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Barriers and facilitators to implementation of nationwide electronic health records in the Russian Far East: A qualitative analysis

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ABSTRACT

Background: Electronic health records (EHRs) are transforming and revolutionizing the healthcare industry. However, whereas developed countries have a high EHR penetration rate, adoption of EHRs in developing countries is lagging behind. Recently, the Korean and Russian governments have been pursuing economic cooperation in the Russian Far East. Thus, since 2009, Russia's EHR market and healthcare system have been maturing in tandem.

Objective: To qualitatively investigate and analyze the current status of EHRs in the Russian Far East and derive implementation plans for nationwide EHRs.

Methods: A qualitative analysis based on semi-structured interviews with healthcare professionals and administrative officers in the Russian Far East was conducted to illuminate the current status of EHRs and to collect various perspectives on barriers and facilitators to implementation.

Results: The analysis revealed six major barriers and five major facilitators for implementation of nationwide EHRs in the Russian Far East. The barriers include lack of communications, an insufficient system development environment, poor adoption of standard terminology, poor infrastructure, resistance to a new system, and poor functionality. Facilitators include strategic government planning, centrally managed systems, health information exchange, willingness to use new functions, and well-established work processes.

Conclusions: This study's results, along with the experiences of developed countries that have already successfully introduced EHRs, will help support successful introduction of EHRs in the Russian Far East.

1. Introduction

1.1. Background

Digital transformation is revolutionizing in healthcare industry [1,2]. At the heart of this revolution are electronic health records (EHRs) [3,4]. In 2009, the United States implemented the Health Information Technology for Economic and Clinical Health (HITECH) Act, prompted by evidence that EHR use improved the quality of healthcare [5]. By 2017, 96 % of general medical and surgical hospitals, 89 % of rehabilitation centers, 87 % of children's hospitals, and 59 % of acute long-term care hospitals in the US had begun to utilize certified EHRs [6,7]. South Korea also has a high EHR penetration rate; the Health Insurance Review and Assessment Service (HIRA) indicated that as of

2017, 93.6 % of hospitals and 91.6 % of private clinics in the country had adopted electronic medical record (EMR) systems [8]. However, EHR adoption rate in developing countries is lagging. Nationwide implementation of EHRs is urgently needed to improve healthcare quality in these countries.

Recently, the Korean and Russian governments have engaged in economic cooperation in the Russian Far East [9]. Russia's EHR market is maturing in tandem with its healthcare system, with a compound annual growth rate of 10 %–14 % since 2009 [10]; South Korea is an active exporter of EHR systems. BESTCare, a system developed through a national project and thrice accredited with Health Information Management Systems Society EHR Adoption Model (HIMSS EMRAM) stage 7, has already been shared with the Middle East, East Asia, and the US [11]. Within this context, the present study was conducted to

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understand the medical and medical ICT environment of the Russian Far East and to provide consultation for a nationwide EHR adoption plan.

1.2. Prior research

The US has demonstrated significant achievement in national EHR dissemination projects, with one of the highest EHR adoption rates in the world. Under the federal government's guidance, nationally distributed EHRs are actively used to improve medical care quality and reduce costs [6,12]. However, state-led EHR dissemination programs have also had unexpected side effects, such as unfulfilled expectations, EHR market saturation, an innovation vacuum, physician burnout, and data obfuscation [13]. South Korea, in contrast, exemplifies an increased EHR adoption rate regardless of national initiatives. However, South Korean EHRs are used to manage single hospitals or private clinics only, or to make claims to national institutions. It has thus been unnecessary for South Korean hospitals to use EHRs for health information exchange (HIE). Additionally, the hospitals have had difficulty creating value from the big data collected in EHRs [14–17]. In England, the National Health Service (NHS) sought to implement nationwide EHRs in secondary care (i.e., the NHS Care Records Service) but found the task both time consuming and challenging [18]. In developing countries, nationwide distribution of EHRs by the government could help standardize healthcare processes and improve care quality, because differentiation in EMR system implementation often leads to incompatibility, complicating cooperation between hospitals and limiting effective use and analysis of data from different systems or locations [19]. To successfully implement nationwide EHRs, national governments should prepare strategic plans to effectively and easily disseminate EHRs. However, few studies have explored the barriers and facilitators to implementation of nationwide EHRs.

1.3. Aim

This study aimed to qualitatively investigate and analyze the current status of EHR implementation in the Russian Far East, and thereby to derive a plan for nationwide implementation of EHRs.

2. Methods

2.1. Design

The research was conducted in two stages. First, semi-structured interviews were conducted to examine the working environment, IT status, and EHR implementation in hospitals in the Russian Far East. Next, based on the survey, a master plan for the development of the target system was established.

By conducting qualitative analysis based on semi-structured interviews with healthcare professionals and administrative officers in Russian Far East, this study sought to reveal the current status of EHRs in the region and to collect various perspectives on barriers and facilitators to EHR implementation. To conduct qualified qualitative research, this study followed Consolidated Criteria for Reporting Qualitative (COREQ) Research Guidelines [20].

2.2. Setting and participants

This study's semi-structured interviews were conducted at the state medical information center of Primorsky Krai, the Sixth Outpatient Hospital, a national children's hospital, a private children's hospital, the Far Eastern Federal University Hospital, and the Primorsky Krai Department of Health.

To design the qualitative semi-structured interview questionnaire, a preliminary survey was conducted with 13 chief executive officers of the Moscow Health Department Municipal Hospital, who visited Seoul

Table 1

Semi-structured Interview Questionnaire.

1. Please explain the health information policy relevant to EHR adoption in the Russian Far East.
2. From a technical perspective, are there any problems with introducing nationwide EHRs?
3. From a user's perspective, are there any issues that might arise from introducing nationwide EHRs?
4. What types of medical information systems are you currently using?
5. Are there any standard techniques or terminology introduced in your current EHR system?
6. What are the current technical platforms for developing or maintaining EHRs?
7. Please describe the business process associated with your current EHR system (e.g., admission, discharge, and transfer, order communication system, pharmacy, billing, etc.).
8. Are there any issues with EHRs that need to be resolved?
9. Do you have any suggestions or recommendations for EHRs to improve your work experience?
10. Is there anything else you want to mention regarding EHRs?
11. What screens or functions do you use in the EHR, and how do they impact your daily practice?
12. What do you think would have helped to better implement nationwide EHRs?
13. How do you manage information about risky medications, such as opioids and chemotherapeutic agents?

National University Hospital (SNUBH) to participate in educational programs. Basic information on the 13 participants and the interview results of the interview are presented in Supplementary Table 1. The pre-interview was designed based on the factors considered to be important for the introduction of EHR at the national level with reference to the certification of HIMSS EMRAM. The detailed criteria we adopted from the certification is provided in supplementary material.

The preliminary questionnaire included 55 questions in nine areas: 1) Type and size of hospital; 2) Type and size of workforce; 3) Number of hospital visits; 4) Information strategy plan and dedicated department; 5) Information infrastructure (network, computer equipment, medical information system) and maintenance; 6) Medical information exchange; 7) Necessity of a medical information certification system; 8) Information security (personal information security and infrastructure security); and 9) National support plans for to promote informatization. Based on the preliminary questionnaire, a basic questionnaire was constructed, as shown in Table 1.

The study participants were selected through purposive sampling [21]. The goal was to include participants from various professions who had an in-depth knowledge of the work processes involved with EHRs and the hospital IT environment in the Russian Far East.

2.3. Data collection

Data were collected through face-to-face, semi-structured interviews. Professionals from each department of SNUBH participated in the interview sessions. Tae-gi Kim (BA, computer engineer in charge of SNUBH IT system management) led the interview with an IT technician at the state medical information center. Jungwon Cho (MS, unit manager of drug information team in the SNUBH Department of Pharmacy) led the interview with clinical pharmacists in the Sixth Outpatient Hospital, the national children's hospital, and the private children's hospital. SYJ (MD, MPH), HYL (MD, PhD), and Sergey Park (MD) led the interview with clinicians, government officers, and executive officers. Interviews were translated by a native Russian (Yulia Park) and audio-recorded in a closed office or conference room. Each interview lasted from 20–60 min. During the sessions, each interviewer followed the semi-structured interview questionnaire on topics related to the interviewees' experiences and thoughts regarding their environment and strategy for nationwide EHR adoption. The researchers followed the interview guidelines developed based on previous research and approved by members of the eHealth research team at SNUBH.

2.4. Data analysis

Exploratory content analysis was employed to capture interviewees' perspectives on implementation of nationwide EHRs in the Russian Far East. The recorded interviews were transcribed by the researchers, with repeated rounds of review and correction to enhance the accuracy of the transcriptions. To ensure reliability, the transcripts were independently read and coded by two individual researchers (SYJ and HYL). The initial codes were generated inductively from the data and grouped into three major themes by each profession: hospital IT environment; barriers and facilitators; and ideas for strategic implementation of nationwide EHRs. Themes identified as relevant to the study were discussed until SYJ and HYL agreed that they had reached saturation. All researchers verified the results and formed a consensus on the clarified themes.

2.5. Ethics

Before conducting the interviews, the researchers explained the research objectives and purpose. All participants voluntarily signed informed consent forms. No participants refused to participate in an interview. The research protocol was approved by the Institutional Review Board of Human Research of Seoul National University Bundang Hospital, Republic of Korea (Protocol No. B-1910/568-312).

3. Results

3.1. Participant demographics

Interviews were conducted between October 2 and October 4, 2019. The 25 total participants included six physicians, one nurse, three pharmacists, eight IT developers, four government officers, and three executive officers. Participants' demographic characteristics are presented in Table 2. Detailed information on representative participants in each institution is provided in supplementary material.

Hospital officials, including the physicians, nurses, pharmacists, and executive officers, were asked about the overall state of hospital IT, including EHR systems. Government officers were asked about medical information policy for the Russian Far East and plans for the introducing nationwide HIE.

Table 2
Demographic Characteristics of Participants (N = 25).

Category	Variables	n (%)
Interviewee group	Physicians	6 (24)
	Nurses	1 (4)
	Pharmacists	3 (12)
	Executive officers	3 (12)
	Government officers	4 (16)
	IT developers	8 (32)
Gender	Male	12 (48)
	Female	13 (52)
Age (years)	< 30	0 (0)
	31 – 40	8 (32)
	41 – 50	4 (16)
	51 – 60	11 (44)
	61 – 70	2 (8)
	≥ 70	0 (0)
Career length (years)	< 9	9 (36)
	10 – 19	8 (32)
	20 – 29	5 (20)
	30 – 39	3 (12)
	≥ 40	0 (0)

3.2. Barriers

Six significant barriers to implementing nationwide EHRs were identified, related to the current IT environment in hospitals.

3.2.1. Lack of communication between hospitals and the government

Russia has legally allowed telemedicine since January 2018. By 2020, more than 20 % of Russia's population is expected to utilize remote healthcare. Russia has also set a goal to gradually implement nationwide EHRs by 2024, led by the central government. Therefore, an EHR adoption strategy must these legal and policy changes into account. The study's participants were aware of the government's general policy direction, but not its specific methods or strategies. Therefore, the central and local governments should continue to communicate with local hospitals on the introduction of nationwide EHRs.

“Our hospital has its own medical information system [EHR system] and we are trying to develop it. However, the government is not sure how to develop the direction of integrated EHRs.”

3.2.2. Insufficient system development environment

System developers were generally unsatisfied with the development environment, expressing that the development environment provided by the government is unsuitable for development of EHRs for large hospitals. Successful development and adoption of nationwide EHRs requires an environment that can meet the development needs of hospitals of all sizes.

“Our university hospital uses the EMR program on the 1C platform, but it is not a finished product. It is still in development.”

“The platform called 1C is good for small and outpatient clinics, but not for large clinics. In particular, there are many inadequate functions for medical record integration. However, the 1C platform does have the advantage of being user-friendly.”

3.2.3. Poor adoption of standard terminology

One of the most important factors in successful introduction of nationwide EHRs is following interface standards and using standard terminology. The medical industry is particularly diverse in its types of jobs and terms used. Introducing standard terminology is particularly essential for creating value by integrating data from EHRs in many different hospitals.

“Currently, the Russian medical information system uses the international common classification standard, but only some doctors and pharmacists use the standard, and most occupations do not use it.”

3.2.4. Poor infrastructure

To support comprehensive EHRs, infrastructure must be in place. For example, to integrate diagnostic testing information, a device supporting EHRs must be used, and to integrate imaging information, a picture archiving and communication system (PACS) that supports EHR is necessary. To successfully develop and deploy nationwide EHRs, compatible infrastructure must be introduced.

“The Sixth Outpatient Hospital is an internal medicine-oriented hospital consisting of an anti-cancer day ward and a trauma center. Because it is not computerized, test results must be entered manually. Diagnostic and imaging tests are not computerized yet either, but a computerized system will be introduced next year.”

3.2.5. Resistance to a new platform

To introduce a new IT system, lack of IT literacy and vague fear of the new system must first be addressed. Older users, in particular, are prone to resist new environments. In fact, at one hospital, almost all doctors actively utilized EHRs in all departments except internal

medicine, in which the doctors were older.

“Physicians in internal medicine do not use the EHR system because they are older and have difficulty learning how to use computer programs. More than 90 % of medical practitioners other than internists use EHRs.”

3.2.6. Poor functionality

Some hospitals were already using government-developed EHR systems. However, because insufficient functionality made it impossible to conduct all the hospital's work using the government-developed system. In contrast, the private children's hospital developed and used an EHR system to suit the specific hospital's operations and purposes. The user experience of EHRs is important. Negative perceptions of government-developed EHR systems can limit future EHR-enhanced functionality.

“The state-developed EHR system has been in use since January 2019. Drug prescription and nursing-related functions are available, but only in some wards. Important functions such as drug management and transfusion management have not been developed yet, so the necessary records must be written by hand.”

3.3. Facilitators

Five significant facilitators for nationwide EHR implementation were identified, related to the current IT environment in hospitals.

3.3.1. Strategic plan by the government

Strong national commitment is critical to success in introducing nationwide EHRs. It is also important to establish and follow specific and actionable plans. The government officials interviewed in this study repeatedly expressed strong commitment to improving EHRs.

“With the president's strong commitment, Russia is pushing ahead with a long-term phased plan to improve the health information system by 2025 by incorporating not only the federal budget but also state budgets. The plan consists of three stages that begin with applying the medical information system to entire hospitals, then upgrading the system, and finally sharing data between the main hospitals.”

3.3.2. Centrally managed systems

In addition to EHRs themselves, national organization and operation of the EHRs is important for success in nationwide implementation. Some hospitals in the Russian Far East already use a centrally managed system, which benefits introduction and improved functionality of EHRs.

“There are a total of seven outpatient centers in the district of about 60,000 people. Our hospital first established its computer system in 2012, and introduced the current EHR system in 2015. Six outpatient clinics in different districts use the same system, all of which are centrally managed.”

3.3.3. Health information exchange

To expand nationwide EHR use, improve medical care quality, and reduce costs, a smooth exchange of health information must be possible between the hospitals and clinics that use EHRs. Due to Russia's national policy to introduce or encourage HIE, some hospitals have already begun to exchange information with neighbors through EHRs.

“We use a framework called 1C that has a patient appointment, record, prescription, and billing system. We can exchange prescription information with nearby pharmacies.”

3.3.4. Willingness to use new functions

An important factor in the successful introduction of EHRs is

whether users actively use the system's main functions. Active interest in improving hospital operations through use of EHRs should also be maintained. Most of the hospitals surveyed were highly interested in improving hospital operations through EHR use and introducing new features.

“Our hospital is 100 % operated by EMRs. We are having a hard time developing our own Clinical Decision Support System(CDSS). For patients' convenience, I would like to develop and offer the ability to change outpatient appointment dates and check health information online.”

3.3.5. Well-established work processes

Successful EHR deployment requires not only good software but also well-established work processes involving EHRs. Most of the Russian Far East hospitals surveyed were already adapted to work using EHRs.

“Using the EHR system, patients are identified by name, date of birth, and a copy of their passport. If there is an error in the system, we follow the guidelines provided by the developer. When problems arise, all records are written by hand and then re-entered into the system when it is back to normal.”

4. Discussion

4.1. Principal findings

This qualitative study identified six major barriers and five major facilitators to implementing nationwide EHRs in the Russian Far East. Four barriers related to technical issues (insufficient development environment, poor infrastructure, poor adoption of standard terminology, and poor functionality in EHR systems). The other two related to users (resistance to a new system and lack of communication during the implementation planning). The five major facilitators included strategic government planning for implementation, centrally managed systems, and local HIE, along with the hospital-side factors of users' willingness to use new functions and well-established hospital work processes. We analyzed the differences of barriers and facilitators between this research and previous studies and presented the comparison table in the supplementary material. To our knowledge, this is the first study to qualitatively explore the important barriers and facilitators to introducing nationwide EHRs in the Russian Far East region.

4.2. Economic and sociocultural healthcare environments in the Russian Far East

Russia's healthcare system is highly centralized [22]. Public funding of healthcare greatly exceeds that of the US [23]. However, variation in healthcare service delivery makes it difficult to improve the quality of care in Russia, a main reason nationwide EHRs should be implemented [10]. The Russian EHR market is growing in tandem with its healthcare system, with an annual growth rate of 10 %–14 % since 2009 [24]. Large private vendors have entered the Russian EHR market to provide unified access to healthcare data and HIE.

A previous study noted common barriers to EHR implementation in Russia, including lack of technical expertise and economic incentives and distrust of electronic information due to the culture of the Soviet Union [10]. However, almost all end users who participated in this study exhibited positive attitudes toward new EHRs. The study also identified various facilitators to implementation of nationwide EHRs, including a strong commitment by the government, centralized medical information management systems (already adopted to a certain degree), willingness of users to adopt new functions, and well-established in-hospital work systems.

Public-private partnerships (PPPs) have recently been expanded in Russia, now comprising 10 % of overall healthcare spending. For

example, on December 26, 2019, SNUBH signed a participation agreement with the International Medical Cluster (IMC) Foundation to establish a smart hospital in Moscow's Skolkovo international medical hub [25]. If such partnerships are utilized to implement nationwide EHRs, the speed of adoption can be increased.

4.3. Status of IT infrastructure in the Russian Far East

Most IT developers who participated in this study anticipated that Russia's poor infrastructure would hamper adoption of EHRs. In particular, many concerns were expressed regarding the environment for EHR development and operation. Russia has been working to implement nationwide healthcare infrastructure since the early 2000s [26]. A UK Trade and Investment report indicates that the Russian government has committed approximately USD 7 billion to healthcare infrastructure upgrades [27], and the Russian 2020 Health Program aims to improve the efficiency and accessibility of healthcare [28]. It also plans to improve and complement the infrastructure and medical services in the healthcare sector, introduce customized medical services, and foster new health workers. Nevertheless, the medical IT developers interviewed in this study noted that the development infrastructure for EHRs is still lacking, an issue that must be resolved before nationwide EHRs can be implemented successfully. For the government's EHR distribution project to succeed, its infrastructure improvement project, which has already been in progress for 20 years, should be accelerated to establish an adequate technical environment introduction of EHRs.

4.4. Adoption of health information standards

To successfully disseminate nationwide EHRs and facilitate meaningful exchange of medical information an international standard terminology framework must be introduced. Terminology standards such as SNOMED-CT, ICD-10-CM or ICD-9-CM, RxNorm, LOINC, WHO-ATC, and ICNP 2.0 should be actively introduced from the start of EHR development. Additionally, all job divisions in hospitals, not only medical staff, should employ the standard terminology so that medical big data can be used in a valuable way. For example, although the United States has successfully implemented government-led EHR dissemination programs, it still suffers from deficits in HIE. To avoid such difficulties, Russia must successfully facilitate HIE from the initial introduction of EHRs.

4.5. Resistance to a new system

Older staff members exhibited general anxiety regarding new systems. This finding is similar to a previous study that found age to associate with people's satisfaction with EHR adoption [29,30]. Older age is related to lower computer literacy. Thus, the skill sets needed to handle tasks using EHR systems can vary by age group. A number of older staff members were not exposed to computers in the past. This can be solved through well-executed training programs, which should be prepared to provide and make new EHR systems accessible to all age groups.

Overall, hospitals and government agencies in the Russian Far East are eager to introduce nationwide EHRs, but the technical, social, and institutional conditions do not yet support widespread implementation. In particular, the federal government has not shared details of its EHR development plan with local governments and hospitals, leaving them unclear on the direction and expectations of the system. Even in the development process, the federal government must work with local governments and hospitals to ensure that EHRs satisfy the functions required by actual users.

Russia has already introduced telemedicine in 2018, and aims to implement healthcare ICT by 2020, with the goal of providing telemedicine to 20 % of Russia's population [31]. The government is also strongly committed to establishing and improving nationwide EHR use

by 2024, and if appropriate plans are implemented in stages, this goal can be achieved [32]. A pilot project could center on several hospitals in the Russian Far East, borrowing models from countries or regions that have already successfully introduced EHRs; alternatively, PPP projects could create a success model through cooperation between Russian hospitals and the private sector.

As a result of this study, we have learned several lessons for the successful introduction of EHR at the national level. First, to ensure that we do not repeat the mistakes of other countries, the government should consider the appropriate introduction of terminology and interface standards from the onset. For instance, they can consider SNOMED-CT (Systematized Nomenclature of Medicine Clinical Terms) for medical terms providing codes, terms, synonyms and definitions clinical documentation and reporting, ICD-10 (International Disease Classification-10) for diagnosis, LOINC (Logical Observation Identifiers Names and Codes) for health measurements, observations, and documents, WHO-ATC (World Health Organization - Anatomical Therapeutic Chemical Classification System) for medication, ICNP 2.0 (International Classification for Nursing Practice 2.0) for nursing, and HL7 (Health Level 7) for interfaces of medical devices and components of hospital information system. It is advantageous to introduce an international standard system rather than a national standard. As seen in examples of collaborative research in international health and medical crisis situations such as the coronavirus disease (COVID-19) pandemic, the infrastructure for medical information exchange must be designed to meet international standards in the first place so that it is possible to exchange medical information while reducing costs in the future. When the standard system is actively introduced by the central government, a foundation environment is established in which various companies can continue to grow by adhering to the standard system. Second, the government should develop a solid reimbursement plan. The U.S. has rapidly increased its EHR penetration rate in a short span of time based on the reimbursement plan. Korea was able to disseminate PACS in the medical imaging field nationwide in the early 2000s thanks to the national reimbursement policy. Third, cooperations between the central and local government as well as government and private entities are also important. As in the case of the private children's hospital, the private sector already has HIE and PHR as needed. To effectively and efficiently spread EHR at the national level, it is important to discover ideas from private institutions and improve the system based on them to spread them nationwide. Moreover, efforts should be made to improve user awareness and system deployment. EHR dissemination at the national level is not just a simple process of installing the system; it is a comprehensive procedure to introduce standards of medical practice through standard EHR to reduce costs in hospitals and raise the quality of medical care. As seen in examples of collaborative research in international health and medical crisis situations such as the coronavirus disease (COVID-19) pandemic, the infrastructure for medical information exchange must be designed to meet international standards in the first place so that it is possible to exchange medical information while reducing costs in the future [33]. When the standard system is actively introduced by the central government, a foundation environment is established in which various companies can continue to grow by adhering to the standard system. Second, the government should develop a solid reimbursement plan. The U.S. has rapidly increased its EHR penetration rate in a short span of time based on the reimbursement plan [6]. Korea was able to disseminate PACS in the medical imaging field nationwide in the early 2000s thanks to the national reimbursement policy [34]. Third, cooperations between the central and local government as well as government and private entities are also important. As in the case of the private children's hospital, the private sector already has HIE and PHR as needed. To effectively and efficiently spread EHR at the national level, it is important to discover ideas from private institutions and improve the system based on them to spread them nationwide. Moreover, efforts should be made to improve user awareness and system deployment. EHR dissemination at the national

level is not just a simple process of installing the system; it is a comprehensive procedure to introduce standards of medical practice through standard EHR to reduce costs in hospitals and raise the quality of medical care.

4.6. Limitations and future research

This study's strengths include the breadth of clinical disciplines and experience reflected by the interviewees, all end users of EHRs in the Russian Far East Russia. Users from four hospitals and government officers actively participating in nationwide EHR projects were surveyed to investigate barriers and facilitators to introducing nationwide EHRs in detail. Interviews were qualitatively analyzed to understand the factors important to healthcare professionals, IT developers, and government officers.

The study is limited in that participants were recruited from small number of hospitals in the Russian Far East. Therefore, the issues identified may apply only to the local area. However, the study attempted to obtain insights that could be generalized as much as possible, having no dependence on a specific area or system, to derive lessons that can be applied to national planning, especially in a large developing country like Russia.

Future research should collect various opinions from additional hospitals to examine whether the barriers and facilitators proposed in this study apply equally to other healthcare environments.

5. Conclusion

EHRs represent a key aspect of healthcare revolution, allowing hospitals to standardize their work processes, improve care quality, and reduce costs. This study identified six barriers and five facilitators to adoption of nationwide EHRs in the Russian Far East. Along with the experiences of developed countries that have already successfully introduced EHRs, this study's results will help support successful introduction of EHRs in the Russian Far East region.

Data statement

The data used in this study cannot be shared due to the policy of the Institutional Review Board of SNUBH.

Authors' contribution

SYJ and KHL drafted the manuscript as first authors. HH contributed to the discussion. HYL supervised the entire process as corresponding author.

Summary points

What was already known

- EHR adoption rate in developing countries is lagging.
- Nationwide implementation of EHRs is urgently needed to improve healthcare quality in these countries.
- State-led EHR dissemination programs have also had unexpected side effects, such as unfulfilled expectations, EHR market saturation, an innovation vacuum, physician burnout, and data obfuscation

What this study has added

- This study identified six major barriers (insufficient development environment, poor infrastructure, poor adoption of standard terminology, poor functionality in EHR systems, resistance to a new system and lack of communication during the implementation planning) and five major facilitators (strategic government planning for implementation, centrally managed systems, local HIE, users' willingness to use new functions and well-established hospital work processes) to implementing nationwide EHRs in the Russian Far East

- This study's results will help researchers and companies to develop EHRs in the Russian Far East region.

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Declaration of Competing Interest

None declared.

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Appendix A. Supplementary data

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