

Visualization of Usage Status of Healthcare Information Exchange Activity: A Case Study of Mame-NET in Shimane Prefecture, Japan

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Regional Health Information Exchange (HIE) networks have been introduced to facilitate information sharing between hospitals and clinics. An overview of the accessed patient information was conducted to enhance HIE utilization in Shimane Prefecture. Clinics and home nursing facilities had the most substantial browsing activity, followed by hospitals. Clinics were the ones that most frequently accessed hospital information. The numbers of home nursing facilities and clinics that accessed hospital information were comparable. The primary information requests focused on patients' medical records (Subjective, Objective, Assessment, and Plan). HIEs have diverse functionalities and are indispensable for those accustomed to them; however, global challenges persist in improving their overall adoption. To further encourage the utilization of HIEs, it is essential to analyze current usage patterns thoroughly, model practical usage scenarios, and generate interest in a broader user base.

Keywords: Health Information Exchange (HIE), information sharing, patient information, utilization, browsing activity, adoption challenges

INTRODUCTION

In recent years, the rapid digitization of healthcare systems in Japanese medical institutions has led to the widespread adoption of electronic medical records (EMRs). By 2020, 57.2% of hospitals (excluding psychiatric hospitals) and 49.9% of clinics (excluding dental clinics) were using EMRs in Japan [1]. Regional Health Information Exchange (HIE) networks have emerged as instrumental mechanisms to facilitate the seamless sharing of patient medical information across various healthcare facilities [2]. The primary functions of HIE networks include access to patient medical records, verification of test results, medical image sharing, allergy information, and prescription status. HIEs facilitate seamless data exchange among healthcare providers, enhancing convenience for medical professionals and overall patient care quality [2,3]. HIEs have been established throughout Japan to bolster collaboration among medical institutions. There are approximately 300 networks currently in operation, varying in scale from local municipalities to secondary medical service areas and prefectural levels [2].

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Previous reports on the development and implementation of HIE functions and the creation of collaborative structures have demonstrated their usefulness [3-14]. Through HIE, diagnostic image data taken at hospitals can be directly viewed on monitors at clinics [6]. The data stored in HIEs can also allow medical institutions to uphold patient treatment even if a disaster destroys these institutions [8], which is important in the context of Japan and its history with natural disasters. However, despite some large HIEs having substantial patient enrollment covering a significant local population, many networks in Japan face challenges in expanding their user base [2]. There is a lack of understanding regarding the utilization patterns and localized activities within these networks. To develop strategies for increasing HIE utilization, it is necessary to understand the existing operational activities within HIEs.

This study aims to identify high-activity usage methods by analyzing the access logs of "Mame-NET," an HIE operating in Shimane Prefecture. The study focuses on mapping localized HIE utilization and identifying key features of its most active medical institutions.

MATERIALS AND METHODS

Data source

This descriptive study is based on the access logs of Mame-NET, an HIE in Shimane Prefecture [15]. A total of 315 institutions utilize Mame-NET as of 2021, with approximately 65,000 registered patients. The participating institutions included 35 hospitals, 157 clinics, 72 pharmacies, and 45 home nursing facilities. These were divided into two categories, namely "facilities that provide medical information and access other medical institutions" and "facilities that only browse." A total of 33 hospitals, 112 clinics, and 70 pharmacies provided patient medical information. The medical information provided includes summaries, medical records (Subjective, Objective, Assessment, and Plan), physiological examination records, laboratory tests, radiological tests, endoscopy, prescriptions, injections, surgical records, blood transfusion, dialysis records, nursing records, and other tests. Each facility determines which information will be uploaded. Patients registered for

Mame-NET by providing consent and using it at locations such as hospitals, clinics, pharmacies, and community outreach events. Subsequently, medical information is shared within Mame-NET, enabling healthcare institutions to access medical records authorized by the patients and logged by other healthcare facilities.

We obtained access logs with permission from the Shimane Medical Information Network Association, which manages Mame-NET. All records accessed on Mame-NET were stored on the Shimane Medical Information Network Association server.

Aggregation of access logs

We collected access logs stored on the server for a one-month period from October 1 to October 31, 2021—the extracted access logs show which items are viewed by which institution and when. The log unit usage is denoted by a single click, which indicates the instance when the information is viewed. As healthcare workers often open multiple pages on Mame-NET to investigate a single patient, the number of clicks does not directly correspond to the actual number of patients. We did not obtain any information related to patients' medical care. Furthermore, the extracted access logs are stored at the corresponding author's institution, and this study was approved by the Medical Research Ethics Committee of Shimane University Faculty of Medicine (20210921-1).

We tabulated the information referenced by institution typology and used standard descriptive statistics to present access logs recorded on Mame-NET over one month. All the analyses were performed using Microsoft 365 MSO (Microsoft Office 365; Microsoft Corp., Redmond, WA, United States).

RESULTS

A total of 37,360 access logs were collected. Table 1 shows the number of logs accessed between institutional types during the month. Clinics and home nursing facilities had the most frequent browsing activity, followed by hospitals. Clinics most frequently accessed (16,874 clicks) hospital information. Home nursing facilities accessed hospital information (13,262 clicks) at a comparable rate. Information

Table 1. Number of logs between institutional types

| Browsing institutions | Browsed institutions | | |
|-------------------------|----------------------|---------|------------|
| | Hospitals | Clinics | Pharmacies |
| Hospitals | 2,068 | 764 | 4 |
| Clinics | 16,874 | 1,465 | 3 |
| Pharmacies | 717 | 36 | 38 |
| Home nursing facilities | 13,262 | 2,125 | 4 |

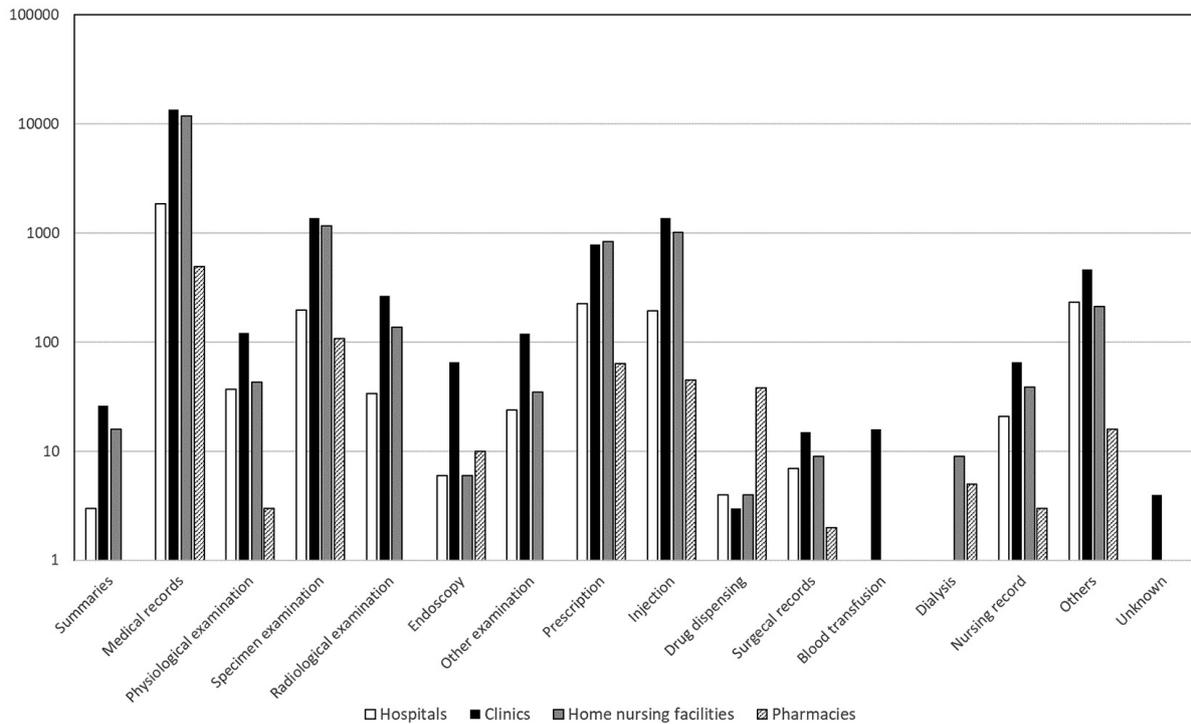


Figure 1. Medical information accessed by each type of institutions.

The number of times accessed is displayed on a logarithmic graph. Medical records on Mame-NET were the most frequently viewed by each type of institution; summaries had few views.

provided by hospitals was the most frequently accessed (32,921 clicks). Pharmacy access was generally low.

Figure 1 presents the information viewed by each type of institution. Given the substantial difference in log numbers between clinics, home nursing facilities, and other facilities, they were represented in a logarithmic graph. All facilities tended to refer most frequently to medical records, followed by drug prescriptions, injections, and antibody testing records. Hospitals, clinics, and home nursing facilities exhibited similar information preferences.

DISCUSSION

HIEs were initially introduced to facilitate informa-

tion sharing between hospitals and clinics. In practice, clinics referring patients to hospitals through HIEs can monitor the treatment, recovery progress, and discharge status of patients at the receiving hospitals. The use of hospital records during discharge has proven to be highly beneficial because it enables the inference of current patient medical condition through access to a continuous stream of data. This trend has been observed in various HIEs, emphasizing the advantages of strengthened collaboration between hospitals and clinics [16,17].

A notable feature of Mame-NET is its inclusion of home nursing facilities, dental clinics, and pharmacies in its framework since its introduction in 2013. While some hospital stakeholders were initially skeptical about expanding the scope of accessible

facilities, the current usage of the HIE by home care facilities is surpassing that of clinics. Importantly, some facilities showed extremely high access activity, but when calculating access per facility per month, it was observed that clinics had 117 and home nursing facilities had 342 accesses. This underscores the utility of accessing hospital and clinical information for nursing patients receiving home care. This accessibility is a notable benefit in the trajectory of future HIEs.

Interestingly, our study anticipated that the utilization of pharmacies would increase; however, the actual uptake was poor. It would be advantageous for dispensing pharmacists to provide appropriate guidance to patients collecting their medications by swiftly accessing medical information from healthcare institutions. This aligns with the specialized expertise expected of pharmacists. Therefore, there is a need to explore avenues for improved uptake by pharmacies [18].

An investigation into the accessed patient information was conducted to enhance the utilization of Mame-NET. The primary focus was on referencing patient medical records (Subjective, Objective, Assessment, and Plan), followed by prescriptions and test results. This trend was consistent across hospitals, clinics, and home nursing facilities. Summary references were relatively infrequent, suggesting that users may have sought more recent and detailed patient information.

From a technical standpoint, Mame-NET's ability to rapidly distribute the information entered by healthcare facilities on the server ensures that up-to-date information for hospitalized patients aligns with user preferences. Directly accessing patient information, prescriptions, and test results via a tablet or computer is more rapid and accurate than contacting the attending physician via phone or email. Although originally developed for clinical physicians, Mame-NET has become indispensable for home care nurses, creating an environment for remote care comparable to in-hospital care.

Despite its convenience, Mame-NET faces several challenges. While some healthcare institutions use it extensively, many do not fully engage with it. HIEs have diverse functionalities and are indispensable for those accustomed to them; however, global chal-

lenges persist in improving their overall adoption. Previous research attempted to identify the factors hindering the effective utilization of HIEs, and it is important to eliminate the adoption barriers identified in these cited studies [19-21]. To increase the adoption of HIEs, it is essential to provide a detailed analysis of current usage patterns, model practical usage scenarios, and generate interest in a broader user base. Additionally, if it becomes clear that HIEs offer good value for money to healthcare institutions, HIE usage may increase in many medical facilities. Thus, future cost studies of HIEs should be conducted to support HIE use. It is also important for healthcare professionals to be made or become aware that HIEs enhance care quality, which can be made possible through repeatedly promoting related information by distributing easy-to-read manuals and other materials.

Limitations and Future Research

Ideally, high activity and utilization of HIEs across all affiliated facilities are desirable. However, there is considerable variation in usage levels among different facilities. It is crucial to note that the data aggregation in this survey was influenced by the access counts of super users. In addition, this access log investigation was limited in the information obtained regarding non-accessible facilities. If HIEs are to be positioned as a cornerstone of the regional healthcare infrastructure and actively introduced in the community, strategies must be devised to encourage more healthcare institutions to adopt the system completely. We are committed to ongoing investigations and interventions for promoting the adoption of Mame-NET.

CONCLUSION

It has been shown that HIEs have expanded their utility beyond the initially envisioned collaboration between hospitals and clinics to include applications in home healthcare. This constitutes a significant discovery, indicating the future direction of HIEs. To further improve HIE adoption, it is essential to have a detailed analysis of current usage patterns, model practical usage scenarios, and generate interest in a broader user base.

Ethics Approval

The study was conducted in accordance with the principles of the Declaration of Helsinki. This study was approved by the Institutional Review Board of Shimane University (20210921-1). Informed consent was not obtained for this study, as it was conducted in accordance with the terms of the Shimane Medical Information Network Association, which provided access logs of Mame-NET.

Autor Contribution

K.N. designed the study, the main conceptual ideas, and the proof outline and collected the data on Mame-NET. S.M. analyzed the collected access logs. K.N. wrote the manuscript with support from T.T., H.S., S.K., and T.M.. All the authors discussed the results and approved the manuscript.

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Conflict of Interest

The authors have declared that no conflict interests exist.

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