

Peer Review File

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Reviewer A

The authors are to be commended on attempting a literature review of a complex subject. The methods are not described at all, and the quality of English is very poor. I recommend that the authors seek advice from an experienced investigator who can guide them on the appropriate structuring of a scientific paper and an editor who can assist with writing clearly in English.

Reply1: Thank you for your opinion. I requested an English expert from an English correction company to revise the entire manuscript. I am sending the Editing confirmation as an attachment.

Reviewer B

The article is well written, but contains several methodological weaknesses that should be corrected:

Comment 1: In the Introduction section the aim and research gap should be presented.

Reply 1: First of all, we greatly appreciate your time and effort. We would like to thank you for suggesting an opportunity to enhance the manuscript with valuable comments that improve the quality of this study. We have revised the detail of Introduction section the aim

and research gap based on your valuable comments as below:

Changes in the text: (current page 4, lines 67~87, current page 5, lines 88~111, current page 6, lines 112~124)

1. INTRODUCTION

Everyone strives for health, which is mainly due to the development of people's economic and living standards (1). Big data analysis is based on data collection, data preprocessing, and data analysis. Data collection includes information collected from 5G-based Internet of Things (IoT) networks, among other important components and processes, from a variety of external and internal sources. External data is collected from service areas, organizations, and markets, while internal sources include operating systems, support systems, and business systems. There are two types of collected data: a data source and an auxiliary tool. IoT devices can collect multimedia data using sensor nodes as a data collection tool. Cameras and GPS systems are equipped with Wi-Fi and Bluetooth technologies, and network data is collected using packet capture applications such as SmartSniff and ComView. The process of storing data after data collection is called data preprocessing, and data storage is one of the more complex tasks with various properties. After storing data, it generates useful information for analyzing and optimizing it using various machine learning methods. This process is used to improve data efficiency and conform to the requirements (2). In comparison to OECD countries, the rate of population aging in Korea is accelerating significantly. As human life expectancy increases due to rapid demographic changes and the development of modern medicine, people are becoming increasingly interested in healthcare

related to physical activity, as a concern for quality of life is correlated with health-related behaviors. Individual healthcare for people over 100 years old has a significant impact on consumption, investment, and the economy. As more people start using smartphones, they are being used as tools to improve their health and physical strength, which is expected to have a positive impact on the field of mobile health and personal healthcare services. Big data can be used to manage individual health conditions and prevent diseases through smart devices based on health and medical data, suggesting the possibility of health promotion in the new healthcare sector (3). As a data quality management plan, it should consider the importance, accuracy, validity, reliability, completeness, readability, timeliness, accessibility, and confidentiality of the data (4). Big data refers to a technology that extracts value from data and analyzes results beyond the ability of existing database management tools to collect, store, manage, and analyze data (5). Various types of big data development refer to technologies that more accurately predict a diverse modern society and efficiently provide, manage, and analyze personalized information (6). Utilizing big data, which can be an important tool for dramatically enhancing human life in areas such as healthcare, aging, and life extension, can reveal true value (7). Recently, in collaboration with IT companies and hospitals, it has been leading the data economy by providing customized services using life logs (calorie consumption, heart rate, blood sugar level, etc.) and artificial intelligence collected through wearable devices. The global statistics portal Statista forecasts the economic value of data in 2022. It is expected to grow to \$260 billion, and the Korean data market will exceed 32 trillion won. The value and impact of data are expected to be even greater (8). Sharing and integrating data from health information is essential to spreading healthcare, and as data needs to be accessed from multiple locations in a distributed system,

the security and privacy of data are critical (9). In the future, big data information services will continue to develop into personalized management services and expand into the healthcare industry. Big data and AI technologies play an important role in epidemic prevention and control (10). The mobile health (mHealth) app changes personal health and lifestyle based on new information and communication technologies and the IoT and enables user behavior change and disease management through data collection and analysis for clinical trials. Based on patient health promotion and medical cost reduction, we aim to review the acceptability of customized healthcare service apps and develop them through continuous research by actively utilizing big data.

Comment 2: I suggest developing the MATERIALS AND METHODS section. It is necessary to add information about this, the procedure for checking databases, what were the keywords to search them, and what was the criterion for the selection and selection of articles.

Reply 2: First of all, we greatly appreciate your time and effort. We would like to thank you for suggesting an opportunity to enhance the manuscript with valuable comments that improve the quality of this study. We have revised the detail of Materials and Methods based on your valuable comments as below:

Changes in the text: (current page 6, lines 125~134, current page 7, lines 135~157, current page 8, lines 159~164)

2. METHODS

2.1. Search strategy

This review of comments to integrate and critically evaluate the literature presents the potential for health promotion as a new healthcare sector that uses big-data-related health and medical data to manage personal health status and prevent diseases. This literature review was descriptive, but we searched PubMed, Medline, Scopus, RISS, ResearchGate, and Google Scholar according to PRISMA guidelines. Focusing on the use of big data, customized health services, health apps, and mHealth smart devices, we aimed to predict the trend of health promotion possibilities using prior research on the historical background of existing theories and correlations between variables. Figure 1 shows the literature search strategy and review process according to PRISMA guidelines.

2.2. Eligibility criteria

The papers included in this review had to meet the following eligibility criteria. The following studies considered the use of big data, smart devices, customized health services, health apps, and mHealth.

2.3. Screening and data extraction

We considered different article types, such as articles, review articles, internet articles, brief reports, and series, as criteria for inclusion. No restrictions were applied on the date of publication or language. The exclusion criteria included accessible full text without raw data, irrelevant topics, university papers, and dissertations not related to the focus of the review.

2.4. Risk of Bias Assessment

All authors independently assessed the methodological caliber of the included studies.

2.5. Study selection

This is a critical literature review. It employs a descriptive review approach. A total of 453 references were selected using representative journal search sites such as PubMed, Google Scholar, Scopus, RISS, and ResearchGate through PRISMA flows. Accordingly, 43 papers were selected in the final stage from 2007 to 2023. The PRISMA flow chart is shown in Figure 1.

Comment 3: In the Results section, I suggest starting by outlining the main narrative elements in the selected articles, and only later characterizing them.

Reply 3: First of all, we greatly appreciate your time and effort. Thank you for suggesting the opportunity to improve the manuscript with valuable comments that improve the quality of this study. Corrected details in Results section, we have summarized and characterized the main narrative elements based on your valuable comments.

Changes in the text: (current page 8, lines 166~182, current page 9, lines 183~206, current page 10, lines 207~230, current page 11, lines 231~254, current page 12, lines 256~277, current page 13, lines 278~301, current page 14, lines 302~325, current page 15, lines 326~04, current page 14, lines 305~315, current page 14, lines 317~327, current page 15, lines 328~349, current page 16, lines 350~352, current page 16, lines 354~372, current page 17, lines 373~396, current Page 18, lines 397~420, current page 19, lines 421~442)

3. RESULTS

3.1. Leverage smart devices focused on big data

With the development of digital technology and the internet, we can use and add information. With the addition of devices capable of producing big data, such as smartphones, data is growing rapidly, leading to a shift to cloud computing instead of storing individual information. It is premised on the collection of a large amount of data, and big data collects data resources secured online and offline and utilizes useful information through data analysis. When a data pattern is formed when human experience and interaction are made, rather than being developed by technology alone, you can try various possibilities using big data and prepare for real-time risks by analyzing information patterns to identify risks in advance. Resources are recreated by forming and pursuing a network step by step. The issues confronting information services, including big data, are an abundance of data and the need for specialized expertise to derive meaningful data. Smart devices that inform individuals about exercise, health status, health checkups, and health information are evolving in a direction for that is convenient in our daily lives (11). Based on big data, medical cloud service governance, medical cloud service resources, platform public services, platform runtime services, infrastructure, security and monitoring, and access across the platform are composed of an eight-tier architecture. The medical cloud service platform of the smart medical system is a public information service system that supports users receiving medical services through smart devices without geographical restrictions. The smart medical cloud shares and implements data for all medical services. Based on cloud computing technology, it extracts information from big data to find effective information to improve patients' medical

experience and efficiency and supplement medical resources (12). It is important to demonstrate and highlight the benefits of personalized healthcare services to promote mHealth use among older adults who are vulnerable to performance expectations, social impacts, and environmental risk factors. Awareness of the target person's surroundings also plays an important role, and there is a need to promote these services, especially at the family and community level. In addition, support from trusted service providers should be strengthened to ensure that older adults continue to receive technical assistance, and a variety of strategies should be used depending on the presence or absence of chronic conditions. The reliability of bio-signal measurement using wearable devices should be further emphasized to increase the use rate among the elderly with chronic diseases (13). It is possible to collect patient health information and utilize various sensors through the IoT network. Specifically, the heart sensor is used for analyzing a patient's heart rate, and the body temperature sensor is used to record the patient's body temperature. The pressure sensor determines the pressure value, so the glucose level or the respiratory, pulse, and gas sensors can collect body information to monitor the patient's health. IoT technology recognizes the current situation in real time with accuracy. Medical sensors and devices help monitor physical problems. After collecting the monitored data, it is sent to the cloud to improve the performance of the medical device by integrating with the smartphone or some medical devices and smartphone applications (14). It is also having a potential impact in other areas, such as cardiovascular disease and prevention management (15). Medical IoT, which encompasses wearable devices, smartphone apps, Internet-based drug delivery systems, and telemedicine technologies, can continuously monitor the health of mild patients, receive medicines at home without hospital care, and receive emergency feedback for rapid treatment (32)(16). Devices such as

smartwatches, fitness bracelets, and smart clothing collect diverse data, including heart rate, oxygen consumption, posture, and sleep quality, to analyze information, improve personalized feedback and fitness, and encourage healthier and more active lifestyles through accurate monitoring (17). Smart shoes can be applied in any field that promotes independence, comfort, and healthy living. Furthermore, it has the potential to create new scientific functions in gait biomechanics with rehabilitation applications, sensor technology, and computing. Assistive footwear designed for individuals with visual or physical impairments, combined with wearable sensors, microfabrication, data collection and processing advances, and portable wireless systems, alert pedestrians of hazard detection and enable safe movement (18). The use of big data plays an important role in all fields of society in implementing mobile technology, and continuous quality control of big data quality management is needed because it deals with life and health, especially in healthcare. As a quality management plan, it should be developed in consideration of the importance, accuracy, validity, reliability, completeness, readability, timeliness, accessibility, and confidentiality of the data (4). This will need to play a role in increasing the accuracy of data information by reducing the error range and reflecting the individual's purpose and characteristics (5). Along with a positive view of big data, negative views such as data infringement and personal information protection exist. Although research related to big data is actively conducted to address this problem, those on analyzing big data are still insufficient. Besides, information infringement on individuals and individual participation rates are low, and additional data measures are needed for quality (6).

3.2. Evolution of smart devices and applications for self-health management

An aging society and the prospect of a future society suffering under climate change are increasing interest in healthcare, while countermeasures are still insufficient. An increase in the elderly population can lead to an increase in the number of chronically ill people, and individual healthcare for the 100-year-old era will have great ripple effects across consumption, investment, and economy (5)(19). With the ubiquity of smartphones, they are being used increasingly as tools to help improve health and fitness. In particular, the market for fitness applications or apps on smartphones involves not only the utilization of programs that measure health and fitness using data gathered from smartphone built-in tools (e.g., global positioning systems, accelerometers, microphones, speakers, and cameras), but also the utilization of these data. It is analyzed as a basis to devise an individualized plan based on the user's goals, and feedback provides personalized coaching and additional motivation to share on social media. Health-related apps play a role as a convenient tool to evaluate and motivate smartphone owners with limited access to medical services. These help change patient behavior and improve health, and it shows all the possibilities of use, including settings such as clinical, prevention, public health, and rehabilitation (6)(20). Smart devices and applications that manage personal health information data in real time are receiving a lot of attention from users. Currently, users of health apps rely only on watching and imitating video content or fitness videos, which use PoseNet, an artificial intelligence (AI) convolutional neural network (CNN) model, to analyze human coordinates, implement applause as part of their movements, or learn by posing. A smart health management system that converts and shows the corresponding value (MET) to an application program can determine the user's exercise calorie consumption. In particular, if you have a device that supports the camera function, PoseNet analyzes posture or motion in real time through a browser anytime, anywhere and calculates calories when the user uses MET. As a model

suitable for the development of smart healthcare services among healthcare platforms, it is highly useful (7)(21). Wearables provide opportunities for home-based healthcare in hospitals and in-hospital healthcare, as well as for healthcare in diverse and poor environments. Accordingly, the wearable device market is expected to reach \$19.5 billion by 2021(8)(22). The technology in wearables is now a driving force that is dramatically changing the healthcare economy. Replacing one in five outpatient counseling or home outpatient visits with a digital visit could save \$40 billion annually (9)(23). ~~In a study of patients with implantable cardiovascular devices (n=43), remote monitoring showed a 25% reduction in patients' medical expenses (10).~~ Handling some of the expensive standard tests and medical services with wearables can effectively reduce medical costs (11)(24). Located in Hyderabad, India, Zoylo is a start-up company that launches mobile application services. The service provided by Zoylo gathers the Indian medical system, where diagnosis, hospital treatment, and drug prescription work are divided, and provides optimal information to customers. It consists of one medical service in India and has established partnerships with 600 cities, doctors, and general hospitals to store customers' electronic medical records, online consultation contents, and health information the cloud so that their medical records can be accessed in any city. You can easily check online and receive medical treatment and prescriptions for medicines, and it connects you to the optimal medical facility by searching for conditions such as medical expenses, pharmacy expenses, hospital distance, and visits. Telemedicine has so far been used intermittently in Indian healthcare, but COVID-19 has provided an opportunity to increase access, and ~~coverage to the Indian healthcare system.~~ by integrating telemedicine systems, visits by doctors and patients can be reduced and viral infections can be prevented (12)(25). ~~The pilot project, which statistically verified the~~

effectiveness of the newly attempted "AI-IoT Healthcare Service for the Elderly" in Seoul, consisted of providing wearable devices to local seniors, checking healthcare missions, and providing non-face-to-face professional counseling with exercise experts, nutritionists, and home nurses. Users can connect their health data (step count, blood pressure, blood sugar, and healthcare missions) to their smartphone app in real time via a wearable device, and this information is monitored remotely by visiting nurses, exercise experts, nutritionists, and other experts at the health center. Based on this information, more than one non-face-to-face consultation has been conducted and health education materials are provided non-face-to-face, so photos or video links related to healthcare are sent to mobile phones at least once a month as push notifications from apps, or text messages encouraging them to perform medical tasks once a week. The home nurse monitors blood pressure, blood sugar levels, and number of steps at least once a week and provides counseling regarding any abnormality (26). The Noom-Coach health application, which helps healthcare only with non-face-to-face interaction, provides services for conditions such as diabetes and chronic diseases to 43 million users around the world. Users record data daily on the app on eating habits and exercise, and health trainers and nutritionists participate in real-time direct chat and coaching. This plays a role in helping to reach the target weight and is a solution designed mainly for the purpose of changing eating habits. Noom-Coach is a lifestyle intervention program for mHealth behavior change and is based on health education content, progress analysis, chat, and community as well as diet and exercise record weight management functions. It was certified as the world's first mobile diabetes prevention program by the Centers for Disease and Prevention in April 2017. This became the first case in which the existing offline-oriented diabetes prevention program (DPP) was expanded to mobile services, and measures

for telemedicine are gradually expanding to individual services ~~(13)~~(27). In terms of self-health management, young people actively and effectively utilize smart devices and health applications, while the elderly are passive in the use and activities of mobile and applications. As such, in order to support and promote physical activities for mobile health services for the elderly, digital gaps that may arise from age, social, economic, geographical, location, and cultural factors should be considered by providing activities suitable for lifestyle ~~(30)~~(13). Interventions in behavioral change technologies, as well as social and professional support, can be effective in order to clearly recognize the older population's access to technology, but the ongoing crisis caused by COVID-19 may create challenges in structuring services. The use of mobile health services should be safely tailored to individual needs ~~(20)~~(28). We demonstrate the broad applicability of big data in studying human behavior during the COVID-19 pandemic. Methods, measurements, and modeling of utilizing human behavior in epidemiology are powerful yet show room for improvement, and investigated methods and applications can provide insight to cope with current epidemics and future disasters (29). The evolution of health promotion services needs to be developed for the elderly in line with an aging society, and the potential for digitalization is obviously great; however, to achieve this, additional research and analysis that is suitable for the elderly and explores the age gap is needed.

3.3. Expanding the customized management service industry with big data as the focus.

Big data on healthcare is directly related to the healthy life of humanity, so it is more important and more useful than any other data and has facilitated developments of innovative

new drugs through data, as well as allowing an integrated and efficient medical system for disease management and health management. As a result, global private companies and tech companies are constantly attempting to establish a data platform for healthcare by collecting large-scale medical and genetic information ~~Data platforms generally show quite different aspects, unlike companies with two or three platforms monopolizing the fields of communication, distribution, media, and SNS. In fact, Microsoft's HealthVault and Google Health aimed to collect and build personal health information and link it with medical information, but Google Health stopped providing services from 2008 to 2012 due to poor individual participation and difficulties with linked systems. Even after that, they are trying various businesses and projects such as Verily, UK NHS (National Health Service) and DeepMind linkage project, Google Fit, etc., but it still seems difficult to enter. In agreeing and evaluating a large amount of complex medical data, many classifications for survival prediction and diagnosis are required, and clinical implementation and ethical issues and security issues of personal information should be improved (23)(30).~~ At the national level, big data on healthcare is collected for public and medical purposes, and institutional aspects related to the use of data are being actively addressed. From research to understand the current status and structure of data, we are continuously researching data linkage, utilization technology, data standardization, interoperability, data security technology, and data itself ~~(14)(31)~~. The customized management service industry, which focuses on big data, will continue to be able to manage chronic disease patients and the elderly, manage patients' prognosis, analyze changes in health indicators, detect risks, provide advice for health promotion, and detect outbreaks at an early stage. It will perform various functions to quickly respond to emergencies through system linkage during emergency response, by providing

hospital reservations and accumulated health information based on this to users and medical experts in the management system. It provides an opportunity to diagnose diseases and develop medical care through health analysis (15)(32). Disease prevention and early detection will reduce national medical costs and improve efficiency of use of medical resources, which will independently contribute to improving the national health level for patient treatment (22) (33). Mobile healthcare services to increase health lifespan and prevent chronic diseases is expected to be of great help in developing various contents. Combining services that consider individual genetic differences, the development of information and communication technologies such as IoT, big data, and AI, and the use of IT technologies in the healthcare industry will not only increase accessibility but also improve sustainability and efficiency in terms of health care (24)(34). ~~The industry centered on big data is driving changes in values, social habits, and trends that reflect this era and creating innovative products that no one has ever thought of (16).~~ Industries centered on AI, IoT, mobile, and big data are diversified and subdivided, creating innovative products that no one thought of, influenced by changes in values, social habits, and trends reflecting this era (16)(35). ~~Based on artificial intelligence and IoT through big data, continuous investment and interest in the convergence industry is expected to require more additional research on user satisfaction and consumer opinions.~~ Personalized health care services and devices combined with science and technology and medical services are evolving at a rapid pace with the growth of the healthcare industry. As a representative example, Health Kit is an application that provides healthcare using a device and implements various types of services such as blood sugar management, electrocardiogram, eating habits, and even checking exercise habits. This means that if the scope ~~and scope~~ of the service expands, ~~personalized health management becomes possible~~

~~through the generated information.~~ the personalized management service will grow into an industry in the future (17)(36). The non-face-to-face service platform for home care considers essential factors such as physical care, psychological care, social function maintenance, mental stability, and home care, and monitoring functions enable systematic patient management in smartphone apps and provides guidance for specific patients. A web-based management platform accesses and manages information entered into an app by affiliated hospital medical staff, which can help identify health problems before your next outpatient visit by identifying data such as health journals, graphs, or photos. The advantages of mobile apps can benefit healthcare staff by collecting rich health data directly and evaluating health conditions more thoroughly (37). The BioHeart Glove (BH Glove) is an open filtering glove synchronized with an app that allows monitoring of several physiological parameters including heart rate, oxygen level and blood pressure. The app, integrated with the glove, uses the data to track blood pressure and uses a unique tracker built into each finger to remind the patient when to take medication or when the patient needs to adjust. Blood pressure levels are differentiated by shapes and, depending on the variability of blood pressure, the patient receives a notification from the app to their phone. A sensor on the back of the hand can remind the patient to sleep, drink water, exercise, or take medication, intelligently track specific eating behaviors, and provide visual or audible indicators to remind the patient to stop. A chime sounds to remind the patient not to give in to cravings. Patients can get healthier recipes in the app and other alternatives in the web application. The app can use the glove's data and personal preferences to create meal plans, medication schedules, exercise routines, and more. In addition, the patient is reminded that eating certain foods can increase or decrease the pressure. Companion apps can track medications, recognize foods, search

content, and discuss potential drug–food interactions (38). Social welfare budgets are increasing in Korea, and these resources were not enough to provide universally needed services, and there were additional barriers to face-to-face and home-visit service patients. To get the most out of what you have, you need to database and automatically connect community resources to meet eligibility criteria (39). The empirical analysis results of customized healthcare have a positive impact on providers and governments. First, healthcare providers, medical personnel, and clinicians should be added to provide more professional and personalized services. Second, we need to pay attention to users feedback to increase satisfaction and motivate them to voluntarily promote health information. Third, it is necessary to improve users' E-health literacy by means such as online and offline service tutorials and consultations, to increase the continuity of app use. Since the advent of COVID-19, as many people consider mobile health services very important as part of public services, governments and people should continue to introduce digital health policies and regulations to optimize the social digital atmosphere and improve subjective norms (40).

Comment 4: In the Conclusions section, I suggest focusing on the trends that are analyzed in the articles and pointing out future research and limitations in current research.

Reply 4: First of all, thank you very much for your time and effort. Thank you for suggesting an opportunity to improve the manuscript with valuable comments that improve the quality of this study. In the conclusion section, we revised the limitations of future research and current research, focusing on trends analyzed in the article.

Changes in the text: (current page 23, lines 536, current page 24, lines 537~555)

5. Conclusions

The mHealth app modifies personal health and lifestyle based on new information and communication technology and the IoT, enables user behavior change and disease management through data collection and analysis, improves patient health, and reviews the acceptability of customized healthcare. As remote devices and applications evolve rapidly, digital and health disparities can persist between populations. To solve these problems, it will be necessary to develop policies and programs that benefit all members of society, including organizations and governments. It is expected to be used as important data for new changes in the healthcare market. Thus, numerous programs for self-health management and personalized management will be implemented through the use of smart devices centered on big data. Additional studies are required to enhance the personal information protection and linkage systems of big data. The use of big data has future-oriented values and will become an increasingly important aspect of society and the economy.