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Original Article

Advancing Healthcare Infrastructure: The Features of Iran's Sina Electronic Health Record System

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Abstract

Background and aims: The Sina Electronic Health Record (SinaEHR) system was developed to support primary care delivery across Iran by enabling chronic disease monitoring, infectious disease surveillance, health policy decision-making, and quality improvement initiatives.

Methods: The SinaEHR system was implemented by Mashhad University of Medical Sciences which contains health records of over 5 million people across various regions of Iran. It utilizes the International Classification of Diseases (ICD) version 10, integrating laboratory results through a laboratory information system to facilitate real-time clinical decision-making.

Results: Widespread implementation of the SinaEHR system has established an invaluable healthcare infrastructure resource for the improvement of primary care services across Iran. Strict security and confidentiality measures are enforced to protect sensitive patient information.

Conclusion: The SinaEHR system significantly advances Iran's healthcare infrastructure by providing a comprehensive electronic health record platform to improve healthcare delivery and promote evidence-based decision-making.

Keywords: Electronic health records, Primary health care, Public health informatics

Introduction

Iran's public healthcare system provides primary, secondary, and tertiary care services overseen by the Ministry of Health and Medical Education (MOHME).[1,2] Primary care is the first point of contact for preventing and managing chronic diseases. Although Iran historically had low electronic health record (EHR) adoption rates, there has been significant progress in recent years in EHR implementation.[3,4]

Other countries worldwide have also made notable strides in leveraging EHR data for research and surveillance purposes. For example, in England, researchers have utilized EHR data from primary care practices to conduct epidemiological studies and support healthcare research.[5] Similarly, the Canadian Primary Care Sentinel Surveillance Network (CPCSSN) has established a national electronic medical record database that enables researchers to access and analyze primary care data across the country.[6] The Netherlands also has a long-standing tradition of using EHR data for healthcare research, with primary care databases such as the Integrated Primary Care Information (IPCI) system providing a valuable resource for observational studies.[7] These examples demonstrate that leading countries in healthcare have recognized the immense potential of EHR systems to support data-driven decision-making, quality improvement, and population health monitoring.

While the SinaEHR system represents a significant advancement in Iran's primary care data infrastructure, considering its capabilities, other similar EHR platforms used in the country, such as Sib and Nab, are essential. These systems serve populations of varying sizes, offer different functionalities, and have been utilized for diverse research and quality improvement initiatives. However, the SinaEHR system has more robust health monitoring and reporting capabilities and comprehensive data security measures, positioning it as a valuable resource for healthcare research and policy development in Iran. The standardized clinical data captured in EHR systems like SinaEHR can provide a comprehensive picture of primary care in Iran and allow for large-scale studies and analyses.[4,8]

Methods

Electronic Health Record System

The introduction of new health network systems, expanding provider responsibilities, population coverage, patient mobility, and multiplicity of forms and software created a need for an electronic data system for primary care in Iran. With permission from the MOHME, Mashhad University of Medical Sciences began developing the Sina Electronic Health Record (SinaEHR) system in 2015 to address this need. After extensive reviews, workflow analysis, and streamlining repetitive processes, SinaEHR

was implemented across all health centers affiliated with Mashhad University of Medical Sciences. Since 2015, the system has continued evolving as a primary care research and disease monitoring data source. It currently covers populations in Mashhad, Torbat Heydarieh, Torbat Jam, Abadan, and regions overseen by Iran University of Medical Sciences.[9]

Patient Identification

Effective use of electronic health records (EHRs) requires standardized data formats and terminology. Data should be collected and defined consistently to enable system interoperability and information sharing.[10] Secondary use of EHR data can support cost-effectiveness evaluations, treatment usefulness assessments, preventive care initiatives, and health system analytics.[11] The International Classification of Diseases (ICD) coding system enables standardized disease classification and has been used globally for decades.[12]

The SinaEHR system incorporates ICD-10 codes for diagnosis capture. Approximately 566 000 coded diagnoses and symptoms have been recorded, covering contagious and non-communicable diseases. Physicians enter confirmed, probable, or suspected diagnoses along with associated dates. Diabetes diagnoses, for example, utilize specified codes (E10 for type 1, E11 for type 2, etc.). The Ministry of Health provided ICD-10 coding guidelines to ensure the consistency of diagnostic codes. Numerous studies have leveraged standardized disease data and laboratory information system available in the SinaEHR system.[9]

The SinaEHR system incorporates an integrated laboratory information system for real-time access to test results to support clinical decision-making. This enables providers to order and receive standardized test results electronically, eliminating manual data entry. Key benefits include reducing redundant test orders, timely result availability, and fewer errors arising from manual data transfer.[9]

Access to longitudinal test data, especially for chronic conditions like diabetes, is crucial for disease management and care optimization. The availability of integrated laboratory data has enabled the development of cardiovascular risk prediction models,[13] glomerular filtration rate,[14] and reference ranges for biochemical markers in the Iranian population.[15] Overall, the integrated lab system enhances the utility of the SinaEHR database for research and clinical care.

Ethical Principles

Any research or study that utilizes SinaEHR system data must obtain approval from the relevant university ethics committee. Studies conducted outside Mashhad University of Medical Sciences require separate ethics approval from that institution and a data-sharing agreement with Mashhad University of Medical Sciences.[9] These ethical principles and approval processes help regulate studies and ensure the appropriate use of the SinaEHR data.

Access and Governance of the SinaEHR System

The SinaEHR system has implemented a comprehensive access and governance framework to ensure the appropriate use and protection of the data.

Access Levels

The system employs a multi-tiered access model with the following user permissions:

Clinician Access

Healthcare providers can view and update patient records relevant to their clinical care responsibilities.

Administrative Access

Designated staff can manage user accounts, monitor system utilization, and oversee data quality.

Researcher Access

Researchers must obtain prior approval from the relevant ethics committee and establish a data-sharing agreement.

Ministry of Health Access

Officials and policymakers can access aggregated anonymized data for healthcare planning and decision-making.

Results

Data Security and Confidentiality

Multiple measures have been implemented in the SinaEHR system to guarantee data security and privacy. All data are transmitted securely over an encrypted virtual private network (VPN). The SinaEHR data are stored in advanced academic data centers with stringent physical and digital security protocols. These comprehensive protections for encrypted data transfer and storage in secured facilities help maintain the confidentiality and integrity of sensitive health information.

Coverage

The SinaEHR system covers over 5 million people in the regions supervised by Mashhad University of Medical Sciences. Over 141 million health services have been provided since the system was launched. The database includes health data from numerous cities, including Mashhad, Bakharz, Taibad, Bardskan, Chenaran, Khalilabad, Khaf, Dargaz, Rashtkhwar, Sarkhs, Shandiz, Freeman, Qochan, Kashmer, Kalat, Kohsarkh and Golbahar. Additionally, data from regions overseen by Iran University of Medical Sciences, Abadan, Torbat Jam, and Heydarieh are incorporated into the system.[9] This extensive coverage enables large-scale health data collection across multiple regions of Iran.

Accuracy and Generalizability of Data

Careful attention has been paid to ensuring the patient

population, healthcare professionals, and participating clinics within SinaEHR represent the broader Iranian population.[1,16] Based on demographic factors like age, gender, and economic status, studies show those covered in SinaEHR largely reflect the general population, though some geographic variances exist. For example, patients from suburban areas of Mashhad may have lower socioeconomic status compared to the general population of Iran. Other clinicians use similar primary care EHR systems such as Sib, Nab, and Parsa that likely record comparable data.[17] Overall, the extensive coverage and representativeness of the SinaEHR data contribute to its accuracy and generalizability for health research and surveillance purposes.

Data Collection System

Patient Data

The SinaEHR data depends on patient visits to providers and subsequent data entry by those providers. Data before 2015 was not captured, but information has been recorded accurately since the onset of the system.[17] Over time, patient referrals and system evolution have resulted in the availability of high-quality and high-volume data.

Recorded patient information includes medical history details entered by patients and providers, such as demographics, current/past diagnoses, medications, lab results, referrals, procedures, and risk factors. Table 1 outlines the comprehensive data elements captured. All services requiring prescriptions, tests, imaging, and so on are now electronically requested and logged. Integration with laboratory and pharmacy modules and clinical response capabilities has yielded substantial test and medication data.

Services and Options of the Sina System

Primary Care Management

- Patient registration and census
- Age-based screening and provider follow-ups
- Vital statistics tracking
- Screening programs for genetic and mental health disorders
- Management of service delivery sites and coverage areas
- Dental services tracking
- Vital signs tracking (Figure 1).

Health Monitoring and Reporting (Figure 2)

- ICD-10 coded cause of death
- ICD-10 differential diagnosis (Figure 2)
- Health indicators and graphs
- Comparison of provider performance metrics for analysis [13-16]
- Infectious disease and syndromic surveillance
- Integration with the WHO IraPEN system

Patient Tracking and Referral

- Patient referral tracking
- Provider visit logs

Administrative Functions

- User management
- Tracking of services provided by users
- Environmental and occupational health systems
- Disaster risk management and monitoring [11,18,19]

Data Utilization

The SinaEHR database represents a unique data source that is not widely available elsewhere in Iran. The data has been utilized to address various research questions, with results disseminated in publications, conferences, and posters. Individual and regional-level data have been used for epidemiologic studies of specific diseases. Specifically, Boskabadi et al used the SinaEHR data to study factors related to diabetes complications,[20] while Bahrami Taghanaki et al investigated the prevalence of psychological distress and associated demographics.[18]

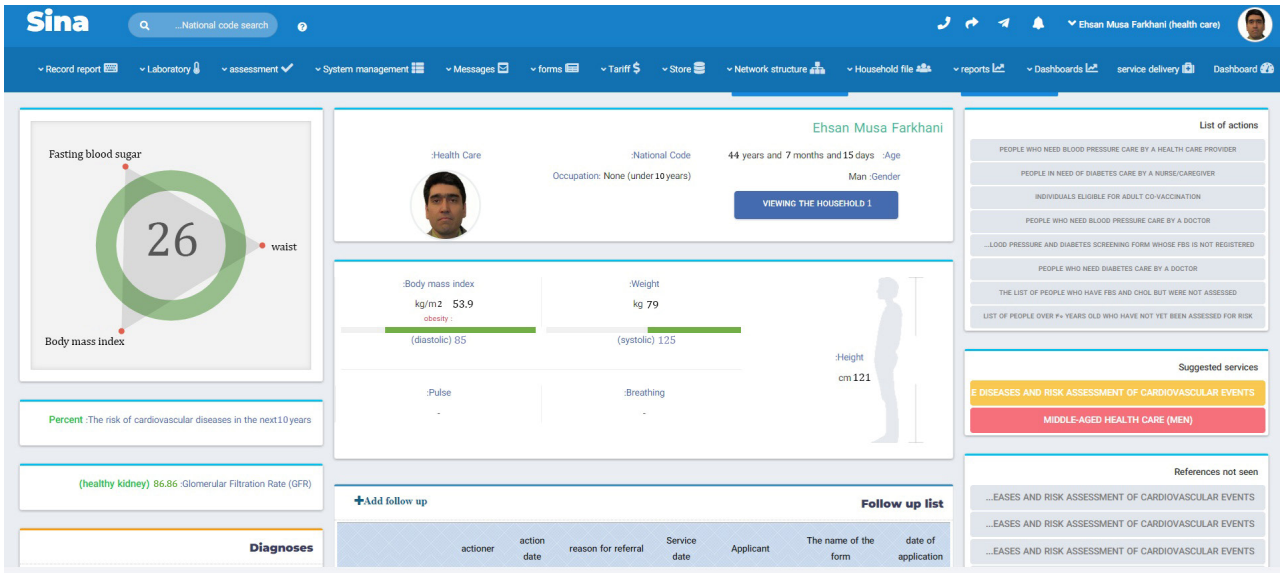

Figure 1. Key Features of the SinaEHR User Interface

Table 1. Data Elements of Sina System

Practice and provider information		
Personnel ID	Fieldwork	
Date of creation	Marital status	
First name	Roles	
Last name	Role name	
Birth date	Role ID	
Gender	Health chart ID	
Verified	Postal code	
Email	Urban/rural area	
Mobile	Latitude	
Nationality	Longitude	
National code	Country division type	
Job field	Address	
Employment type		
Employment date		
Education level		
Family doctor		
Patient Information		
	History of drug abuse	Family history
Member ID	Drug type	Household ID
First name	Dosage	Address
Last name	History of use	Number of members
National node	Start date of use	Role in the household
Birth place	History of immunization	Application ID
Nationality	Admission ID	Birth history
Birth date	Admission date	Abortion
Identity number	Description	Death child
Father's name	Vaccination	Gravidity
Gender	Diagnosis	Living children
Marital status	Past medical history	Household food insecurity
Education	Obstetric history	Psychological assessment
Mobile	Vital signs	Syndromic surveillance
Job	Travel history	Z score of weight for age
Date of death	Chief complaint	Pregnancy admission data
Insurance	Weight	Nutritional data
Insurer ID	Height	Frailty assessment of elderly
Insurance expiration date	Blood pressure	Supplementation data
Family ID	Waist/hip ratio	Cardiovascular risk score
Supervisor ID	GFR	GIS data
	Cancer registration data	Domestic violence
Location Information		
	Country division ID	
Address	County ID	
Postal code	Area type id	
Phone number	Parent area code	
Region	Parent region type code	
Block number	Country code	
	Province code	
	City code	
Laboratory Results		
	Urine test	CBC test
Thyroid	Urine protein	Laboratory test result ID
Admission ID	PH	Eosinophil count
Laboratory test result ID	Nitrite	Eosinophil type
Free T3	Leukocyte	Basophil count
Free T4	microorganism	basophils
Total T3	ketones	Basophil type
Total T4	Urine glucose	hematocrit
TSH	Cells in the urine	hemoglobin
Liver function	Urinary concentration	Lymphocyte count
Laboratory test result ID	Clarity of urine	Type of lymphocytes
Albumin	Blood pressure test	The amount of hemoglobin
Alkaline phosphate	Diastolic pressure	Hemoglobin concentration
direct bilirubin	Systolic pressure	Red blood cell size
Indirect bilirubin	Blood glucose test	Microscopic features
SGOT	Glycated hemoglobin	Monocyte count
SGPT	Lipid profile test	Types of monocytes
Total bilirubin	HDL	Neutrophil count
gamma-glutamyl transferase	LDL	Type of neutrophils
Lactate dehydrogenase	triglyceride	platelet
Total globulins	Total cholesterol	Red blood cell count
		White blood cell count

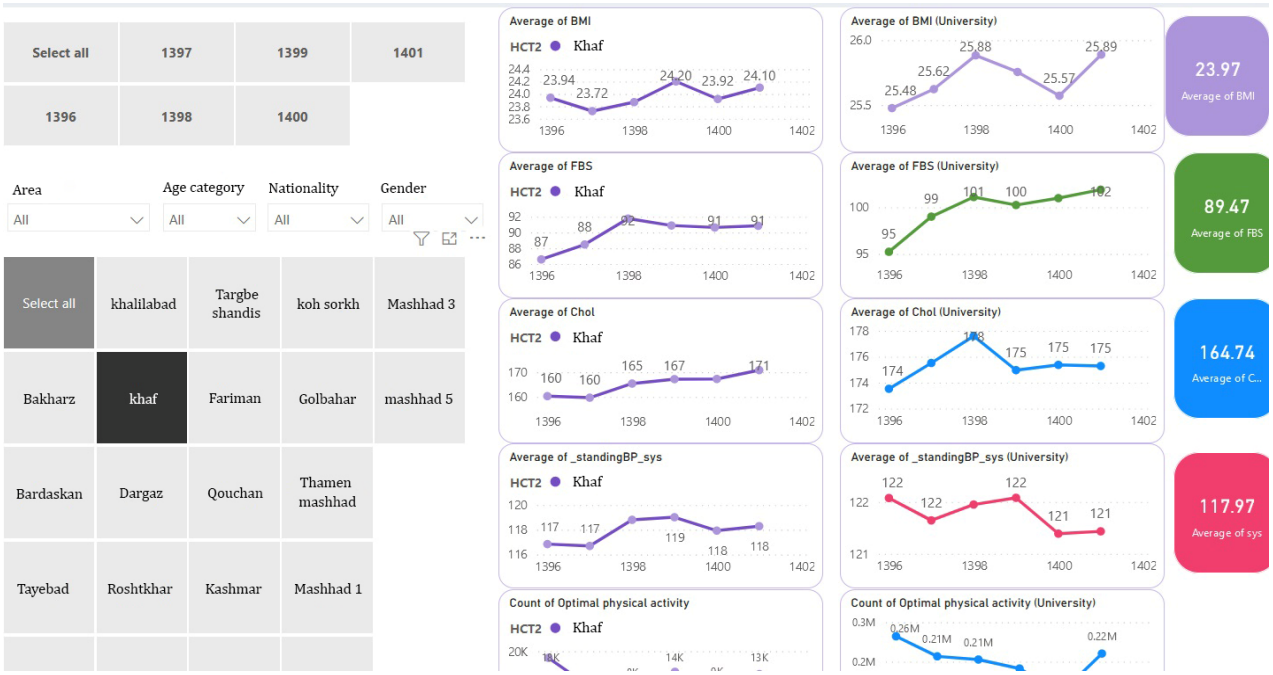

Figure 2. Sample Dashboard of Sina System

Abbasi et al conducted a population-based case-control study on risk factors of sleep disorders in the elderly using the SinaEHR data[19]. Additionally, Bahrami Taghanaki et al utilized the SinaEHR data to study the validity of self-reported hypertension in the population of Mashhad.[18]

In cardiovascular research, Beygi et al compared the Framingham Risk Score and Globorisk cardiovascular risk prediction models in the Iranian population using the SinaEHR data.[13] Furthermore, Hoseini et al evaluated the glomerular filtration rate and compared it with international standard values in a large population-based study, leveraging the comprehensive data available in the SinaEHR system.[14] These studies demonstrate the valuable insights the SinaEHR data has provided for various epidemiological and public health investigations in Iran, covering various topics, including chronic diseases, mental health, and cardiovascular risk assessment.

The vast amount of data available in the SinaEHR system is invaluable for observational and interventional research studies. Linking the SinaEHR data to other systems, such as national death registries and hospital information systems, would provide researchers with integrated data resources to pursue more impactful studies. This integration could improve epidemiological research, enhance clinical insights, expand data for health policy decisions, and facilitate increased research collaboration. Establishing secure and standardized data-sharing mechanisms between the SinaEHR system and relevant databases, both within and outside the Ministry of Health, could help address the current lack of a national data aggregation service and unlock the full potential of this valuable resource for Iranian healthcare research and policy.

A significant strength of SinaEHR is its ability to capture longitudinal patient data to enable impactful analyses. It represents a substantial improvement over paper-based and legacy systems. The data is securely stored using robust health IT infrastructures, providing a low-cost integrated data source with appropriate permissions. However, the need for a national data aggregation service limits comparative analyses against other regional primary care systems.

Researchers interested in leveraging SinaEHR data are advised to obtain ethics approval from Mashhad University of Medical Sciences or their home institution. External institutions require data-sharing agreements to gain access. Overall, the availability of high-quality longitudinal primary care data in SinaEHR is a significant asset for Iranian health research. Ongoing efforts to expand integration and interoperability will further unlock its potential to drive data-informed care delivery and policy improvements.

Discussion

The SinaEHR system represents a significant advancement in Iran's healthcare data infrastructure, providing a comprehensive EHR platform for primary care. Its widespread implementation has established an invaluable resource for informing health policy, enabling disease surveillance, supporting research, and improving the quality of care. Integrating laboratory data and using standardized terminologies like the ICD-10 coding system enhance the utility of the system for clinical decision-making and data analysis.

Several other countries have implemented similar nationwide or regional EHR systems for primary care that enable population health monitoring and research. For example, the Netherlands' IPCI database contains longitudinal EHR data from general practitioners covering over 1.5 million patients. It has been leveraged extensively

for observational studies on diabetes, cardiovascular disease, and cancer.[7,21]

CPCSSN is another multi-province primary care EHR repository containing de-identified patient data from over 1.5 million Canadians.[22] Similar to SinaEHR, it is a valuable resource for chronic disease surveillance, epidemiological research, and quality improvement initiatives.[6,23]

In England, the Royal College of General Practitioners Research and Surveillance Centre has been extracting anonymized EHR data from a network of primary care practices for over 50 years to support public health monitoring and research studies.[24] Its database covers over 35 million patients, demonstrating the immense potential of leveraging primary care EHRs for population health insights across large geographic areas.

The Results Analysis Base of Navarre (BARDENA) is a comprehensive data warehouse that integrates EHRs across the Spanish region of Navarre. It consolidates data from primary care, hospital, and specialized outpatient services for over 660 000 residents of Navarre. BARDENA contains longitudinal clinical information, including diagnoses, procedures, lab results, imaging, medications, and health service utilization captured through Navarre's decentralized public health system.[25]

While the SinaEHR system offers capabilities comparable to these established primary care data networks, it faces some unique challenges in the Iranian context. One key issue has been ensuring comprehensive and standardized data capture from the numerous regional EHR systems beyond SinaEHR.[3] Establishing national data standards and interoperability will be crucial for aggregating data from different platforms to support large-scale analyses and surveillance.

As with any EHR database, maintaining high data quality by promoting consistent documentation practices across providers will be an ongoing priority as the SinaEHR system continues to expand. Robust data quality assurance processes and provider training may be beneficial to maximize the usability of the captured information. The availability of comprehensive longitudinal data in the SinaEHR system presents significant opportunities for improving healthcare delivery and research in Iran that are aligned with other countries' experiences of successfully leveraging primary care EHR system. Initiatives to enhance the integration of SinaEHR with other national data sources and explore use cases beyond primary care could further amplify its impact on the Iranian healthcare landscape.

Conclusion

In conclusion, the SinaEHR system significantly advances Iran's healthcare data infrastructure. It provides reliable real-time primary care data with robust security provisions. Widespread implementation has established an invaluable resource to drive improvements in service delivery, policy decisions, disease monitoring, and research. SinaEHR represents a substantial step forward for Iranian health informatics. Further efforts to expand its integration and scope will unlock additional potential to generate data-driven insights.

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Competing Interests

The authors declare that there is no conflict of interests.

Ethical Approval

Ethical considerations in this study included obtaining permission from the Ethics Committee of Mashhad University of Medical Sciences (IR.MUMS.REC.1397.221).

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