HIR

Healthcare Informatics Research

What We Need to Prepare for the Fourth Industrial Revolution

Dukyong Yoon, MD, PhD

Department of Biomedical Informatics, Ajou University School of Medicine, Suwon, Korea

We are currently faced with the Fourth Industrial Revolution. The Fourth Industrial Revolution can be summarized as the increase in productivity due to artificial intelligence (AI) and hyper-connectivity [1]. Diverse new technologies are being proposed that integrate the physical, biological, and digital worlds, and new technology will be embedded, even in the human body. For example, a technology like the smart watch combines human body information with the digital world.

Many people have hopeful expectations for the future of the Fourth Industrial Revolution. Among other things, medical and life sciences are being discussed as key areas of this revolution, unlike previous Industrial Revolutions.

AI, such as IBM's Watson, is expected to be able to make a more accurate diagnoses than current specialists in some areas [2]. Wearable Internet technology will monitor our health in everyday life. By 2022, 10% of the world's population is expected to wear apparel connected to the Internet [3]. Even now, smart watches are on the market. Furthermore, due to the development of implantable technologies, the first implantable mobile phone is expected to be commercialized in 2023 [3]. Ultimately, devices with communication and motion/health monitoring functions are expected to be implanted in the body. These changes are expected to help people manage their health more closely.

Under such circumstances, it is necessary to examine whether our medical society is ready for the Fourth Industrial Revolution. The core of this revolution is the creation of new knowledge and values based on connections to various types of information. Because most health data are concentrated in hospitals, how well the current medical society stores information will be key for progression to the Fourth Industrial Revolution.

Are hospitals prepared for this kind of environment? The author recently reported on the current state of information technology in all general and tertiary teaching hospitals in Korea in 2015 [4]. All hospitals were surveyed to estimate the level of adoption of Electronic Health Record (EHR) systems according to 24 core functions on documentation, results, order entry, and decision support. An interesting point is that the EHR adoption rate was higher in Korean hospitals (37.2%) than in US hospitals (15.1%) in 2010, but the opposite result was observed in 2015 (58.1% vs. 75.2%). The level of financial and political support provided to US hospitals by the HITECH Act may have influenced this result. Although this survey was only conducted in Korea, the situations of most countries that do not fully support hospital informatization might be similar.

In addition to basic medical records, diverse types of valuable data are being generated in hospitals, but they are not collected properly. A representative example is that of biosignals (electrocardiogram [ECG], electroencephalogram [EEG], respiratory data, SpO_2, etc.). Previous studies have suggested that these data are useful for predicting major clinical events [5,6]. They could also constitute core data for developing prediction algorithms for wearable devices. However, most hospitals do not store these types of data, or they store them in a form abbreviated every few minutes rather

than as raw data. This situation is more serious in smaller hospitals. However, their data are very important because they represent the general public.

The following tasks should be carried out. First, basic clinical data from daily practice should be computerized to a level that can be used. Second, we should determine what data are being overlooked and begin to store them in a form that can be used in the future. The development of AI technology may reduce concerns about precise standardization. However, data that are not stored cannot be used in any way. Third, these activities should be carried out not only in large institutions, such as tertiary teaching hospitals, but also in smaller institutions. Lastly, full support at the national level will be needed to implement these proposals.

It is time to look back at the foundation of our medical industry to successfully become a fourth industrial society. If we focus only on leveraging the information we have and do not pay sufficient attention to building a basic infrastructure, we will be unable to make the Fourth Industrial Revolution a reality.

References

1. Schwab K. The Fourth Industrial Revolution. Geneva, Switzerland: World Economic Forum; 2016.
2. Weiler A. mHealth and big data will bring meaning and value to patient-reported outcomes. Mhealth 2016;2:2.
3. World Economic Forum. Deep shift: technology tipping points and societal impact. Geneva, Switzerland: World Economic Forum; 2015.
4. Kim YG, Jung K, Park YT, Shin D, Cho SY, Yoon D, et al. Rate of electronic health record adoption in South Korea: A nation-wide survey. Int J Med Inform 2017; 101:100-7.
5. Lehman LW, Adams RP, Mayaud L, Moody GB, Malhotra A, Mark RG, et al. A physiological time series dynamics-based approach to patient monitoring and outcome prediction. IEEE J Biomed Health Inform 2015;19(3):1068-76.
6. Moss TJ, Lake DE, Calland JF, Enfield KB, Delos JB, Fairchild KD, et al. Signatures of subacute potentially catastrophic illness in the ICU: model development and validation. Crit Care Med 2016;44(9):1639-48.