homogenization and lagging informatization. The smart station model compensates for the shortcomings of traditional models with its technological advancement and service flexibility, but high operational costs and the digital divide among the elderly remain urgent issues to address. The study proposes promoting the deep integration of the two models through the construction of data-sharing platforms, family doctor collaboration mechanisms, and policy optimization. The research is presented from three perspectives: theoretical construction, practical cases, and policy recommendations, providing systematic references for health management in an aging society.

Keywords: Community elderly; health examination; health smart station; SWOT analysis; integration of medical and preventive care

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1. Introduction

Globally, population aging has become an irreversible social trend. United Nations data show that by 2050, the proportion of the global population aged 60 and above will reach 22%, with China's elderly population expected to exceed 480 million, accounting for 39% of the total population (United Nations, 2020). As the city with the highest aging rate in China (36. 1% in 2023), Shanghai's innovative practices in community health service models hold significant exemplary value. In 2024, the Shanghai Municipal Health Commission issued the "Notice on Further Improving Health Management Services for the Elderly in Shanghai" (hereinafter referred to as the "Notice"), explicitly proposing the integration of traditional examinations with smart technologies and the goals of "digital empowerment" and "integration of medical and preventive care" [1]. Against this backdrop, innovation in community health service models has become a key strategy to address the challenges of aging. Traditional health examination models and emerging health smart station (health kiosk) models each have unique characteristics. How to leverage their respective strengths, address their weaknesses, and achieve complementary advantages and resource integration are pressing issues to resolve. This study employs the SWOT analysis method to systematically compare the strengths, weaknesses, opportunities, and threats of the two models. Combining international experience and local practices, it proposes collaborative development pathways, aiming to provide theoretical support and practical guidance for the implementation of the "Healthy China" strategy [2]. The

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theoretical significance of this study is in enriching the theoretical system of community elderly health management and expanding the application of SWOT analysis in the health service field. Its practical significance is in providing evidence-based decision-making references for policymakers and operationable implementation pathways for community health service institutions. The research results hold significant value for optimizing elderly health management services, improving health service efficiency, and promoting the integration of medical and preventive care [3].

2. Literature Review and Theoretical Framework

2.1 Theoretical Basis of Community Health Service Models

The theoretical construction of community health service models should be based on Health Promotion Theory and the Chronic Care Model. Health Promotion Theory emphasizes improving health levels through environmental support and individual behavioral interventions, while the Chronic Care Model focuses on the integration of medical resources and the cultivation of patients' self-management abilities. The Community-Based Care Process Model (CBCPM) proposed by Galof and Balantič (2021) further emphasizes the autonomy and participation of the elderly in health management, providing important theoretical support for this study [4].

2.2 Research Progress at Home and Abroad

2.2.1 Research on Traditional Health Examination Models

The traditional health examination model centers on community health service centers, achieving basic health screening through annual examinations and data archiving. Research shows that this model has significant advantages in reducing medical costs and improving service coverage. However, its limitations have also been widely discussed, such as low service frequency, outdated technical methods, and data silos. For example, a survey in a Beijing community found that only 30% of the elderly were satisfied with the personalized services of traditional examinations [5].

2.2.2 Innovative Practices of Health Smart Station Models

The smart station model relies on IoT, big data, and AI technologies to achieve real-time health monitoring and personalized services [6]. A study by Qin Yan on 212 smart health stations in a city found that this model has clear advantages in service diversity and technological advancement but also faces challenges such as high operational costs and low acceptance among the elderly [7]. Internationally, Singapore's "HealthHub" project significantly improved chronic disease management efficiency by integrating wearable devices and family doctor systems. Domestically [8], pilot projects like Hangzhou's "Smart Health Kiosk" increased the blood glucose control compliance rate of diabetic patients by 18% through dynamic blood pressure monitoring and AI-assisted diagnosis.

2.3 Policy Context and Shanghai Practices

The issuance of the "Notice" by Shanghai marks the policy-level emphasis on innovation in health service models. The "Notice" not only requires "standardized implementation of elderly health examinations" but also emphasizes "promoting digital empowerment" and "integrating medical and elderly care". The "Shanghai Basic Elderly Care Service List" further clarifies the service content and standards for elderly health management, providing a policy foundation for the collaborative development of the two models. For example, Xuhui District achieved cross-institutional sharing of health data through the linkage of smart stations and community health service centers, with a coverage rate of 82%. This practice provides replicable experience for other cities nationwide[9].

3. Research Methods and Data Sources

3.1 Research Design

This study adopts a mixed-methods approach, combining quantitative analysis and qualitative research:

(1) Literature analysis: Systematically reviewing domestic and international research, focusing on policy documents and technical reports to construct a theoretical framework.

(2) SWOT analysis framework: Comparing the two models from four dimensions—internal strengths, weaknesses, external opportunities, and threats.

(3) Case study method: Selecting practical cases from typical areas in Shanghai to analyze their implementation effects and lessons learned.

3.2 Data Collection

(1) Policy documents: Including the "Notice on Further Improving Health Management Services for the Elderly in Shanghai" and its annexes, the "Shanghai Basic Elderly Care Service List (2023 Edition)," and the "Shanghai Healthy Aging Action Plan (2022-2025) [10]."

(2) Technical parameters: Data on equipment usage in smart stations and health record sharing rates from the Shanghai Health Information Platform and annual reports of district health commissions [11].

(3) International experience: Collecting international experiences such as Japan's "Long-term Care Prevention" model, the U.S. PACE program, and Germany's long-term care insurance model through literature searches and international cooperation projects [12].

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3.3 Analysis Methods

(1) Descriptive statistical analysis: Conducting statistical analysis on indicators such as coverage rates, service frequency, and user satisfaction for the two models.

(2) Comparative analysis: Systematically comparing the performance of the two models across different dimensions to identify differences and complementary points.

(3) Content analysis: Coding and extracting themes from policy documents and case materials to summarize policy directions and practical experiences [13].

4. SWOT Analysis of Traditional Health Examination Models

4.1 Strengths

4.1.1 High Policy Implementation Efficienc

The "Notice" explicitly includes elderly health examinations in the basic public health service assessment system, requiring "coverage of $\geqslant$ 90% for permanent residents aged 65 and above"

The traditional model relies on a mature community health service system, with clear policy implementation paths and high efficiency. For example, Xuhui District achieved a coverage rate of 98% in 2023 through multi-department collaboration, far exceeding the national standard.

4.1.2 Centralized Medical Resources

The traditional model relies on community health service centers, integrating general practitioners, nurses, and testing equipment to form standardized service processes. The strong professional backgrounds of medical staff ensure service quality. For example, the blood pressure measurement error rate in a Jing'an District center was controlled within 3%, significantly better than home self-testing devices [14].

4.1.3 High Social Trust

The endorsement of public medical institutions gives the elderly high trust in examination results. Surveys show that 85% of respondents consider traditional examinations "authoritative and reliable". This trust foundation helps improve participation and compliance among the elderly.

4.2 Weaknesses

4.2.1 Homogenized Service Content

Basic examination items account for over 70%, while tumor marker screening coverage is only 12%. Severe service homogenization makes it difficult to meet the diverse health needs of the elderly.

4.2.2 Lack of Dynamic Health Management

Annual single examinations cannot meet the continuous management needs of chronic disease patients. For example, diabetic patients receive only one blood glucose test per year, making it ineffective for monitoring daily fluctuations. The lack of dynamic monitoring mechanisms reduces the effectiveness of health management.

4.2.3 Low Informatization Level

Only 35% of communities achieve cross-institutional sharing of health records, and data silos lead to repeated examinations and resource waste. Lagging informatization construction hinders improvements in service efficiency and resource optimization.

4.3 Opportunities

4.3.1 Potential for Digital Transformation

The "digital empowerment" policy proposed in the "Notice" supports technological upgrades. For example, Tencent's AI fundus screening system has been piloted in some communities, achieving an accuracy rate of 92%. Digital transformation will significantly improve the service efficiency and quality of traditional models.

4.3.2 Policy Synergy Effects

Shanghai is promoting the construction of "community health service center health management centers," with a 20% increase in the 2024 fiscal budget for equipment procurement and staff training. Policy support provides resource guarantees for upgrading traditional models.

4.4 Threats

4.4.1 Diversion Effect of Smart Stations

High-income elderly groups are more inclined to choose personalized services. Among smart station users in Pudong New Area, 65% have a monthly income exceeding 8,000 yuan. User diversion may lead to a homogenized service target structure for traditional models.

4.4.2 Uneven Allocation of Grassroots Resources

The doctor-to-patient ratio in suburban communities is only 1:2500, making it difficult to meet the "annual examination without missing" target required by the "Notice". Uneven resource allocation restricts the service quality and coverage of traditional models.

5. SWOT Analysis of Health Smart Station Models

5.1 Strengths

5.1.1 Diversified Service Scenarios

The smart station model supports "bedside examinations," providing portable ultrasound and ECG tests for bedridden elderly. In Yangpu District pilots, 90% of bedridden elderly found the service "convenient". Diversified service scenarios significantly improve accessibility, especially for the mobility-impaired elderly.

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5.1.2 Real-Time Health Monitoring Capability

Dynamic blood pressure and glucose device data can be synchronized in real-time with family doctor systems, with abnormal data response times under 2 hours. Real-time monitoring helps detect health risks early, improving intervention timeliness and effectiveness.

5.1.3 Cross-Institutional Data Integration Efficiency

Using ID numbers as unique identifiers, health data from tertiary hospitals, communities, and elderly care institutions are aggregated. In Changning District, the data sharing rate reached 82%, significantly reducing repeated examination rates. Data integration enhances the continuity and synergy of health management.

5.2 Weaknesses

5.2.1 High Operational Cost Pressure

The annual maintenance cost for a single smart station exceeds 50,000 yuan, with 70% relying on government subsidies, raising sustainability concerns. High costs hinder large-scale promotion and long-term operation of the model.

5.2.2 Prominent Digital Divide Issue

60% of the elderly require family assistance to operate smart devices. A Huangpu District user survey showed that only 40% of the elderly could independently complete basic operations. The digital divide limits service popularization and effective use.

5.2.3 Incomplete Referral Mechanisms

Only 40% of stations have established green channels with tertiary hospitals. In Hongkou District, a delayed referral led to the deterioration of a diabetic patient's condition. Incomplete referral mechanisms hinder timely intervention for health risks.

5.3 Opportunities

5.3.1 Release of Policy Dividends

The "Notice" encourages "adding recommended examination items" and supports the introduction of high-end equipment. For example, United Imaging's AI bone densitometer has been piloted in Putuo District, improving detection efficiency by 50%. Policy support provides space for technological innovation.

5.3.2 Deepening of Medical-Elderly Care Integration

Embedding services in elderly care institutions to provide "health management + rehabilitation care." In Putuo District's "station-care integration" pilot, chronic disease control rates among

institutionalized elderly increased by 25%. Medical-elderly care integration expands service boundaries and enhances comprehensive benefits.

5.4 Threats

5.4.1 Rapid Technological Iteration

The update cycle for wearable devices has shortened to 1.5 years, increasing equipment replacement costs. Compatibility issues with a brand of smartwatches led to data loss in 2023. Accelerated technological iteration brings challenges in equipment updates and data compatibility.

5.4.2 Privacy Leakage Risks

Centralized storage of health data may violate the "Personal Information Protection Law." In 2023, a station was fined 500,000 yuan for data leakage. Data security and privacy protection have become significant constraints on model development.

6. Collaborative Pathways and Policy Recommendations

6.1 Building a Data-Sharing Platform

6.1.1 Municipal Health Data Cloud Platform

Referencing the "Basic Content of Residents' Electronic Health Record Homepage (Trial)," unify data standards and interface protocols to achieve interoperability among community, hospital, and station data. It is recommended to use blockchain technology to ensure data security and API interfaces for multi-system connectivity, addressing data silo issues.

6.1.2 Core Role of Family Doctors

Empower family doctors with data management authority to integrate examination reports and dynamic monitoring data, formulating personalized intervention plans. WHO research shows that family doctor-led health management can reduce chronic disease complication rates by 30%. It is recommended to link family doctor contracting services with smart station usage, forming a "contracting-monitoring-intervention" closed loop.

6.2 Age-Friendly Technological Adaptations

6.2.1 Optimized Operation Interfaces

Adopt voice interaction, large-font designs, and one-click call functions (referencing Huawei Health App's age-friendly version). It is recommended to develop elderly-specific operation interfaces to lower usage barriers and improve acceptance.

6.2.2 Community Training System Construction

Establish a "health ambassador" volunteer team to conduct regular training on smart device usage. Minhang District's "Silver Age School" project increased independent operation rates among the elderly from 20% to 65% (Shanghai Municipal Health Commission, 2023). It is recommended to incorporate training into regular community activities, forming a long-term mechanism.

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6.3 Improving Policy Support Measures

6.3.1 Inclusion in Medical Insurance Coverage

Include some smart station services (e.g., chronic disease dynamic monitoring) in the medical insurance reimbursement catalog to reduce the financial burden on the elderly. Research shows that medical insurance coverage can increase service utilization by 40% (Li Su and Su Zhen, 2021). It is recommended to adopt a differentiated payment strategy of "full coverage for basic items and partial reimbursement for other items."

6.3.2 Legislative Protection of Data Security

Formulate the "Shanghai Community Health Data Management Regulations," clarifying data ownership, usage permissions, and leakage accountability mechanisms (Shanghai Municipal Health Commission, 2024). It is recommended to establish a health data ethics committee to standardize the entire process of data collection, storage, and usage.

6.4 Learning from International Experience

6.4.1 Japan's "Long-term Care Prevention" Model

Achieve early intervention in health management through collaboration between community health stations and family doctors. This model reduced hospitalization rates among Tokyo's elderly by 18%. It is recommended to introduce a prevention-oriented health management philosophy, strengthening early intervention mechanisms.

6.4.2 U.S. PACE Program

Integrate medical and elderly care services, providing full-cycle management through interdisciplinary teams. Shanghai can learn from its team collaboration mechanisms to improve service continuity (Segelman et al., 2019). It is recommended to build a "medical-rehabilitation-elderly care" integrated service model for full-cycle health management.

7. Economic and Ethical Analysis

7.1 Cost-Benefit Assessment

7.1.1 Economic Efficiency of Traditional Models

The per capita annual cost of traditional health examination models is approximately 200 yuan, but hidden costs (e.g., repeated examinations) are high. Jing'an District calculations show that data silos result in an annual waste of medical resources of about 1.2 million yuan (Shanghai Municipal Health Commission, 2023). Although traditional models have low initial investment, long-term benefits are constrained by insufficient data sharing.

7.1.2 Long-Term Benefits of Smart Stations

Despite high initial investment (per capita annual cost of 500 yuan), smart station models can recoup costs within five years by reducing hospitalization rates. Yangpu District pilot data show a 15% decline in hospitalization rates among diabetic patients, saving approximately 2 million yuan annually in medical costs (Shanghai Municipal Health Commission, 2023). In the long run, smart station models offer higher cost-benefit ratios.

7.1.3 Economic Advantages of Collaborative Models

The collaborative development of the two models can optimize resource allocation and reduce overall operational costs. For example, sharing testing equipment and human resources can lower redundant construction costs by about 30% (Shanghai Municipal Health Commission, 2023). It is recommended to adopt a differentiated pricing strategy of "basic services + value-added services" to improve economic sustainability.

7.2 Ethics and Privacy Protection

7.2.1 Informed Consent Mechanisms

Ensure the elderly fully understand data usage before using smart stations and obtain explicit authorization through simplified agreements. It is recommended to develop illustrated informed consent forms to improve understanding and participation among the elderly.

7.2.2 Data Encryption Technologies

Use blockchain technology for decentralized storage of health data to reduce leakage risks. A tech company's pilot project improved data security by 90% (Shanghai Municipal Health Commission, 2023). It is recommended to establish a multi-layered data security protection system to ensure privacy protection.

7.2.3 Equitable Access for Vulnerable Groups

Ensure low-income, elderly, and disabled groups have equitable access to health services. It is recommended to establish special subsidies and implement differentiated service strategies for vulnerable groups to avoid exacerbating health inequalities due to the digital divide.

8. Conclusion and Outlook

Traditional health examination models and health smart station models exhibit significant complementarity in service coverage, technological application, and cost-effectiveness. Through the SWOT analysis framework, this study systematically compares the strengths and weaknesses of the two models and proposes collaborative development pathways. The research finds that traditional models have advantages in policy implementation, medical resource integration, and social trust but face challenges such as service homogenization, lack of dynamic management, and lagging informatization. Smart station models excel in service diversification, real-time monitoring, and data integration but are constrained by

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high operational costs, the digital divide, and incomplete referral mechanisms.

Moving forward, the "Notice" should serve as a guiding principle to build a "policy-technology-community" trinity collaborative system: First, break down data barriers and achieve information sharing through the construction of a municipal health data cloud platform. Second, reduce usage barriers and improve elderly participation through age-friendly technological adaptations and community training. Finally, provide institutional guarantees to ensure service sustainability through policy optimization.

With the advancement of the "Healthy Shanghai 2030" strategy, the deep integration of the two models will provide replicable and scalable "Shanghai experience" for health management in an aging society. Future research could further explore cross-regional collaboration mechanisms and the application of AI in health prediction, providing theoretical and practical support for building smarter, more efficient, and more humane community health service systems.

9. Research Limitations

This study is primarily based on practical experiences in Shanghai, and regional differences should be considered when applying the findings. Additionally, as the smart station model is relatively new, long-term effectiveness evaluations require further research.

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