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Popularization of Medical Information

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Objectives: Despite the popularization of technology and the high penetration rate of smartphones and mobile devices, differences exist in the accessibility, utilization capabilities, and quality of technology depending on users' characteristics. Since these discrepancies can threaten health information equity, popularization of medical information is essential. This review article examines domestic and international cases of popularization of medical information, and discusses the related issues, expectations, and practical measures to achieve the popularization of medical information. **Methods:** In this study, medical information was categorized as Electronic Health Records/Electronic Medical Records (EHR/EMRs; hospital-driven medical information), personal health records (PHRs; user-driven medical information), and patient-generated health data (PGHD; user-generated medical information [outside hospitals]). This article reviewed the domestic and international use status, acceptance rates, and use cases for each type of medical information. Issues and expectations about policies and cases related to the popularization of medical information were also described, and finally, practical measures to accomplish the popularization of medical information were discussed. **Results:** To achieve the popularization of medical information, the following measures should be considered: engaging health consumers to participate in the early stages of information production, cultivating digital literacy, producing easy-to-use and interesting medical content, visualizing health information, and creating a medical thesaurus. **Conclusions:** Healthcare providers should make regular efforts to popularize medical information. The popularization of medical information is an essential process to achieve health equity and digital health equity.

Keywords: Personal Health Records, Electronic Health Records, Consumer Health Informatics, Health Equity, Information Literacy

I. Introduction

The scope of medical information is truly extensive, ranging from medical records created in hospitals to health records and health information derived from those. In general, such medical information can be categorized as Electronic Health Records/Electronic Medical Records (EHRs/EMRs), personal health records (PHRs), and patient-generated health data (PGHD). EHRs refer to medical records that can be used nationwide by various medical institutions, while EMRs contain electronically recorded medical information that is created and used mainly within a single medical institution. PHRs refer to all personal health information individually managed by the relevant patient or user, and PGHD refers to data generated, recorded, and collected outside the hospital

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by a patient or his/her family or caregiver in relation to the patient's health.

The popularization of medical information is a process for achieving health equity based on the concept of equity in health information, according to which health-related information should be provided in consideration of individual circumstances and needs [1]. The popularization of medical information is different from medical knowledge popularization, as it contributes to health equity and, furthermore, digital health equity. In other words, disparities in the quality of healthcare and treatment among population groups can be caused by unequal access to healthcare services, the digital divide, and disparities in medical information [2].

Despite the current popularization of technology and the high penetration rate of communication devices (91% of adults own smartphones as of 2018), various user groups still experience differences in accessibility, utilization capabilities, and quality in terms of technology [3]. Given this, it is a legitimate goal to provide medical information appropriate to the needs and level of users.

The purpose of this study is to examine domestic and international cases and to present practical measures for the popularization of medical information to achieve health equity and further digital health equity.

II. Popularization of Medical Information: Domestic and International Cases

1. EHRs/EMRs (Hospital-Driven Medical Information)

Although EHRs are a groundbreaking idea, no country has yet implemented them in 100% of its medical institutions. In the United States, approximately 94% of hospitals have introduced EHR systems as of 2018. The adoption rate in Europe is still significantly low, but the goal has been to introduce the system to all medical institutions by 2020. More specifically, Europe is attempting to integrate medical information from multiple agencies using a system called HealthConnect. A McKinsey analysis found that this integrated EHR system could not only improve the cure rate of diseases, but could also save about $1 billion in costs as well, including expenses for paperwork or in-person visits to the hospital.

The global EMR system market, worth $14.2 billion in 2020, is projected to reach $20.7 billion in 2025 [4]. In Korea, the Ministry of Health and Welfare introduced the Health Information Exchange project based on the EMR system in 2017 and plans to expand the project nationwide by 2022. According to data from the Korea Health Industry Development Institute, the adoption rate of the EMR system in general hospitals in Korea is fairly high, exceeding 90%, but for medical clinics, adoption stands at only about 60%. The adoption rate of the web-based EMR system is 37.1% in general hospitals [5].

Apple has developed a healthcare information application (Apple Health) in partnership with Epic, the largest EMR company in the United States, with more than 100 million users across the US patients using Epic's smartphone application, MyChart, on their smartphones can browse their medical information, contact medical professionals, and manage their appointments for future visits. Seoul National University (SNU) Bundang Hospital in Korea has built a next-generation hospital information system based on EMR to enable the exchange and access of medical information and data with SNU Boramae Medical Center and SNU Hospital Healthcare System Gangnam Center.

2. PHRs (User-Driven Medical Information)

The global PHR market is expected to grow at an annual average rate of 24%, from $65.7 billion in 2016 to $192.6 billion in 2021 [6]. The PHR market in Korea is projected to grow annually by 12.5%, from KRW 1.217 trillion in 2016 to KRW 2.173 trillion in 2021 [6].

Despite various attempts in Korea, however, monetization in the PHR sector remains difficult, since only a handful of users are willing to pay for PHR services. There also are a number of obstacles blocking more extensive use of such services, such as the availability of telemedicine and accessibility to proper medical devices, as well as insufficient verification of the utility of the services. Under these circumstances, large-sized hospitals in Korea are operating a self-developed PHR system linked to EMRs, while a small number of leading companies have launched PHR platforms, operating PHR-based services on their own [7,8]. To further promote PHR services, Korea should introduce PHR-based patient healthcare services to public hospitals (e.g., Veterans Health Service Medical Centers, Workers' Compensation Hospitals, etc.) with the support of the government, as is the case of the United States and Australia. This would help to raise public awareness of self-care and the utility of PHR services.

Blue Button, which has been used since 2010 by the US Department of Veterans Affairs, allows individuals to access and download personal medical records through the internet in secured text or PDF format. LifeSemantics-LifeRecord, developed in Korea, is an integrated PHR management service provided by a commercial business, not a medical institution or a government agency. Aiming to be an open PHR platform, it provides an environment where the user's lifelog

can be structurally stored and managed in connection with wearable health device brands such as Fitbit and Nike.

3. PGHD (User-Generated Medical Information: Outside the Hospital)

As health consumers change to proactive healthcare, focusing more on disease prevention and management, the value of PGHD is expected to rise and "My Data" (obtained by digital healthcare systems) is becoming more important as well. PGHD is emerging in the healthcare sector because most patients, in practice, spend the majority of their time outside the hospital. Therefore, it is difficult to accurately assess a patient's health status using only data measured on the hospital premises. The merit of PGHD is that it can provide the necessary information for managing a patient's chronic diseases, collecting medical data without requiring him or her to make in-person visits to a hospital. This can also improve patient safety, by providing them with accurate information regarding medications and allergies.

Apple has introduced Apple Watch, which is capable of measuring not only steps taken, heart rate, and sleep patterns, but also electrocardiography (ECG) and oxygen saturation data. The health data measured by Apple Watch can then be shared with various other linked mobile apps. In Korea, the Galaxy Watch Active 2, which is capable of measuring ECG data, was released in 2019. It can collect user health information, automatically measuring exercise data (e.g., walking and cycling) and detecting sleep patterns in four stages.

III. Issues and Expectations regarding Popularization of Medical Information

1. EMRs: Popularization Policy

Currently, EMRs are demonstrating the concept of patient safety by preventing medical accidents in advance, as well as the potential of medical data for medical artificial intelligence (AI) learning. Since each medical institution has different EMR structures, however, EMRs have played a limited role in expanding the usage of medical information. Thus, it may be misleading to claim that Korea has a competitive advantage in the medical AI sector using medical information based only on its relatively high distribution rate of the EMR system. Prior to establishing data sets for medical information exchange and medical AI learning, therefore, the standardization of medical information should be carried out first [9]. Standardized medical information will promote the exchange and utilization of medical information, ushering in the future of highly advanced, next-generation medical care.

2. PHRs: Access to Medical Records

To date, medical records have been created and maintained by hospitals and medical professionals, and patients need to visit the hospital in person to access or issue such records, mostly in the form of paper copies. For some time, however, patients have wanted access to their medical records online, as in the case of online certificate issuance services (which had only been available at the relevant local government offices in the past). The public now wants to receive electronic copies of their medical records via the hospital's website, so that they can conveniently deliver their medical records to a new medical specialist at a different hospital.

Despite the added convenience, however, this method could have limitations in terms of privacy since computerized medical records are personal information. Given the considerably high adoption rate of the EMR system in Korea, an online medical records issuance system serving electronic documents is expected to be implemented in a short period of time, as long as social consensus is built, backed by public demand and proper personal information protection measures. The smooth exchange of medical information between hospitals would eliminate the hassles of issuing copies of medical records every time a patient is transferred to another hospital. In particular, people who need to visit hospitals frequently could enjoy the benefits of requesting and viewing their medical records via web service or e-mail.

3. PGHD: The Example of Diabetes Management

PGHD would be useful for managing diabetes. Patients with poor glycemic control performance must monitor their blood sugar levels by self-checking up to four times a day. This method, however, may not work effectively if the patient does not comply with the doctor's prescription. The introduction of continuous glucose monitoring systems (CGMS) has been of great interest because it can potentially overcome this problem. Diabetes is often considered to be the disease most likely to be conquered by the introduction of digital healthcare [10,11]. In contrast to the high expectations of the CGMS developers and patients with diabetes, however, some endocrinologists specializing in diabetes are concerned that the accuracy of the system is not sufficiently trustworthy. Nonetheless, accuracy will gradually increase if sufficient relevant data are accumulated over time, allowing more doctors to prescribe CGMS to patients and thereby enabling better treatment for patients with diabetes [12,13].

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IV. Practical Measures for Popularization of Medical Information

For the popularization of medical information to advance, it is important to consider the current situation and public awareness in our society. Multilateral investigations and in-depth analyses are also required. Several elements affect the popularization of medical information, including advances in medical care, paradigm shifts, and technological progress in the ICT sector and highly pathogenic and deadly human coronaviruses like the Middle East respiratory syndrome coronavirus (MERS-CoV) and coronavirus disease 2019 (COVID-19) [14,15].

As the focus of modern medical care has shifted from clinical treatment to disease prevention and health promotion, personalized information needs to be provided for each patient as well. In addition, information, once monopolized by traditional media such as broadcasting networks and newspaper agencies, is now widely distributed and produced through the internet and social network services (SNS). This broader access also means that monitoring systems and information filtering measures are crucial, as well as social consensus, so that high-quality medical information can be provided to the general public. Research and development of various types of visual content are also necessary.

To achieve the popularization of medical information, the following measures may need to be considered. First, it is necessary to engage consumers starting as early as possible in the information production (planning) stage. The process of providing medical information can be similar to the process in which product information or content is matched with products for sale. Information services are frequently added to tangible or intangible products for delivery to consumers. Since medical content tends to be difficult to understand and is not consumer-friendly, some people may be marginalized from using medical information. To ensure that medical information will attract consumers' interest and be more actively used, consumer experiences must be discussed and taken into account from the early stages. For instance, journalists writing relevant articles from the perspective of consumers, health information content creators, service design experts, marketers, and other individuals with relevant expertise should participate in demand surveys, the composition and delivery of content, and effectiveness analysis and evaluation.

Second, it will be necessary to analyze consumers' information needs to deliver customized information to them. A consumer identification process must be performed as a priority to ensure that the public can use medical information to promote their health. However, providing personalized information to everyone is not possible in terms of cost and manpower. Until the accumulation of big data and the ability of AI algorithms to personalize such information, efforts should be focused on user group-specific analyses and the production of customized content.

Third, it will be necessary to cultivate the information literacy of the public. The biggest obstacle to the popularization of medical information is educating the public about how to select and understand relevant information. In particular, the elderly and user groups with a low level of education have lower literacy levels, inevitably being left behind as the "information-underprivileged" in the digital age, due to their lack of interest and ability to understand health-related content. To address this issue, a training program entitled "Development of program for news literacy education for the elderly and its effectiveness verification" has been provided. It was designed to help cultivate the ability of the elderly to discern information delivered via media and use it efficiently. As a result, it was found that such programs have not only improved elderly individuals' level of understanding of news, but have also given them an effective way to access and consume knowledge information logically and critically. This sense of efficacy has also led to improved self-esteem and quality of life. The development and dissemination of these educational programs should be considered important because the disparity between different classes or knowledge levels can ultimately lead to inequality in health.

Fourth, the concept of the graphical user interface (GUI) should be applied to medical information design. A GUI is employed to make the exchange of information between humans and computers easier. To popularize a system, it is essential to develop a design that is universally accessible to everyone, regardless of knowledge level or age group. Through an information visualization process, medical information should be provided in diagrams or isotypes, an internationally used visual language that anyone can understand, regardless of educational background, nationality, or age. For example, an electronic manometer for home use (a self-check tool for blood pressure) was designed based on the user's perspective. This device shows blood pressure levels on the display in graphs, icons, or short sentences instead of numerical values, presenting blood pressure information for a certain period of time and other relevant details in easy-to-grasp visuals [16].

Fifth, a standard form of medical (health) information and a synonym dictionary (thesaurus) should be created. Con-

fusing medical terminology and unstandardized forms make it more difficult for the public to acquire accurate medical knowledge, serving as obstacles to the popularization of medical information. To tackle this issue, a synonym dictionary that clarifies different medical terms with the same pronunciation should be created, so that anyone can easily check and accurately understand confusing terms. In addition, it is also necessary to reduce errors or distortions in the medical information contained in the medical glossary or commentary by making sure that only qualified professionals primarily handle medical information. Medical terms are popularized as the terms used by medical providers are delivered to patients and users. Thus, healthcare providers should strive to develop standardized forms and medical terms that can be easily understood by the general public.

V. Discussion

The popularization of medical information is an essential process to achieve public health equity. However, disparities in the accessibility and utilization of medical information between different social and economic groups are growing wider, and issues of asymmetry in medical knowledge and health inequality are becoming worse.

Against this backdrop, this article proposes the following suggestions to successfully popularize medical information. First, medical consumers should be engaged from the early stages of information production. Second, digital literacy education and training should be provided over the long term, based on analyses of public demand for information. Third, competent experts capable of producing easy-to-use and fun medical content should be cultivated. Fourth, medical information should be visualized and presented from the perspective of the user experience. Finally, a medical thesaurus should be created to help clarify confusing terms for users.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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