



Exploring diffusion strategies for mHealth promotion using evolutionary game model

Yi Chen^{a,b}, Shuai Ding^{a,b,*}, Handong Zheng^{a,b}, Youtao Zhang^c, Shanlin Yang^{a,b,*}

^aSchool of Management, Hefei University of Technology, Anhui, Hefei 23009, China

^bKey Laboratory of Process Optimization and Intelligent Decision-Making (Ministry of Education), Hefei University of Technology, Anhui, Hefei 23009, China

^cDepartment of Computer Science, University of Pittsburgh, Pittsburgh, PA 15213, USA

ARTICLE INFO

MSC:
00-01
99-00

Keywords:
mHealth
Evolutionary game theory
Hospitals
Patients
Behavior selection

ABSTRACT

Mobile health (mHealth) is an emerging healthcare practice that provides public health information and medical care services using mobile communication devices, such as smartphones and tablet computers. Given the service convenience and the great potential in reducing medical expense, the promotion of mHealth has become an indispensable component of healthcare reform in China. While Chinese government has shown strong support in promoting mHealth, the behaviors of different participants in mHealth have not been well studied, which prevents its fast diffusion in China. In this paper, by analyzing the current status of mHealth in China, we leverage the evolutionary game theory to build a novel model to capture the behaviors of two key participants, e.g., hospitals and patients, in mHealth. We analyze the payoff matrix between hospitals and patients such that a replicator dynamic system can be built. We validate the proposed model with detailed simulations. Our observations benefit not only the mHealth participants but also the government policy makers.

© 2018 Elsevier Inc. All rights reserved.

1. Introduction

mHealth (mobile health) is an emerging healthcare practice that provides public health information and medical care services using mobile communication devices, such as smartphones and tablet computers [1,2]. mHealth demonstrates the development trend of cross-border integration for scientific and technological progress and clinical medicine practice. Different from the traditional electronic health (eHealth) that heavily relies on the computer and Internet, mHealth takes the advantages of wireless cellular communication capability (e.g., mobility) and relatively small size and low weight (e.g., portability) of mobile devices to deliver health services with fewer temporal and spatial constraints [3].

Certainly, mHealth also have some limitations. In places where there is no wireless coverage or when mobile devices have battery or access problems, mobile health is simply not possible [3]. Patients need to buy a mobile device to get mHealth services, it may increase the extra-costs for them. Training and educating stakeholders (patients, health professionals, and mHealth developers) is a huge task. mHealth also generate new security and privacy issues for patients [4]. Those concerns need to be addressed. Despite all this, mHealth is emerging in China, many large medical institutions have started to offer

* Corresponding authors.

E-mail addresses: dingshuai@hfut.edu.cn (S. Ding), yangsl@hfut.edu.cn (S. Yang).

mHealth service to patients in rural and suburban areas, such as remote consultation and diagnosis, hospital appointment registration, chronic disease management, etc.

China, due to its stable economy development and income increase in both urban and rural areas, has shown an enormous demand increase for quality health care. However, the current healthcare system in China faces many issues. The most issues in China medical system is inequitable distribution of healthcare resources among different regions. What's more, most trained healthcare professionals are densely employed in large hospitals in big cities. These situations are deteriorating in China, which have led to expensive medical bills and increased tension between health care providers and receivers, i.e., hospitals and patients. The ultimate aim of healthcare reform in China is to ensure that everyone, including those who are disadvantaged, enjoys the government's medical services. mHealth, given its great potential in cost reduction and communication convenience, is particularly valuable to the developing countries, e.g., China.

mHealth can be applied at various levels in the healthcare system and play an increasingly more important role in the healthcare market. According to a report from BCC Research, the global tele-home and tele-hospital/clinic market is expected to grow from nearly \$23.8 billion in 2016 to roughly \$55.1 billion in 2021, with a compound annual growth rate of 18.3%. The same report also illustrates that the global mHealth market was nearly \$1.5 billion in 2012, and is expected to reach \$21.5 billion in 2018, showing a compound annual growth rate of 54.9%. In recent years, mHealth has gradually played an important role in providing health services in developing countries. While many mHealth projects have been implemented in these countries, most of them are demo systems such that there exist great potentials to explore.

The main goal of this paper is to investigate mHealth diffusion in developing countries, especially in China. We build a novel model based on evolutionary game theory, which is a powerful tool for betterment of human lives [5]. Many reviews have recently explored the utility of evolutionary games. D'Orsogna and Perc review several quantitative mathematical models of crime, including adversarial evolutionary game, to understand the multiple of aspects of crime and to identify possible prevention and amelioration strategies [6]. The utility of evolutionary games is also explored on human cooperation [7], vaccination [8]. By building a novel model based on evolutionary game theory, we study the interaction of two key participants in mHealth, e.g., hospitals and patients, and the important factors that affect mHealth diffusion. We simulate the evolution of the model, which reveals the decision-making behaviors of the two key participants and the sustainability of the system. The observations that we make in this paper are valuable not only to hospitals and patients, but also to government policy-makers when choosing appropriate methods to promote mHealth diffusion.

In the rest of the paper, Section 2 presents the background and analyzes the need for mHealth in China. We present the hypothesis and the proposed model to capture the dynamic behaviors of two key participants in mHealth in Section 3. We briefly discuss the evolutionary game theory in Section 3. Section 4 discusses the process of the strategy evolution. We simulate and discuss the model in details in Section 5, and conclude the paper in Section 6.

2. Background

2.1. mHealth basics

mHealth (mobile health) emerges as a sub-field of eHealth (electronic health). In 2011, the World Health Organization (WHO) defined mHealth as “medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices [9]”. mHealth has grown rapidly in recent years due to the wide adoption of mobile devices and wireless networking technologies [10].

With the potential to bring transformative changes to current healthcare systems [11], mHealth has become one of the most important topics in research community [12]. We next briefly discuss four major benefits of mHealth, i.e., expand healthcare coverage, monitor and manage disease conditions, improve decision making, and provide suitable healthcare in emergencies.

- mHealth can expand healthcare coverage effectively, especially in developing countries and in rural and remote areas [13–16]. For physicians, they can access the medical records with ease. For patients, they may receive healthcare services with fewer time and location constraints. The latter is particularly important for children and adolescents living in areas with limited medical resources [17]. Using mobile devices, such as smartphones, and personal digital assistants (PDAs), patients can choose when and where to receive healthcare services, i.e., the time and places that they feel the most convenient, whether in a waiting room, at home, or on a job site [18–20].
- mHealth can effectively and timely monitor and manage disease conditions, especially chronic diseases. The current mHealth technologies can monitor a person's health conditions that include not only the physical activities and heart rates, but also measures that traditional electronic health recorders have troubles to capture, e.g., social interactions and toxic exposures. Mobile devices including smartphones, provide a convenient yet low-cost method to track daily routines and lifestyles, which facilitates effective self-management of the condition [21–24]. Chronic diseases like diabetes, asthma, and obesity account for 46% of global disease burden, mHealth makes it feasible for patients to collect and share relevant data at any time, not just when they visit a clinic, which enables the delivery of optimal treatment timely [25,26].
- mHealth improves the efficiency of healthcare processes and the quality of medical services [3]. Many healthcare processes are complex, making it difficult for healthcare professionals to reach quick decisions under tight constraints, such

Download English Version:

<https://daneshyari.com/en/article/8900725>

Download Persian Version:

<https://daneshyari.com/article/8900725>

[Daneshyari.com](https://daneshyari.com)