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Postprint: A Study on the Usage Status and Influencing Factors of Community Electronic Health Records

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Abstract

Background Since the implementation of resident electronic health record initiatives, phased achievements have been made. Shenzhen City, Guangdong Province has achieved its target establishment rate, and the usage rate has become the core indicator for optimizing the management of this work.

Objective To investigate the utilization of resident electronic health records in Bao'an District, Shenzhen, analyze its influencing factors, and provide evidence for improving health record usage rates and optimizing community health resource allocation.

Methods As of December 31, 2022, the Shenzhen Community Health Service Information System contained 4,077,665 resident electronic health records in Bao'an District. Systematic sampling was employed to extract 403,700 records, and 401,853 records meeting the research criteria were selected for analysis. Information on outpatient records, follow-up records, and physical examination records from resident health records was extracted. The 1-year, 2-year, and 3-year usage rates of resident electronic health records were calculated, and multivariate Logistic regression was used to analyze factors influencing usage.

Results The 1-year, 2-year, and 3-year usage rates of resident health records were 59.30% (238,131/401,853), 74.90% (301,032/401,853), and 80.10% (321,853/401,853), respectively. Multivariate Logistic regression analysis revealed that age, ethnicity, residence type, marital status, education level, occupation, medical expense payment method, record establishment duration, and whether the record had a family doctor contract identifier, elderly project identifier, hypertension project identifier, or diabetes project identifier were influencing factors of 1-year, 2-year, and 3-year usage of resident electronic health records ($P<0.05$). Specifically, compared with residents aged 21-45

years, those aged 0-1, 2-3, and 4-6 years had higher usage rates (OR>1.00, P<0.05), while those aged 46-60 and $ $61 years had lower usage rates (OR<1.00, P<0.05). Compared with residents with non-Shenzhen household registration, those with Shenzhen household registration had higher usage rates (OR>1.00, P<0.05). Compared with residents enrolled in urban employee basic medical insurance, those with urban resident basic medical insurance, self-pay, and other medical expense payment methods had lower usage rates (OR<1.00, P<0.05). Compared with residents with <1 year of record establishment, those with $ $1 year had lower usage rates (OR<1.00, P<0.05). Compared with residents without corresponding project identifiers, those with family doctor contract identifier, elderly project identifier, hypertension project identifier, and diabetes project identifier had higher 1-year usage rates [OR (95%CI) were 3.77 (3.70-3.84), 2.73 (2.53-2.94), 4.40 (4.11-4.72), and 3.10 (2.78-3.47), respectively, P<0.05], and also higher 2-year and 3-year usage rates (OR>1.00, P<0.05).

Conclusion The usage rate of electronic health records among residents in Bao'an District has improved compared with previous periods, but there remains room for improvement. Focus should be placed on non-elderly individuals, middle-aged and elderly persons with hypertension/diabetes project identifiers, residents without family doctor contracts, those with urban resident basic medical insurance/self-pay/other payment methods, and non-household registration residents.

Full Text

Study on the Utilization and Influencing Factors of Community Electronic Health Records

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Abstract

Background: Since their implementation, residents' electronic health records have achieved phased success. In Shenzhen, Guangdong Province, the target filing rate has been achieved, shifting the focus of optimization management to utilization rate as the core indicator. **Objective:** To understand the utilization of electronic health records among residents in Bao'an District, Shenzhen, and analyze its influencing factors to provide evidence for improving health record utilization and optimizing community health resource allocation. **Methods:** As of December 31, 2022, the Shenzhen Community Health Service Information System contained 4,077,665 electronic health records for Bao'an District residents. Using systematic sampling with an interval of 10, we selected 403,700 records,

from which 401,853 valid records meeting study requirements were included for analysis. Outpatient records, follow-up records, and physical examination data were extracted to calculate 1-year, 2-year, and 3-year utilization rates. Multivariate logistic regression analysis was employed to identify influencing factors. **Results:** The 1-year, 2-year, and 3-year utilization rates were 59.30% (238,131/401,853), 74.90% (301,032/401,853), and 80.10% (321,853/401,853), respectively. Multivariate logistic regression revealed that age, ethnicity, residency status, marital status, education level, occupation, medical expense payment method, record establishment duration, and whether records had family doctor contract markers, elderly program markers, hypertension program markers, or diabetes program markers were all significant influencing factors (P<0.05). Specifically, compared with residents aged 21–45 years, those aged 0–1, 2–3, and 4–6 years showed higher utilization rates (OR>1.00, P<0.05), while those aged 46–60 and $ $61 years showed lower rates (OR<1.00, P<0.05). Permanent Shenzhen household registration residents had higher utilization rates than non-registered permanent residents (OR>1.00, P<0.05). Compared with urban employee basic medical insurance enrollees, those with urban resident basic medical insurance, full self-payment, or other payment methods had lower utilization rates (OR<1.00, P<0.05). Residents with records established $ $1 year had lower utilization than those with records <1 year (OR<1.00, P<0.05). Records with family doctor contract markers, elderly program markers, hypertension program markers, or diabetes program markers showed significantly higher 1-year utilization rates [OR (95%CI) = 3.77 (3.70–3.84), 2.73 (2.53–2.94), 4.40 (4.11–4.72), and 3.10 (2.78–3.47), respectively, P<0.05], with similarly elevated 2-year and 3-year rates (OR>1.00, P<0.05). **Conclusion:** While electronic health record utilization in Bao'an District has improved compared with previous levels, further enhancement is possible. Priority attention should focus on non-elderly residents, middle-aged and elderly individuals without hypertension/diabetes program markers, residents without family doctor contracts, those with urban resident basic medical insurance/self-payment/other payment methods, and non-household registration residents.

Keywords: Electronic health records; Health services utilization research; Community health services; Contracted family doctor services; Influencing factors analysis

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As a fundamental component of basic public health services, residents' health records represent standardized documentation created by medical institutions during service delivery. These records serve as crucial evidence for providing comprehensive, continuous, and coordinated health care services, and their utilization represents an effective method for improving community health outcomes while enhancing health service capacity and medical quality. The value of health records lies not in their creation but in their active use—creation forms the foundation, while utilization is the key. Previous research on health record management and utilization has primarily relied on small-sample questionnaire

surveys, with information system-based studies limited to individual communities, lacking large-sample objective data analysis. This study analyzes over 400,000 health records from Bao'an District using the Shenzhen Community Health Service Information System to examine electronic health record utilization patterns and influencing factors, providing evidence for rational community health resource allocation.

1. Methods

1.1 Data Sources

As of December 31, 2022, the Shenzhen Community Health Service Information System contained 4,077,665 electronic health records for Bao'an District residents. Using systematic sampling with an interval of 10, we selected 403,700 records. After excluding records with substantial missing personal information and duplicates, 401,853 valid records were obtained for analysis.

1.2 Research Methods

Between September and November 2023, two researchers extracted outpatient records, follow-up records, and physical examination data, including: (1) general characteristics such as gender, age, ethnicity, household registration and residency status, marital status, education level, occupation, and medical expense payment method; and (2) record establishment details such as establishment date and markers for family doctor contracts, elderly programs, hypertension programs, and diabetes programs. Permanent residency was defined as continuous residence in Shenzhen for $ $6 months, with residency status categorized as either permanent Shenzhen household registration or permanent non-Shenzhen household registration.

According to the *National Basic Public Health Service Standards (Third Edition) Operational Manual*, records with dynamic entries refer to health records linked to medical service records and/or containing service records meeting corresponding protocol requirements. Medical records refer to patient visit records at community health service centers, while protocol-compliant service records include hypertension/diabetes follow-up records and physical examination records for elderly or chronic disease patients. The dynamic utilization rate of health records refers to the proportion of records with at least one health service entry within a specified period. The 1-year, 2-year, and 3-year utilization rates represent the proportions of health records with $ $1 dynamic entry within 1, 2, and 3 years, respectively.

1.3 Statistical Methods

We established a database using Excel 2016 for data entry and management, and performed statistical analysis using R 4.2.2. Categorical data were expressed as relative frequencies, with inter-group comparisons conducted using

^{2} tests. Multivariate logistic regression analysis was used to identify factors influencing electronic health record utilization. Previous research indicates that residents prioritize medical records, physical examination information, key population management records, vaccination information, and test reports, and show strong demand for interoperable electronic health records and data platforms. Residents also demonstrate considerable recognition of family doctor services, suggesting that family doctor contracts, elderly health management, and hypertension/diabetes patient management may be primary factors influencing health record utilization. Therefore, we constructed two multivariate logistic regression models: Model 1 included basic resident characteristics and record establishment duration as independent variables, while Model 2 added four additional variables—family doctor contract marker, elderly program marker, hypertension program marker, and diabetes program marker. The significance level was set at α=0.05.

2. Results

2.1 General Characteristics of Residents

Among the 401,853 residents with established records, 208,924 (51.99%) were male and 192,929 (48.01%) were female, yielding a male-to-female ratio of 1.08:1. The majority were aged 21–45 years [241,600 (60.10%)], followed by 46–60 years [66,365 (16.50%)], 7–12 years [23,963 (6.0%)], $ $61 years [21,198 (5.30%)], and 13–20 years [20,426 (5.10%)]. Residents aged 0–1, 2–3, and 4–6 years each accounted for <5%. Permanent Shenzhen household registration residents numbered 61,164 (15.20%), while permanent non-Shenzhen household registration residents numbered 340,689 (84.80%), yielding a ratio of 5.57:1.

2.2 Establishment and Utilization of Electronic Health Records

As of December 31, 2022, among the 401,853 records, the majority had been established for 2 years [88,629 (22.10%)], followed by $ $5 years [82,529 (20.50%)], 1 year [75,578 (18.80%)], 3 years [54,511 (13.60%)], 4 years [52,819 (13.10%)], and <1 year [47,787 (11.90%)]. A total of 122,512 records (30.50%) had family doctor contracts, while 11,047 (2.70%), 18,624 (4.60%), and 7,208 (1.80%) had elderly, hypertension, and diabetes program markers, respectively.

The overall 1-year, 2-year, and 3-year utilization rates were 59.30% (238,131/401,853), 74.90% (301,032/401,853), and 80.10% (321,853/401,853), respectively. Specifically, records with family doctor contracts showed utilization rates of 83.87% (102,755/122,512), 92.87% (113,772/122,512), and 95.32% (116,782/122,512) at 1, 2, and 3 years, respectively. Records with elderly program markers showed rates of 85.50% (9,445/11,047), 94.35% (10,423/11,047), and 96.57% (10,668/11,047). Records with hypertension program markers showed rates of 94.86% (17,667/18,624), 97.03% (18,070/18,624), and 97.70% (18,195/18,624). Records with diabetes program markers showed rates of 95.13% (6,857/7,208), 97.23% (7,008/7,208), and 97.97% (7,062/7,208).

2.3 Comparison of EHR Utilization Rates by Resident Characteristics

Statistically significant differences ($P<0.05$) in 1-year utilization rates were observed across gender, age, residency status, marital status, education level, occupation, medical expense payment method, record establishment duration, and markers for family doctor contracts, elderly programs, hypertension programs, and diabetes programs. Ethnicity showed no significant difference ($P>0.05$). Similarly, significant differences ($P<0.05$) in 2-year and 3-year utilization rates were found across all these variables except ethnicity .

2.4 Multivariate Logistic Regression Analysis

2.4.1 Model 1 Using 1-year, 2-year, and 3-year utilization as dependent variables (unused=0, used=1), and gender, age, ethnicity, residency status, marital status, education level, occupation, medical expense payment method, and record establishment duration as independent variables, multivariate logistic regression revealed that gender, age, ethnicity, residency status, marital status, education level, occupation, medical expense payment method, and record establishment duration significantly influenced 1-year utilization ($P<0.05$). Gender, age, residency status, marital status, education level, occupation, medical expense payment method, and record establishment duration significantly influenced 2-year and 3-year utilization ($P<0.05$) .

2.4.2 Model 2 Using the same dependent variables and adding family doctor contract marker, elderly program marker, hypertension program marker, and diabetes program marker as independent variables, multivariate logistic regression showed that age, ethnicity, residency status, marital status, education level, occupation, medical expense payment method, record establishment duration, and all four program markers significantly influenced 1-year, 2-year, and 3-year utilization ($P<0.05$) .

Discussion

The 1-year, 2-year, and 3-year utilization rates of electronic health records among Bao'an District residents were 59.30%, 74.90%, and 80.10%, respectively—substantially higher than findings from a 2014 study in Guangming District, Shenzhen (30.27% and 64.78% for 1-year and 2-year rates). This improvement reflects both enhanced health awareness among residents and increased community health service accessibility resulting from recent health administrative department initiatives, making residents more willing to seek care at community health centers. Bao'an District's utilization rates exceed those reported in Guangxi (44.43% in 2018) and Chongqing's Rongchang District (57.91% in 2021), but fall below rates in Shandong (64.53% in 2019), Chongqing's main urban area (64.70% in 2017), and Guangzhou (78.10% in 2017). These variations may stem from different data collection methods—Shandong and Chongqing's main urban area studies used resident

questionnaires, Guangxi used annual basic public health service reports, while Guangzhou used quarterly statistics. Additionally, Shenzhen's large migrant population, with more non-registered than registered residents, contributes to high mobility, as evidenced by the predominance of records established for exactly 2 years. Research indicates that migrant populations face weaker record establishment systems, lower medical consultation rates, and more prevalent "dead record" problems.

Demographic structure influences utilization rates, which generally decline during youth (ages 21–45) but increase during middle age (46–60) and older adulthood (>60), reflecting higher healthcare needs among "young and old" populations. Registered household residents show higher utilization rates, likely due to greater stability and fixed residences. Married individuals demonstrate higher utilization than unmarried individuals, possibly because of older age and increased family health responsibilities. Urban employee basic medical insurance enrollees show higher utilization than those with urban resident basic medical insurance, self-payment, or other methods, likely because employment-based insurance requires formal labor contracts, indicating stable employment and higher health awareness with greater propensity to seek professional care. Records established $ $1 year show lower utilization than those <1 year, suggesting that new records are often created during initial visits and that "dead records" without dynamic entries accumulate over time.

Family doctor contracts and chronic disease management programs markedly impact utilization. Records with family doctor contracts showed 1-year, 2-year, and 3-year utilization rates of 83.87%, 92.87%, and 95.32%, respectively; elderly program records showed 85.50%, 94.35%, and 96.57%; hypertension program records showed 94.86%, 97.03%, and 97.70%; and diabetes program records showed 95.13%, 97.23%, and 97.97%. All hypertension and diabetes program utilization rates exceeded 90.00%, indicating high utilization of public health services for elderly health management and chronic disease management in Bao'an District, consistent with Wang Guoping's findings. This likely reflects policy requirements for community health institutions to provide at least one annual physical examination for elderly residents and at least four follow-up visits plus one annual physical examination for hypertension and diabetes patients. Family doctor contract services provide comprehensive, effective, and continuous integrated medical care, with high resident utilization, compliance, and satisfaction. Implementation of family doctor contract services effectively improves basic health service utilization and acceptance. Multivariate analysis revealed that after controlling for elderly, hypertension, and diabetes program variables and family doctor contracts, the OR for older adulthood utilization shifted from >1.00 to <1.00 relative to youth, suggesting that Bao'an District's high utilization rates primarily stem from family doctor services and chronic disease management programs, consistent with Lu Xuewei's Shenzhen study identifying medical records, physical examination information, and key population management records as the three most highly utilized components.

Considerable room for improvement remains in Bao'an District's health record utilization. Beyond the three key populations (elderly, hypertension, and diabetes patients) and family doctor contract enrollees, other groups show relatively low utilization. Community health services should be strengthened for permanent residents outside these priority groups.

This study extracted all utilization data from the Shenzhen Community Health Service Information System. However, because Shenzhen's community health centers maintain separate systems for child health care, maternal health care, immunization, tuberculosis, and mental health that are not interoperable with the main system, utilization records from these systems could not be extracted, potentially underestimating utilization for certain populations. Future efforts should enhance system interoperability to improve utilization rates. This study's strength lies in its large sample size and regional representativeness, though data collection occurred during the COVID-19 pandemic, which may introduce some bias. Continued monitoring and comparative analysis are warranted.

Author Contributions: HE Meiliang conceptualized and designed the study, supervised implementation, organized data, and drafted the manuscript; LIU Xiuliang cleaned and organized data, performed statistical analysis, and prepared tables; ZHAO Meigui and GUO Yanfang revised the manuscript; XU Ying oversaw quality control and review, assumed overall responsibility, and provided supervision.

Conflict of Interest Statement: The authors declare no conflicts of interest.

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