

Postprint: A Study on the Current Status and Outcomes of Information Technology Development in Primary-Level Healthcare Institutions in Sichuan Province

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Abstract

Background Healthcare informatization is an effective means to enhance the service capacity of primary-level medical and health institutions. Since the “Twelfth Five-Year Plan” period, Sichuan Province has attached great importance to the informatization construction of primary-level healthcare, aiming to empower primary-level management capabilities and service capacity enhancement through health information. However, there is currently a lack of research on the current status of healthcare informatization construction and application across the entire province.

Objective To summarize the current status and effectiveness of informatization construction in primary-level medical and health institutions in Sichuan Province.

Methods From May to June 2023, a stratified random sampling method was used to conduct a questionnaire survey among 143 district/county health administrative departments and 1,028 primary-level medical and health institutions across 21 prefecture-level cities in Sichuan Province. The questionnaire content covered aspects such as information personnel, information infrastructure, information systems, and information technology application. The survey questionnaire was deployed on the provincial unified primary-level health platform and was completed by personnel familiar with informatization construction from each primary-level medical and health institution.

Results Regarding personnel, 40.95% (421/1,028) of institutions had information personnel, with an average of (0.48 ± 1.12) part-time personnel and (0.25 ± 1.08) full-time personnel per institution. Primary-level medical and health institutions have completed information standard level coordinated construction pattern. In terms of system construction, the proportion configured with HIS systems

external/superior vertical systems. Regarding technology application, the electronic health record rate reached 94.93% (2,021/2,129), the overall electronic medical record usage rate reached 77.43% (796/1,028), 32.60% (1,091/3,347) of institution's Traditional Chinese Medicine (TCM) departments were connected to the Sichuan Provincial TCM Department Health Information Platform, and the proportions of institutions that achieved health record access, inter-consultation contracting, inter-consultation follow-up, and configured basic public health service terminals were 83.46% (858/1,028), 56.91% (585/1,028), 68.77% (707/1,028), and 81.91% (842/1,028), respectively, with 74.12% (762/1,028) of medical consortium institutions conducting business collaboration between superior and subordinate levels.

Conclusion Since the “Twelfth Five-Year Plan” period, the informatization construction of primary-level medical and health institutions in Sichuan Province has been generally favorable, demonstrating development trends of comprehensively consolidated infrastructure, diversified development of basic medical service functions, and coordinated integration of basic public health service functions. Informatization has gradually adapted to the development of integrated medical and health service systems, and the application of new technologies continues to expand the ecological application scenarios of primary-level health informatization.

Full Text

Abstract

Background: Health informatization is an effective means to enhance the service capacity of primary healthcare institutions. Since the 12th Five-Year Plan period, Sichuan Province has attached great importance to primary healthcare informatization construction, aiming to empower primary-level management and service capabilities through health information. However, there is currently a lack of research on the current status of health informatization construction and application across the province. **Objective:** To summarize the current status and effectiveness of information technology construction in primary healthcare institutions in Sichuan Province. **Methods:** From May to June 2023, a questionnaire survey was conducted on 143 district and county health administrative departments and 1,028 primary healthcare institutions across 21 prefecture-level cities in Sichuan Province using a stratified random sampling method. The questionnaire covered aspects including information personnel, information infrastructure, information systems, and information technology applications. The survey was deployed on the provincial unified primary healthcare platform and completed by personnel familiar with informatization construction from each institution. **Results:** Regarding personnel, 40.95% (421/1,028) of institutions had information technology staff, with an average of (0.48 ± 1.12) part-time staff and (0.25 ± 1.08) full-time staff per institution. Primary healthcare institutions have completed information standardization construction

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external/superior vertical systems. Regarding technology application, the electronic health record conversion rate reached 94.93% (2,021/2,129), and the overall electronic medical record usage rate reached 77.43% (796/1,028). Traditional Chinese Medicine (TCM) centers in 32.60% (1,091/3,347) of institutions were connected to the Sichuan Provincial TCM Center Health Information Platform. The proportions of institutions achieving health record access, consultation contracting, consultation follow-up, and basic public health service terminal configuration were 83.46% (858/1,028), 56.91% (585/1,028), 68.77% (707/1,028), and 81.91% (842/1,028), respectively. Business collaboration between higher- and lower-level institutions within medical consortia was conducted by 74.12% (762/1,028) of institutions. **Conclusion:** Since the 12th Five-Year Plan period, the overall informatization construction in primary healthcare institutions in Sichuan Province has been favorable, demonstrating development trends of comprehensive infrastructure consolidation, diversified development of basic medical service functions, and integrated coordination of basic public health service functions. Informatization has gradually adapted to the development of integrated healthcare delivery systems, with new technology applications continuously expanding the ecological application scenarios of primary healthcare informatization.

Introduction

Primary healthcare informatization forms the foundation of health informatization construction, aiming to meet the information needs of basic medical services for urban and rural residents, health record management, basic public health services, primary institution management, health information services, and medical service coordination. Primary healthcare informatization construction enhances primary-level service capacity, management capabilities, and resource allocation efficiency. Sichuan Province has prioritized primary healthcare informatization work. The 12th Five-Year Plan proposed building a “shared and open medical and health information system” following the approach of “top-level design, middle-level integration, and primary-level unification.” During the 13th Five-Year Plan period, Sichuan emphasized the standardization of primary health information infrastructure, aiming to establish a sound infrastructure, achieve full industry coverage of information systems, and build an interconnected provincial population health information service system, investing substantial resources in health informatization construction. As emerging technologies such as cloud computing, Internet of Things, big data, artificial intelligence, and 5G are increasingly applied in healthcare, the value of health informatization in reducing burden, enabling capacity, improving quality, and enhancing efficiency has become more prominent. The role of health informatization in improving both management and service capabilities of medical institutions warrants further exploration and amplification. During the 14th Five-Year Plan period, Sichuan’s health informatization will be committed to achieving interconnectivity, ecological applications, and comprehensive empowerment.

After more than a decade of development, national primary healthcare informatization has achieved significant breakthroughs in infrastructure, system functionality, interconnectivity, and application effectiveness, gradually transitioning from single business applications to comprehensive intelligent applications. However, what is the specific construction status in Sichuan Province? What are the achievements? What existing problems remain? Currently, few scholars have conducted large-scale investigations to explore the actual situation. This study aims to analyze the current status and effectiveness of informatization construction in primary healthcare institutions in Sichuan Province, summarize experiences and problems, and thereby provide references for primary healthcare informatization construction in Sichuan and other provinces nationwide.

Methods

Study Design and Sampling

From May to June 2023, using a stratified quota sampling method, we selected 3,347 primary healthcare institutions (excluding community health service stations and village clinics) from 183 counties (cities, districts) across all 21 prefecture-level cities in Sichuan Province as the sampling pool. From each county (city, district), 6-8 primary healthcare institutions were randomly selected for the questionnaire survey. A total of 1,028 institutions from 143 counties were sampled, including 116 community health service centers and 912 township health centers. The number of sampled institutions varied across cities, with more from Nanchong, Leshan, and Dazhou, and fewer from Suining and Guang'an. Missing counties were from the Aba Tibetan and Qiang Autonomous Prefecture and Liangshan Yi Autonomous Prefecture. The sampled primary healthcare institutions accounted for 30.71% of similar institutions in the province, with sampled community health service centers accounting for 21.17% and township health centers accounting for 32.58%.

Survey Instrument

The “Primary Healthcare Institution Informatization Construction Survey Form” used in this study primarily referenced the *National Standards and Specifications for Informatization Construction in Primary Healthcare Institutions (Trial)* (National Health Planning Letter [2019] No. 87). The survey framework was constructed from information infrastructure, business information systems, information system applications, and construction support. Based on recommendations from experts in primary healthcare informatization, additional items regarding smart applications in primary care and informatization construction of compact county medical communities were included. The questionnaire was deployed on the provincial unified “Sichuan Health Record Cloud Platform” and completed online by responsible persons from the surveyed primary healthcare institutions. This platform covers 231 functions including public health, population monitoring, elderly health, and health examinations, comprehensively supporting basic public health services

in Sichuan Province. Currently, the platform covers all 183 counties in the province, with 3,347 primary healthcare institutions using it and managing health records for 84 million people.

Interview Methods

Using an interview outline developed by research team members, we conducted on-site investigations and interviews at 12 primary healthcare institutions in 5 prefecture-level cities (Leshan, Suining, Yibin, Zigong, Deyang) and 6 districts/counties, selected based on high, medium, and low levels of primary healthcare informatization development across the province. Experienced interviewers conducted the interviews, focusing on current informatization construction status, ecological application effectiveness, and existing problems. The interview process was recorded and transcribed into documents by designated personnel.

Quality Control

Quality control was implemented throughout the entire survey process. First, respondents were required to be personnel familiar with primary healthcare informatization business. Second, the questionnaire included mandatory fields, question notes, logical jumps, and time limits. Pre-testing, online Q&A, and other methods were used for quality control. After the survey, some responses were verified by telephone, and logical checks were performed using statistical methods.

Statistical Analysis

Data were cleaned using Microsoft Excel and analyzed using SPSS 25.0 for descriptive statistical analysis. Categorical data were expressed as relative numbers, and measurement data were expressed as $(\bar{x}\pm s)$.

Results

2.1 Information Infrastructure

2.1.1 District and County Data Centers All surveyed districts and counties were equipped with data centers. 46.55% (27/58) of districts and counties had self-built machine rooms, with 88.89% (24/27) exceeding 5 years of use. 24.14% (14/58) used colocation facilities, 12.07% (7/58) used third-party cloud data centers, and 17.24% (10/58) used prefecture-level coordinated data centers. Among the surveyed districts and counties, 70.69% (41/58) had not extended their health dedicated network to the village level, and 55.64% (572/1,028) of institutions could not achieve information sharing with their subordinate villages (communities).

2.1.2 Institutional Hardware Facilities All surveyed institutions were equipped with computers, printers, and other office equipment. 29.67% (305/1,028) of institutions had self-built machine rooms, and 19.26% (198/1,028) had local physical servers, of which 81.31% (161/198) had servers exceeding 5 years of use. 29.67% (305/1,028) of primary healthcare institutions configured machine rooms.

2.1.3 Data Security The Hospital Information Systems (HIS) in Sichuan's primary healthcare institutions mainly adopted private cloud deployment, with primary healthcare informatization data centers coordinated at the prefecture and county levels. 93.01% (3,113/3,347) of institutions used the health record cloud service platform for basic public health services, deployed centrally at the provincial level. Maternal and child health, immunization planning, health statistics, and mental health vertical systems in Sichuan's primary healthcare institutions all used government affairs cloud deployment.

2.2 Information System Construction

2.2.1 Basic Medical Systems 98.83% (1,016/1,028) of primary institutions were equipped with HIS systems, of which 92.31% (949/1,028) used provincially coordinated HIS systems and 6.52% (67/1,028) used HIS systems from other vendors. In business management systems, primary healthcare institutions used an average of (2.28 ± 2.63) clinical service systems and (2.56 ± 1.97) medical management systems.

2.2.2 Basic Public Health and Family Doctor Contracting Systems 99.61% (1,024/1,028) of institutions used basic public health service systems, and 99.32% (10 21/1,028) used family doctor contract management systems. Among these, 96.50% (992/1,028) and 95.72% (984/1,028) of institutions used provincially coordinated deployment systems, respectively.

2.2.3 Vertical System Access and Connectivity Primary healthcare institutions accessed an average of (10.00 ± 20.81) external/superior vertical systems. Data reporting for these vertical systems took an average of 10.00 hours, representing a heavy reporting burden.

2.2.4 Other Business Systems In addition to basic medical and basic public health systems, primary healthcare institutions also configured various ecological application systems covering business management, auxiliary decision-making, and convenience services. Surveyed institutions configured an average of (0.46 ± 0.96) data decision analysis applications, (2.92 ± 2.56) operational management systems, and (0.56 ± 0.50) convenience service applications. 20.62% (212/1,028) of institutions had configured rational drug use systems, 22.08% (227/1,028) had configured intelligent outbound call systems, and 8.07% (83/1,028) had configured clinical decision support systems.

2.3 Information Technology Applications

2.3.1 Basic Medical Informatization Applications The basic functions of the provincial unified HIS for primary healthcare institutions have expanded from 53 items at initial construction to 89 items. Among surveyed institutions, the overall electronic medical record usage rate reached 77.43% (796/1,028), with 2.72% (28/1,028) of institutions having passed the national electronic medical record system application level grading evaluation. Of these, 42.86% (12/28) were at Level 1, 32.14% (9/28) at Level 2, and 25.00% (7/28) at Level 3. Province-wide, 32.60% (1,091/3,347) of institutions' TCM centers were connected to the Sichuan Provincial TCM Center Health Information Platform to conduct TCM services through informatization means, with 79.01% (862/1,091) connected through provincial coordination and 20.99% (229/1,091) through district/county decentralized access.

2.3.2 Medical-Prevention Integration Applications Sichuan Province manages 62.31 million electronic health records, with an electronic health record conversion rate of 94.93% (20.21 million/21.29 million). Health record data sharing and access during diagnosis and treatment processes has been realized over 500 million times, with 19.47 million medical and health data linkages. Medical-prevention integration services are actively implemented, with 83.46% (858/1,028) of institutions achieving health record access during diagnosis and treatment services, as detailed in Table 2 .

2.3.3 Basic Public Health Service Terminal Applications Among surveyed institutions, 81.91% (842/1,028) were equipped with and using basic public health service terminals, as detailed in Table 3 . 59.73% (614/1,028) of institutions could automatically upload data from health all-in-one machines and wearable devices to the public health system.

2.3.4 Higher- and Lower-Level Business Collaboration Applications In this survey, informatization has supported 227 county-level secondary centers in achieving unified management of personnel, finance, and materials between general hospitals and branch hospitals, integrating business processes such as unified inpatient information forms, test orders from general hospitals executed by branch hospitals, and mutual referrals. 74.12% (762/1,028) of institutions conducted business collaboration between higher- and lower-level institutions within medical consortia through informatization means. The most common collaborative service was two-way referral, accounting for 66.83% (687/1,028), followed by family doctor contract business collaboration and remote imaging, each accounting for 41.44% (426/1,028) and 36.19% (372/1,028), respectively, as shown in Table 4 .

2.3.5 Internet Plus Convenience Services 24.32% (250/1,028) of institutions opened WeChat public accounts to conduct appointment registration,

payment, and inquiry services; 14.59% (150/1,028) configured self-service terminal equipment; 11.19% (115/1,028) opened outpatient triage queuing systems; and 3.70% (38/1,028) deployed internet hospitals.

2.4 Primary Healthcare Information Personnel

In this survey, 65.52% (38/58) of districts and counties had informatization departments and personnel, and 18.97% (11/58) had no informatization department but had full-time information personnel. On average, each district/county had (1.12 ± 1.29) part-time personnel and (0.82 ± 1.05) full-time personnel. 40.95 ± 1.12 part-time personnel and (0.25 ± 1.08) full-time personnel, as shown in Table 5.

2.5 Primary Healthcare Information Policy Environment

Since the 12th Five-Year Plan period, Sichuan Province has promulgated a series of primary healthcare informatization policies, including the *Notice on Further Strengthening the Application of Primary Healthcare Institution Management Information Systems* (Sichuan Health Office Letter [2017] No. 1), the *Notice on Issuing the Implementation Plan for Promoting the Construction of "Internet Plus Healthcare" Demonstration Province in Sichuan* (Sichuan Office Letter [2019] No. 64), and the *Pilot Implementation Plan for Compact County Medical Community Construction in Sichuan Province* (Sichuan Health Development [2019] No. 32). Standard documents include the *Guidelines for Informatization Construction of Compact County Medical and Health Communities in Sichuan Province (Trial)* (Sichuan Health Letter [2020] No. 85). Planning policies include the *14th Five-Year Plan for National Health Informatization* and the *Three-Year Action Plan for Health Informatization in Sichuan Province (2023-2025)*. These policies clarify the objectives, principles, basic requirements, key tasks, safeguard measures, and assessment mechanisms for primary healthcare informatization construction, providing guiding opinions and creating a favorable development environment for primary healthcare informatization and ecological applications in Sichuan Province. Sichuan will adhere to the principle of "independent development of core systems, secure and controlled data openness, and ecological expansion of value-added applications" to vigorously promote provincially coordinated integrated construction of primary information systems, further advancing a provincial-level efficient coordination framework for primary information systems that integrates medical-prevention fusion, sharing and openness, application innovation, and ecological applications.

Discussion

3.1 Comprehensive Consolidation of Primary Healthcare Information Infrastructure in Sichuan Province

According to this study's findings, all districts and counties in Sichuan have established data centers, and core information systems in primary healthcare

institutions have basically achieved unified deployment, with significantly improved coordinated construction levels, laying the foundation for connectivity and application of primary healthcare information among institutions, regions, and businesses. By the end of the 13th Five-Year Plan period, all primary healthcare institutions within the province were basically equipped with computers, printers, telemedicine terminals, and other informatization equipment, achieving connection to the health dedicated network and completing information standardization construction, with certain improvements in hardware and information security levels. The configuration rate of business information systems in primary healthcare institutions has significantly increased, with clinical service, medical management, data decision analysis, operational management, and convenience service systems gradually being applied at the primary level, covering all aspects of primary healthcare institution management and services. Sichuan's health informatization has established an ecological construction foundation featuring dedicated network layout, infrastructure standardization, coordinated construction of core systems, secure and controlled data openness, and comprehensive layout of business systems.

3.2 Primary Healthcare Informatization Construction Supporting Diversified Development of Basic Medical Service Functions

Primary healthcare informatization construction serves as a “lever” for improving medical service efficiency in primary healthcare institutions. Information technology-supported medical applications can effectively break through service bottlenecks and expand the types and scope of primary healthcare services. In this study, relying on hospital management information systems, the basic medical management functions of primary healthcare institutions have expanded from 53 items at system construction initiation to 89 items, with continuously improving applications. The usage rate of Electronic Medical Record (EMR) systems in Sichuan's primary healthcare institutions has reached 77.43%, higher than the national average of 68.20%. The construction of hospital information platforms based on electronic medical records facilitates the expansion of electronic medical records to various diagnosis and treatment links such as outpatient services, imaging, and laboratory tests, embedding clinical pathways, diagnosis and treatment guidelines, and technical specifications into information systems, providing a foundation for primary-level diagnosis and treatment, laboratory examinations, and TCM services. In this survey, the usage rates of Picture Archiving and Communication Systems (PACS), Laboratory Information Systems (LIS), ECG management systems, and chronic disease management systems in primary institutions are gradually increasing. Some leading institutions have also adopted operation and anesthesia management systems, blood transfusion management systems, and clinical pathway systems. The continuous increase in business system types has expanded the scope of basic medical services supported by business systems, significantly enhancing the basic medical service capabilities of primary healthcare institutions. Therefore, it is necessary to further strengthen the coverage of EMR, PACS, LIS, and

ECG management systems in primary healthcare institutions to amplify the enabling effect of primary information system construction on primary medical service capabilities. Additionally, informatization has made TCM services more convenient, with 1,091 institutions in Sichuan already connected to the provincial TCM center health information platform. The connection to the TCM center information platform provides primary TCM centers with diverse information services such as TCM electronic medical records, syndrome differentiation and treatment, and knowledge bases, offering substantial support for clinical decision-making by primary TCM practitioners and significantly improving their syndrome differentiation and treatment capabilities. This enables the public to access standardized, convenient, and effective TCM services nearby and warrants further promotion and exploration of more TCM informatization services.

3.3 Primary Healthcare Informatization Construction Supporting Integrated Development of Basic Public Health Service Functions

Nationally, the financial guarantee and work assessment system for the basic public health sector are relatively well-established with clear requirements, and all regions have focused on developing basic public health service management functions in primary healthcare information systems, achieving outstanding application effects. After more than a decade of construction and deployment, the informatization application effects of basic public health services in Sichuan have become prominent. First, Sichuan's unified construction of the health record cloud service platform has achieved data integration, dynamic interaction, and sharing of the entire population information database and electronic health record database, realizing "one file per person" across the province. The informatization management rate of residents' health records continues to increase, higher than the national average of 92.10%. Second, Sichuan continues to strengthen the integration of basic public health business processes. The provincially coordinated basic public health and family doctor contract systems have basically achieved full coverage, enabling primary healthcare institutions to integrate business processes for entire population management, basic public health, and family doctor contracts, supporting three types of coordination: collaborative data collection, medical-prevention integrated services, and general-specialist collaborative contracting. Furthermore, 51.26% of institutions have been equipped with mobile terminals for public health services and family doctor contracts, and six districts/counties have built regional health portals, while 22 districts/counties have established regional family doctor contract applications. The mobile service capabilities for family doctor contract services in these institutions have been significantly enhanced and deserve promotion in other institutions. Internet of Things technology has also been gradually applied to basic public health services. Health kiosks, health all-in-one machines, mobile physical examination vehicles, and portable follow-up kits connected to the health record cloud platform can automatically obtain data such as height, weight, and blood pressure, and can collect health examination and follow-up

data to health records in real time, achieving paperless physical examinations and significantly enabling basic public health services.

3.4 Primary Healthcare Informatization Construction Gradually Adapting to Integrated Healthcare Delivery System Development

Sichuan Province has effectively connected primary healthcare institutions, tertiary hospitals, and residents through informatization means, constructing an integrated healthcare delivery system with family doctor service teams as the main body, medical consortium information platforms as the support, and tertiary hospital specialists in collaboration. Information services based on county-level secondary centers, county medical communities, telemedicine collaboration networks, urban medical groups, and specialty alliances have brought convenient medical experiences and high-quality services to residents. First, informatization has supported 227 county-level secondary centers in achieving unified management of personnel, finance, and materials between general hospitals and branch hospitals, realizing unified inpatient information forms, mutual recognition and sharing of laboratory test results, and orderly development of mutual referrals and telemedicine. Second, informatization has effectively supported business collaboration within medical community members. The focus of medical community informatization construction is to promote the integration of information systems among member units to facilitate two-way referrals, medical-prevention integration, and telemedicine between higher- and lower-level hospitals through informatization means, achieving automatic transfer of electronic referral forms and electronic medical records, general-specialist collaboration, promoting the 下沉 of high-quality resources, improving the accessibility of high-quality resources, and enhancing the continuity of medical services and health management. According to this survey, 74.12% of primary healthcare institutions in Sichuan can conduct business collaboration with higher-level units, demonstrating remarkable effectiveness of business collaboration services supported by informatization. Finally, informatization has supported the development of telemedicine and regional laboratory services. 50.60% of primary healthcare institutions have developed telemedicine services, achieving two-way transmission of case data and diagnostic results, promoting the 下沉 of high-quality medical resources and solving residents' problems of "difficult and distant access to medical care." 66.83% of institutions have developed regional laboratory external examination services. Through the collaboration model of "primary-level ordering, higher-level testing," informatization means have been used to achieve full business process linkage of external examination ordering, cold chain transportation, and report return, facilitating convenient access to medical care for the masses.

3.5 New Technology Applications Continuously Expanding Ecological Application Scenarios of Primary Healthcare Informatization

With the development of primary healthcare informatization, mobile Internet, big data, and artificial intelligence technologies have become development trends for enabling primary healthcare services and innovating service models. Sichuan Province has good prospects for new technologies to empower primary healthcare, demonstrated in three aspects. First, artificial intelligence technology supports the application of new business systems in primary care, improving medical service efficiency. In this survey, some primary healthcare institutions began to apply rational drug use management systems, intelligent outbound call systems, and clinical decision support systems. The application of such artificial intelligence technologies in basic medical and public health services can provide doctors with clinical decision support such as disease diagnosis and rational drug use, and provide public health management personnel with intelligent voice and SMS services for follow-up visits, contract signing, and chronic disease management, effectively improving the work efficiency of primary healthcare personnel. Second, big data analysis has promoted the integration of public health and clinical medical information and service collaboration. Big data analysis can leverage the fundamental role of residents' electronic health records to achieve dynamic collection of data on the entire population, electronic medical records, health examinations, and basic public health services into residents' health records. Big data analysis of chronic disease populations has enabled active push of population tags and real-time access to health profiles, supporting primary healthcare personnel in conducting medical-prevention integrated services such as health record access, consultation contracting, and consultation follow-up during diagnosis and treatment processes. In this survey, 83.46% of institutions have achieved health record access during diagnosis and treatment, 68.77% have achieved consultation follow-up, and 56.91% have achieved consultation contracting, demonstrating significant effectiveness of big data analysis in enabling medical-prevention integration. Third, "Internet Plus" convenience services have extended to primary care. Primary healthcare institutions in Sichuan have gradually launched "Internet Plus" services such as WeChat public accounts and self-service terminals, providing online appointment registration, mobile payment, and self-service inquiry services, enhancing the convenience and accessibility of diagnosis and treatment services. Such "Internet Plus" convenience services have increased the service scope, covered population, and types of routine business services of primary healthcare institutions, allowing residents to complete pre- and post-diagnosis processes such as appointment registration, report inquiry, and fee payment at home, continuously extending service capabilities.

3.6 Shortcomings in Primary Healthcare Information Ecology Construction

After more than a decade of persistent primary healthcare informatization construction, primary healthcare institutions in Sichuan Province have achieved fruitful results in informatization applications, but certain shortcomings remain to be addressed. First, the coordination mechanism for primary healthcare informatization construction is not sound, and policy guidance is inconsistent, manifested by the dispersion of primary healthcare informatization requirements in various business policy guidance documents, lacking unified policy requirements for primary healthcare informatization. Second, primary healthcare institution infrastructure construction is insufficient, with low configuration rates for machine rooms and servers and widespread equipment aging problems. Third, while information service application effects in primary healthcare institutions are significant, the application rates of TCM services, intelligent terminal applications, higher- and lower-level business collaboration services, and Internet Plus convenience services clearly need improvement. Fourth, primary healthcare institutions have numerous vertical systems with low interconnectivity, primitive data reporting methods, and extremely heavy data reporting burdens.

Recommendations

Based on these findings, we propose several recommendations. First, primary healthcare informatization construction requires coordinated management. This includes strengthening policy guidance to form unified, continuous, and rigid primary informatization policies to create a favorable information ecology environment, and enhancing the leadership responsibilities of informatization departments by implementing primary informatization construction as a “top priority” project for party and government leaders, clarifying responsibility boundaries for primary informatization construction, consolidating the provincially coordinated primary informatization network foundation, and eliminating or avoiding “information silos” as much as possible. Second, we must adhere to application orientation to improve the timeliness of primary informatization construction. This includes establishing a continuous and collaborative medical and health service system orientation to leverage the core supporting role of the “Primary Healthcare Institution Management Information System” and “Health Record Cloud Service Platform” in promoting medical-prevention integration, higher- and lower-level business collaboration services, and intelligent public health services. We should also deepen “Internet Plus” inclusive convenience services to extend more convenience services to primary care, improving service accessibility and efficiency. Additionally, we should further promote the application of new technologies in primary institutions, providing decision support for primary healthcare personnel through artificial intelligence, big data, and mobile medical technologies to optimize primary service processes and reduce the work burden on medical personnel. Finally, we must adhere to sharing and openness to further expand the primary informatization application ecology. This includes

establishing a unified primary digital ecological foundation with complete functions, unified standards, and open sharing; building a business collaboration integration platform with unified user authentication, business authorization, and service interface management to provide basic technical service capabilities for expanding primary informatization ecological applications; and providing a new primary information system cloud construction model at the provincial level that is “functionally rich, vendor-diverse, and ready-to-use” for primary healthcare institutions to reduce technology acceptance difficulty, improve application enthusiasm, shorten information system construction cycles, and reduce costs.

Conclusion

This study summarized the current status and effectiveness of informatization construction in primary healthcare institutions in Sichuan Province. Currently, the overall informatization construction in Sichuan’s primary healthcare institutions is favorable, demonstrating development trends of comprehensive infrastructure consolidation, diversified development of basic medical service functions, and integrated coordination of basic public health service functions. Informatization has gradually adapted to the development of integrated healthcare delivery systems, with new technology applications continuously expanding ecological application scenarios for primary healthcare informatization. However, problems remain, including unsound coordination mechanisms for primary healthcare informatization construction with inconsistent policy guidance, insufficient infrastructure construction in primary healthcare institutions with widespread equipment aging, inadequate application of convenience services, higher- and lower-level business collaboration services, and intelligent terminals, as well as low interconnectivity among vertical systems and heavy reporting burdens. Our team will continue to monitor the progress, enabling scenarios, and constraints of primary healthcare informatization construction in Sichuan, deeply analyzing the mechanisms through which health informatization influences primary healthcare service capacity, diagnosis and treatment effectiveness, and diagnosis and treatment models, to provide policy recommendations for primary healthcare informatization construction in Sichuan and nationwide.

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