CYBERPHARMACY: A FUTURE PLATFORM OF SERIOUS GAMES FOR HEALTHCARE

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ABSTRACT

Digital technologies have had an innovative impact on healthcare and medicine. In order to grow the serious games for healthcare (SGHs) market, it is necessary to identify issues related to the establishment and operation of a distribution platform. In particular, a platform strategy needs to distribute efficiently and effectively SGHs by participating various stakeholders such as game developers, consumers (patients), medical experts, and government officials. Therefore, this study presents a distribution platform called *CyberPharmacy* as a strategy necessary to establish and operate a SGHs distribution platform.

KEYWORDS

CyberPharmacy, Serious Games for Healthcare, Digital Therapeutics (DTx), Distribution Platform, Hyper-Personalization

1. INTRODUCTION

The term serious game began in 1970 with the book "Serious Games" by sociologist Clark C. Abt (Abt, 1970), who defined serious games as 'games whose main purpose is education, not play and pleasure for users'. Since then, the applied area of serious games has expanded not only to the field of education but also to military, healthcare, and business. Serious games for health (SGHs) are categorized by a set of users such as personal, professional, research/academic and public health cross related with a set of serious games objectives including preventive, therapeutic, assessment, education, and informatics. (Wattanasoontorn et al., 2013).

Recently, digital therapeutics (DTx) is emerged as a new therapeutic approach for the prevention management, or treatment of chronic, behaviour-changeable diseases (Kim & Choi, 2021). DTx is "an evidence-based therapeutic intervention using high-quality software programs to prevent, manage, or treat a medical disorder or disease" (DTA, 2020). DTx is implemented in various forms, such as applications, virtual reality, and chatbots, as well as (serious) games. The medical paradigm shift triggered by the FDA's DTx approval and rapid development of digital technologies such as extended reality (XR), artificial intelligence (AI), big data, machine learning (ML) and 5G networks are leading digital healthcare innovation.

In order to grow the SGHs market, it is necessary to identify issues related to the establishment and operation of a distribution platform. In particular, a platform strategy needs to distribute efficiently and effectively SGHs by participating various stakeholders such as game developers, consumers (patients), medical experts, and government officials. Therefore, this study presents a distribution platform called *CyberPharmacy* as a strategy necessary to establish and operate a SGHs distribution platform.

2. RELATED WORK

2.1 Comparison between Serious Games for Health and DTx

Based on the primary commercialization approach (Gautam *et al.*, 2020), SGHs can be divided into three types: DTC, OTC, and Rx. First, there are direct-to-consumer (DTC) SGHs. The DTC type refers to serious games for health that consumers can choose and use without going through the hands of doctors or pharmacists. The

DTC type covers a wide range of general health and wellness concepts as opposed to specific indications. The second type is the over-the-counter (OTC) SGHs. The OTC type means serious games for healthcare that are not prescribed by a doctor, but can be handed over to a patient at the judgment of a pharmacist. In other words, although approval from the Ministry of Food and Drug Safety in Korea is not required, SGHs belonging to the OCT type can be used to retain clinical data, help manage diseases, or optimize medication. Finally, it is a medical prescription (Rx) type of SGHs. The Rx type is a cure for disease, which should be used according to the degree of disease and may have serious side effects, so it is illegal to medicate, prescribe, use these SGHs without a doctor's prescription.

In general, SGHs are distributed through games developers, publishers, and distributors and delivered to consumers. Given the aforementioned commercialization approach of SGHs, it can be classified in the type of DTC. However, after *EndeavorRx*® was first approved by the FDA, a lot of SGHs have been developed in the form of Rx. In the future, Rx-type SGHs are expected to increase through government approval. In addition, SGHs in the type of DTC and OTC and SGHs in the type of variants are expected to increase rapidly, and the market size of SGSs is expected to be growing sharply.

2.2 Healthcare Paradigm Shift

Tarakji *et al.* (2020) suggested that digital technologies have had an innovative impact on healthcare and medicine. Traditional models required collaboration between doctors, scientists, and industries to create drug therapy or device therapy, and to undergo comprehensive testing and clinical trials before physicians could apply it directly to patients. Recent emerging models follow the process of innovative companies developing products, presenting them directly to consumers, and introducing some FDA-approved products to the medical community. With the new model, doctors and healthcare providers often find themselves on the receiving end and realize that they cannot keep up with technological advances. In the case of the DTC-type SGHs, its effectiveness has been verified based on data obtained while using the SGHs and has emerged as a new way to enter the medical community.

According to Goldsmith *et al.* (2022), the paradigm shift in healthcare can be summarized as follows. First of all, AI and ML will lead the current human-driven drug screening and development in the future, and human capabilities will be dramatically expanded by utilizing these technologies. Second, medication is now often prescribed to everyone in a one-size-fits-all manner, and patients are left to mass market therapeutics. However, in the future, personalized treatment optimized by developing genome sequencing, precision dosing, and data analytics will be possible. In addition, advances in these technologies will help patients save money and optimize their healthcare systems. Finally, prevention, detection, and treatment of diseases are currently managed preferentially through episodic in-person consultations for patients. In the future, however, healthcare will take advantage of the accessibility provided by technology. Health risks can be proactively analysed using DTx, genomics, ML, and telehealth. Keywords for future healthcare can be summarized as (1) technology (ML and AI), (2) personalization and optimization, and (3) accessibility.

3. CYBERPHARMACY MODEL

CyberPharmacy is a distribution platform for SGHs. The participants of the SGHs may vary for each distribution stage according to the type of DTC, OTC, and Rx. For example, Rx-type SGHs are diagnosed by a physician, but in the case of a DTC, the consumers (patients) are diagnosed by themselves. SGHs are more likely to be selected through recommendations by AI as well as medical experts such as doctors and pharmacists based on the actual effects and data experienced by consumers (patients) after SGHs use rather than being verified for safety and effectiveness by the government such as FDA. Therefore, beyond the stages of research/development, approval, manufacturing, distribution, and consumption of traditional medicines, the development of SGHs and the use of consumers (patients) will evolve into a method of applying them to the pharmaceutical community.

CyberPharmacy is a multi-sided distribution platform involving various stakeholders such as medical experts, game developers, consumers (patients), and pharmaceutical companies. As shown in Figure 1, the distribution process goes through diagnosis, prescription, design, computing, personalized SGHs, and remote monitoring. It is noteworthy here that SGHs allow consumers (patients) to have an optimal medical experience

through remote monitoring. In addition, intelligent recommendation systems and diagnostic systems using AI and ML may be applied to lead to full cusomizaiotn and optimal health coutcomes. The data collected through these monitoring can be used to optimize the current state of the consumers (patients) as well as to provide SGHs that are highly effective to other consumers (patients).

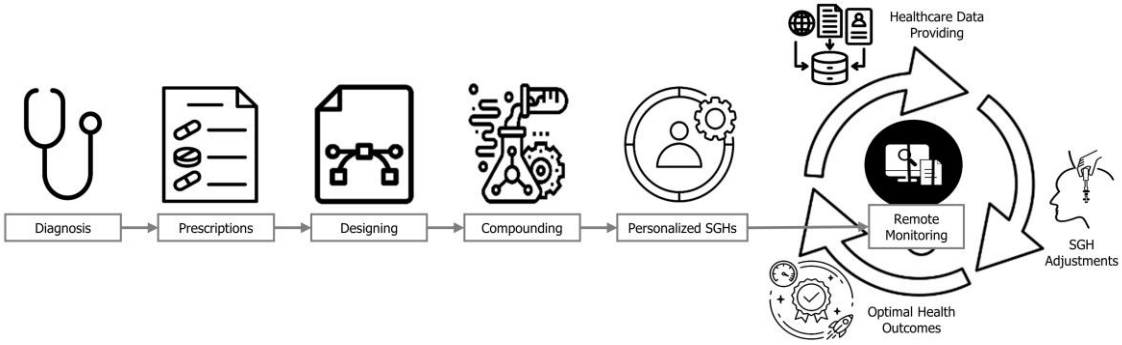

Figure 1. Cyberpharmacy process model

4. CONCLUSIONS

CyberPharmacy plays the following role as a distribution platform. First, *CyberPharmacy* integrates the knowledge of various stakeholders such as medical experts, game developers, consumers (patients), and pharmaceutical companies to provide services ranging from the development of SGHs components and modules for diagnosis, prescription, designing, compounding, and remote monitoring. Second, *CyberPharmacy* can provide full customization through hyper-personalization, which is an advanced and real-time customization of offering, content and customer experience at an individual level. Third, experiential knowledge can complement mechanisms that can provide various services in real time and streamline governance. As customized services are developed, diagnosed, prescribed, designed, and used through *CyberPharmacy*, learning occurs, and data related to *CyberPharmacy* operation are accumulated through this experience. By analysing and utilizing the data, it is possible to supplement the current maintenance mechanism and streamline governance.

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